Argentina
Water Resources Management
Policy Issues and Notes
THEMATIC ANNEXES
VOLUME III

February 25, 2000

Argentina Country Management Unit and
Environmentally and Socially Sustainable Development Network, and
Finance, Private Sector and Infrastructure
Latin America and the Caribbean Regional Office
INDEX

VOLUME III

(THEMATIC ANNEXES)

ANNEX A: CONSTITUTIONAL, LEGAL AND INSTITUTIONAL FRAMEWORK OF WATER RESOURCES IN ARGENTINA

ANNEX B: ASPECTOS ECONÓMICOS Y FINANCIEROS

ANNEX C: GROUNDWATER

ANNEX D: IRRIGACIÓN EN ARGENTINA

ANNEX E-1: WATER QUALITY PROBLEMS IN THE PROVINCE OF CÓRDOBA

ANNEX E-2: WATER QUALITY PROBLEMS IN THE PROVINCE OF CATAMARCA

ANNEX E-3: WATER QUALITY PROBLEMS IN THE PROVINCE OF TUCUMÁN

ANNEX E-4: WATER QUALITY PROBLEMS IN THE PROVINCE OF MENDOZA

ANNEX F: WATER AND SANITATION SECTOR IN ARGENTINA. REVIEW AND STRATEGY

ANNEX G. LECCIONES DE LAS EXPERIENCIAS INTERNACIONALES

ANNEX H. CONCEPT PAPER
ANNEX A:

CONSTITUTIONAL, LEGAL AND INSTITUTIONAL FRAMEWORK OF WATER RESOURCES IN ARGENTINA
INDEX

I. PRESENTATION

II. EXECUTIVE SUMMARY

III. WATER SCHEME AT NATIONAL LEVEL
   III.A. National Constitution
   III.B. Ownership of Waters According to Civil Code
   III.C. Complementary Legislation
   III.D. Draft Laws Being Processed and Under Discussion

IV. INTERNATIONAL WATERS AND WATERSHEDS

V. PROVINCIAL WATER SCHEME
   V.A. Provincial Constitutions
   V.B. Provincial Water Legislation
   V.C. Main Features
   V.D. Groundwater

VI. INSTITUTIONAL ORGANIZATION FOR WATER RESOURCE MANAGEMENT
   VI.A. National Level
   VI.A.1. Decentralized Agencies of the Secretariat of Natural Resources
   VI.A.2. Other Agencies Dealing with Resource Management
   VI.A.4. Federal Environmental Pact
   VI.A.5. Institutional Structure for Collection and Consolidation of Water Information
   VI.B. Inter-jurisdictional Agencies
   VI.B.1. Watershed Agencies
   VI.B.2. Watershed Agencies in Process of Being Formed or Reactivated
   VI.B.3. Regional Groundwater Center – CRAS
   VI.C. Institutional Agencies at Provincial Level
   VI.C.1. Institutional Structures for Watershed Management within Provinces

VII. WATER RESOURCE AND LAND USE PLANNING.
    VII.A. Resource Allocation
    VII.B. Water Registry and Cadaster
    VII.C. Use of Water Resources. Competition for Use
    VII.D. Reuse of Wastewater

VIII. WATER ECONOMY
   VIII.A. Tax Regulations and/or Tariffs for Use
VIII.B. Enforcement of Legal Provisions  
VIII.C. Recovery of Public Investment  

IX. PRIVATE SECTOR PARTICIPATION IN RESOURCE MANAGEMENT.  
IX.A. Drinking Water and Sewer Services  
IX.B. Irrigation Infrastructure  
IX.C. Concession for Construction of Public Works  

X. POLLUTION AND WATER QUALITY REGULATIONS.  
XA. Regulatory Gap  
X.B. Pollution and Water Quality Provisions in the Province of Mendoza  

XI. INSTITUTIONAL AND LEGAL STRUCTURE FOR CONFLICT RESOLUTION.  
XI.A. Inter-jurisdictional Conflicts  
XI:B. Conflicts among Users  

XII. PRINCIPAL INTERNATIONAL EXPERIENCE.  

XIII. SYNTHESIS OF DIAGNOSTIC AND MAIN PROBLEMS DETECTED.  
XIII.A. Absence of Regulatory Framework at National Level  
XIII.B. Provincial Legislation lacking efficiency and effectiveness  
XIII.C. Principle of Inherent Importance, Its Implication on Water Economy  
XIII.D. Weak Power by National Authority to Convene Provinces  
XIII.E. Institutional Fragmentation and Manifest Weakness of Water Authority at Provincial Level  
XIII.F. Interprovincial Conflicts over Water Regulation  
XIII.G. Water Management Separated from Land Use Planning and from the Watershed as a Management Unit  
XIII.H. Limited Participation by Users in Resource Management  

XIV. CHALLENGES AND OPPORTUNITIES FOR REFORM.  
XIV.A. Search for Consensus to Regulate Article 41 of the National Constitution  
XIV.B. Opportunity to Formulate Coherent, Homogenous Provincial Legislation  
XIV.C. Political Momentum, Opportunity to Favor Institutional Rearrangement
REFERENCES
APPENDIX #1. Organizational Structure of INA and Programs It Promotes through its Specialized Centers
APPENDIX #2. Overview of Institutional Organization at Provincial Level
APPENDIX #3. Synthesis of Principal International Experiences
APPENDIX #4. Decrees Modifying the Structure of Water Resources
CONSTITUTIONAL, LEGAL AND LEGAL FRAMEWORK OF WATER RESOURCES IN ARGENTINA

I. PRESENTATION

II. EXECUTIVE SUMMARY

III. WATER SCHEME AT NATIONAL LEVEL

III.A NATIONAL CONSTITUTION

1. Argentina’s federal structure is based on the duties assigned in art. 121 of the National Constitution, according to which “..provinces hold all power not delegated to the Federal Government by this Constitution, and that which is expressly reserved by special agreements at the time of its incorporation”. The 1994 constitutional reform added article 124 of the charter and expressly stated that “provinces have original ownership of natural resources existing in their territory.”

2. In other cases the nation’s authority is held in an inter-jurisdictional manner, as in the case of navigable rivers, national routes, air that passes from one jurisdiction to another and carries pollution, etc. Recent statements by the Supreme Court of Justice, in decisions on controversies such as those arising between the Provinces of Mendoza and La Pampa over the Atuel River, have established the principle that the regulation of interprovincial rivers is promoted by means of treaties between provinces, based on the powers conferred by article 125 of the Constitution. By extension, the same principle should be applied to groundwater when aquifers cross provincial borders.

3. The constitutional reform of 1994 in turn establishes in article 41 the right of all inhabitants to enjoy a healthy environment suitable for human development and productive activities, the safeguarding of environmental assets for present and future generations, and the priority obligation of repairing environmental damage according to legal regulations. In turn, it grants the nation the authority to “enact rules that contain minimum prerequisites for protection, and [grants] provinces [the authority] needed to complement them without altering local jurisdictions.”

4. According to the wording of article 41 of the Constitution it is clear that the National Congress is authorized to enact a regulation the sets the minimum prerequisites for protection to be observed throughout the territory.

III.B Ownership of waters according to Civil Code
5. From the distribution of powers stems the national Congress’s authority to establish, through the Civil Code, essential principles regarding the legal condition of waters: i) public ownership of surface and ground water (Article 2340); and ii) the principle of special concession for water use (articles 2341, 2342 and 2642).

III.C Complementary legislation

6. In addition to the Civil Code, Argentine Water Law includes the Commercial, Mining and Penal Codes, federal laws on energy, navigation, transportation, Ports System, Jurisdiction over Argentine Waters, Interprovincial Commerce, Prevention of Ocean Pollution by hydrocarbons, and the Toxic Waste Scheme (law 24.051). All of these regulations directly or indirectly contain provisions regarding water resources.

7. Law 24.354 created the National System of Public Investments. Annex I to this law incorporates the list of projects that should complement feasibility or environmental impact studies.

8. In terms of fiscal incentives, the Tax Deferral law # 22.021 has had great importance. It was modified under laws #22.702 and 22.973. Its scope of enforcement includes the Provinces of San Juan, La Rioja, Catamarca and San Luis. The tax to be deferred is the IVA and in turn it authorizes deducting taxes on earnings, investments made in cattle farming (including wells and elements for irrigation; drilling, pumps and motors to extract water).

9. The fiscal incentives mentioned above have attracted to the region a significant number of companies established in non-irrigation areas and whose main source of water supply is from aquifers.

---

1 Most Provinces have ratified this law.
III.D Draft Laws Being Processed and under Consultation

10. Article 41 of the National Constitution and its future regulation has been the subject of debate, during which a number of projects on “Minimum prerequisites for Environment Protection” have been generated, such as:

11. **Soil Conservation, Prevention of and Fight against Desertification**, filed in the Chamber of Deputies on December 15, 1998. Among its guiding principles, this project considers **soil use according to suitability**, an essential principle in the management of watersheds which are proposed as the basic unit for natural resource planning. Among other instruments to achieve compliance with objectives is Environmental Planning, which includes **Land Use Planning**.

12. In turn, the project contemplates the establishment of a national information, monitoring and early warning system that concentrates physical, biological, economic, social and legal data concerning environmental resources affected by or vulnerable to the processes of desertification.

13. **Minimum Environmental Budget Scheme for Water Protection**, in consultation with the Secretariat of Natural Resources. The project establishes generic categories for streams and bodies of water, and their allocation to certain uses according to their natural conditions and aptitudes. For each category, the regulation of the law shall establish environmental quality standards.

14. The project makes the national authority responsible for the creation of a National Network for Registries of Sources of flows to bodies and streams of water, to which provincial and local authorities are obliged to provide information.

15. **National System for Reduction of Water Pollution.** The project’s objective is to reduce pollution levels in water resources throughout the country. For this purpose, it establishes Pollution Reduction Titles (TRC) which are translated into temporary authorizations to dump waste into bodies of water.

16. TRCs should be issued by the provincial authority in the case of provincial watersheds and by interprovincial agencies in the case of watersheds shared by two or more provinces. These same authorities must determine the polluting substances, classify them and establish the equivalency unit.

17. TRCs are proposed for eight (8) years, with annual reduction percentage levels from the first year of issuance, when a 7% reduction must be shown, to 15% by the end of the eighth year. TRCs are transferable, and those that reach decontamination levels higher than those established may transfer the proportionate part to watersheds that issue levels higher than those agreed.

18. The project contemplates the creation of the **National Program for Environmental Technology Promotion** comprised of national and provincial authorities and others from the city of Buenos Aires. Its objective is to research and develop new technologies on decontamination. At the provincial level,
Special Commissions are created in each watershed, comprised of authorities, civil society, and NGOs whose objective is to study and protect the environment.

19. 95% of economic resources generated by TRCs will be allocated to the National Program for Environmental Technology Promotion and 5% to relevant authorities at the provincial or inter-jurisdictional level.

20. **Scheme for Preventing and Fighting Pollution of Maritime, River, Lake and Port Waters.** Filed with the Senate’s Water Resources Commission in April 1999. The project regulates and prevents prevention from ships or naval artifacts, oil exploration and drilling platforms.

**IV. INTERNATIONAL WATERS AND WATERSHEDS**

21. On this matter the national government has authority, through the Ministry of Foreign Relations, Secretariat of Latin American Relations and Affairs, which is in charge of coordinating watershed issues in the Plate, Uruguay, Paraná, Bermejo, Pilcomayo Rivers and other watersheds considered to be international.

22. For the enforcement of international treaties on this subject various agencies have been created to deal with the coordination of one watershed’s efforts (Inter-Governmental Coordinating Committee for the River Plate Watershed); with the administration of international sections of rivers (River Plate Administration Commission, Uruguay River Administration); with the design, construction, operation and maintenance of large bi-national water operations (Yacyretá Binational Agency, Salto Grande Joint Technical Commission, Joint Argentine-Paraguayan Commission on the Paraná River); or with inventory and planning tasks (Argentine-Chilean Integration Commission).

**V. PROVINCIAL WATER SCHEME**

8.4.1 V.A Provincial Constitutions

23. The right to a healthy environment has constitutional priority in various provincial constitutions, most of which contain generic references to the issue of the environment and/or natural resources and some of them (Provinces of Jujuy, La Rioja, Mendoza, Salta and San Juan) especially incorporate the water scheme and grant constitutional rank to the principle of *water’s inherent importance to land*. This principle of legal tradition in Argentina is incorporated by all provinces (except San Luís) in their water laws. This implies:

a) Water rights are linked to land, and property rights are inseparable from them.

b) They may not be seized or expropriated unless with the land for which they were granted.

c) They may not be the subject of contracts but rather as an integral part of land for which they were granted; and
d) Water use rights granted for irrigation carry with them the obligation of being used exclusively in the registered area, and a new concession or modification of the current one must be processed so that it can be used on adjoining lands even though ownership belongs to the concessionaire.

24. This provision causes some dysfunction that translates into a degree of inefficiency of the law; its inflexibility makes it unsuited to resolving cases and situations that may occur. An example is the Province of Mendoza, where land surveyors report as clandestine those crops planted in unregistered areas, although this does not imply any consequence due to the provision’s inapplicability.

8.4.2 V.B Provincial Water Legislation

25. The main expression of the legal regulation of water by provinces, except by the Province of Mendoza, began in 1940 with the issuance of codes for Salta and Jujuy. These laws regulated all uses to which water was subject at that historic moment (irrigation was economically preponderant), safeguards against erosion of riverbanks and infiltration, the exercise of water inspection and the organization, powers and operation of the water administration.

26. The institutions found in the first laws (most of them still in force) are essentially public water use concessions, priority uses, administrative easements, consideration of groundwater as private, guidelines on distribution, regulation of users’ participation in administration, defense and drainage, inspection of water and its channels and riverbanks.

27. A second law enacted in the 1970s includes the codes for Santiago del Estero, San Luis, San Juan, La Rioja, and La Pampa, incorporating various water policy principles, and regulation of water as a natural, environmental and economic resource.

28. Although laws issued since the 1970s systematized their provisions and brought them together in books, titles, chapters and sections, few provinces have what is considered, from the standpoint of legislative technique, a code as regards an orderly, systematic set of provisions dealing with water.

V.C. Main features

29. Laws in general characterize water use concessions which are authorized under the following premises: i) they are granted with the clause “without detriment to third parties,” which implies respect for previously acquired rights; ii) they do not implicitly carry an alienation of water but rather confer to the concessionaire a

---

2 A matrix indicating current provincial water laws may be found in the OUTLINE FOR LEGAL FRAMEWORK REVIEW. Argentina, May 1999, prepared by Dr. Cesar Magnani. This document is an integral of this study.
subjective right of use; iii) the administration is not responsible for the reduction or decrease of volume granted; iv) non-use of water within a period of five years from the time the concession is granted and noncompliance with payments of taxes, rents and other contributions stemming therefrom, are causes for the right to be forfeited; and v) revocation of the concession when reasons of public interest are involved implies compensation for any damage that may arise.

30. It is common in provincial legislation to set priorities for water use, set for each province in accordance with the territory’s economic use. Requirements should be met, giving preference to the highest-ranked activity for usage while respecting the key importance of use for human consumption. The absence of the concept of environmental uses is constant in all such legislation.

31. A generalized characteristic is the inflexibility of guidelines on this subject and their inoperability. Provinces that have recently modified their laws (e.g., Salta), despite setting their order of priorities, grant power to the respective authority, when it grants concessions, to favor those activities that, due to greater economic or social importance, merit such treatment. Nevertheless, inflexibility persists for those already granted, events in which the concessionaire who needs to make a different economic use of his right must request prior intervention by the authority.

32. In general, water legislation is not complied with. The law’s level of effectiveness and efficiency is low. Inefficient use, non-payment of financial charges, lack of maintenance of distribution networks, clandestine or marginal use in a broad sense, prohibited sales and transfers, different types of pollution, the absence of up-to-date cadasters and registries, deficient participation by users and noncompliance with the system of priorities for use, are proof of how laws are not complied with (Mathos Escorihuela 1994).

8.5 V.D. GROUNDWATER

33. In terms of groundwater, provincial legislation is meager. This is due in good part to the private water scheme in use until 1954, when article 2340 of the Civil Code was modified and public ownership was declared. Until that date, the only limitation to an owner’s right to drill on his farm and use groundwater was called “abuse of one’s right” expressed in the intention to cause harm. Because it was difficult to prove such “intention” it may be said that rights to drill for and use water were nearly unlimited.

34. There is some regulation on drilling for water on publicly owned lands. In order to carry out such works, permission is required from the relevant authority and, at the end of the works, the concession must be requested, but no follow-up is

---

3 Information extracted from presentation by Dr. Mathus Escorihuela at the National Seminar on Irrigated Areas held in Tucumán in September 1994. Complemented by interviews with authorities and users in the Provinces of Jujuy and Salta.
usually made on the rights thereof, with respect to control of extractions, polluting activities in certain aquifer buffer areas, capping of abandoned wells, etc.

35. Under law 4035, the Province of Mendoza regulates groundwater separately from surface water; other Provinces, including Jujuy, Salta, San Juan, and La Pampa, incorporate in the same water law the treatment to which these waters must be subjected. On the other hand, other provinces such as Tucumán, whose law dates back to 1897, have a total lack of guidelines on this matter.

36. Other provisions generally related to the inspection exercise, including those of Neuquén and Río Negro, deal with groundwater protection when they are related to mineral and hydrocarbon exploration and execution, with the Provincial Secretariat of Energy and Mining responsible for monitoring and control.

VI. INSTITUTIONAL ORGANIZATION FOR WATER RESOURCE MANAGEMENT

VI.A National Level

37. Various actions and measures have been developed in the country to institutionalize policy preparation and water resources administration at national level. One of these was the creation in 1991 of the Secretariat of Natural Resources and Environment, whose name later changed in 1996 to the Secretariat of Natural Resources and Sustainable Development, overseen by the office of the President.

38. The Under-Secretariat of Water Resources oversees the National Bureau of Water Policy, which is in charge of planning and executing national water policy, supervising compliance and coordinating plans, programs and projects related to water resources, and the National Bureau of Water Resources Administration, which is essentially responsible for proposing and executing policies, programs and projects related to public water works. See the following organizational chart:
VI.A.1. Decentralized Agencies of the Secretariat of Natural Resources

39. **National Institute for Water and the Environment (INA)**, whose objective is to meet the requirements of studying, researching, developing and providing specialized services in the field of water and environmental development, control and preservation, aimed at implementing and developing a national environmental policy.

40. INA continues the tasks begun in 1973 by the National Institute of Water Science and Technology (INCYTH), whose functions and powers have been expanded, incorporating environmental variables into the water resources study. Appendix 1 shows the structure of INA and the various programs it promotes through its specialized centers.

41. **National Sanitation Works Agency (ENHOSA)**, converted to a decentralized agency under decree 146/98, has the duties of the former “National Drinking Water Service” (SNAP), replaced in September 1988 by the Federal Drinking Water Council and now replaced by ENHOSA.

42. This agency, with IDB and IBRD financing, and to a lesser extent with funds from the National Treasury, has assisted the former National Sanitary Works company, as well as provinces and municipalities, in sector development by granting loans for the construction, rehabilitation and optimization of drinking water and sewer works, and with the institutional and operational improvement of service providers.

VI.A.2 Other Agencies Dealing with Resource Management

43. Although the Secretariat of Natural Resources and Sustainable Development, through the Under-Secretariat of Water Resources, is the national agency par excellence dedicated to water issues, its task of amalgamating the issue is quite
difficult. In effect, the different ministries apply environmental standards suited to their own sphere of operation; thus, an effective task of coordination is necessary in regulation and in actions for a leading environmental policy nationwide.

44. In terms of irrigation and drainage, the National Water and Electric Company, until its recent dissolution, played a very important role. Created in the 1940s in continuation of the former General Bureau of Irrigation, it came to be in charge of the construction and administration of irrigation and agricultural sanitation systems in eleven (11) of the country’s provinces. Beginning in the 1970s, these systems were gradually transferred to the provinces.

45. Today, irrigated agriculture at the national level is handled through the Ministry of Economy, Public Works and Services, under the Secretariat of Agriculture, Livestock, Fisheries and Nutrition (SAGPyA). Through various types of actions, essentially of the Provincial Agricultural Services (PROSAP), it works in different ways on problems existing in public irrigation systems, the consolidation of intensive agriculture with comprehensive irrigation, and the promotion of complementary irrigation for traditional agricultural activities in sustainable productive systems throughout the Pampa region.

46. The Ministry of the Interior is another area of the national government with involvement in water resources management since it has the expertise to: i) deal with the coordination of actions required to resolve unusual or emergency situations that occur throughout the country; and b) deal with the legal scheme of waters in interprovincial rivers and their tributaries.

47. This Ministry, through the Secretariat of Provincial Economic Reform Assistance, arranges for the allocation to provinces of funds from multilateral credit agencies, non-governmental agencies, and bilateral sources of financing, and also administers and coordinates their execution.

48. Other actions directly dealing with water resources management are promoted by: i) the Ministry of Health and Social Action with regard to drinking water supply, disposal of liquid waste, and all other sanitary services under its scope of activity; and ii) the Ministry of Defense regarding technical activities dealing with water and air navigation if under its jurisdiction, under which are included the National Meteorological Service, a branch of the Argentine Air Force, and the Naval Hydrographic Service, a branch of the Argentine National Navy.

VI.A.3 Federal Council on the Environment (COFEMA)

49. COFEMA is a permanent agency created on August 31, 1990 as a public enterprise to reach agreement on and prepare an environmental policy coordinated among member states. One might say that it is an inter-jurisdictional agency in which the country, the city of Buenos Aires and all provinces are represented.
50. COFEMA was recognized by all provinces that signed the Federal Environmental Pact (to be discussed in more detail later) as a valid instrument for coordinating environmental policy in the Argentine Republic. Not all provinces that signed the document managed to have it ratified by their respective legislatures; as a result, they either send no delegates or do not always send the same one, and therefore lose coherence in their actions.

51. As a multijurisdictional agency, it has served to exchange opinions and show that a federal body is being formed, whose aim is to carry out highly relevant functions—if it can establish individual autonomy and joint strength.

52. Under the scope of COFEMA (April 14, 1999 session), the Inter-jurisdictional Watershed Committee was created, comprised of representatives from Water Resources Administrations in each province and from the Secretariat of Natural Resources and Sustainable Development, for the purpose of providing advice on issues related to the management and sustainable use of water resources. At the same session, the need to set up a Commission responsible for water issues was presented and is currently being studied. Due to its importance as an agency that brings together the country’s different jurisdictions on this matter, it is necessary to institutionally revitalize COFEMA as a means of facilitating integration policies nationwide, in order to achieve compliance with the objectives—nowadays difficult to attain—that justified its creation.

VI.A.4 Federal Environmental Pact

53. In July 1993, the federal government and the 23 provinces signed the Federal Environmental Pact and agreed to carry out policies aimed at executing program 21, promoting the unification of environmental agencies, systematizing legislation by preparing digests, and developing environmental awareness. This pact, like COFEMA, was also not ratified by all provinces.

VI.A.5 Institutional Structure for Collection and Consolidation of Water Information

54. Activities related to the procurement of meteorological, hydrological and water quality data are assigned to different national and provincial agencies.

55. In 1972 the country’s former State Secretariat of Water Resources set up an intergovernmental working group on water information, with the participation of qualified representatives of all provinces and national agencies. This group, during its two years of work, promoted efforts to systematize and standardize data for the purpose of establishing and institutionalizing a National Water Information System.

56. Unfortunately, institutional difficulties caused the project to be aborted and left unfinished. Another important source of information on groundwater is in the hands of the now defunct Regional Groundwater Center (CRAS), but no measures were taken to systematize and integrate the existing national information system.
The lack of coordination and unity in this area persists; thus, one may observe in the various draft laws, through which the mandate of article 41 of the National Constitution is developed, the creation of various national information systems with similar purposes but without any apparent unification in an integrated system.

VI.B Inter-jurisdictional Agencies

VI.B.1 Watershed agencies

The promotion and organization of Watershed Committees with the participation of all provinces and agencies that had some type of jurisdiction over a watershed, were the objectives of the country’s former State Secretariat of Water Resources, created in 1969. Previous attempts had been made to establish similar entities, but they lacked a coherent and ongoing policy.

Ten Watershed Committees were eventually formed, which together covered 656,000 Km². Unfortunately, major jurisdictional conflicts arose in most of them, in terms of the administration and auditing of their financial resources, so their duration was brief. There remain three organizations that are formally established, operational and directly related to PROSAP, which leads to the conclusion that much of their activity is maintained due to financial support they can obtain through said program. These are:

60. **Inter-jurisdictional Committee for the Colorado River (COIRCO)**. Created by the treaty signed at the Sixth Conference of Governors of the Colorado River in 1976 and ratified by national law 21611 of 1977, it is comprised of the federal government and the provinces of Buenos Aires, Mendoza, La Pampa, Neuquén and Río Negro and has its own statutes and bylaws. Its objective is to ensure the execution of the single program to prepare irrigation areas and distribute river volumes.

61. **Regional Commission for the Bermejo River (COREBRE)**. Comprised of the federal government and the provinces of Chaco, Formosa, Jujuy, Santa Fe and Santiago del Estero. It was established in 1981 and ratified by national and provincial laws between 1981 and 1983, and its statutes and bylaws approved in 1989. Its objective is to adopt decisions and carry out the administration of actions needed for the comprehensive, rational and multiple development of water resources in the river basin.

62. **Inter-jurisdictional Authority for the Watersheds of the Limay, Neuquén and Negro Rivers**. An authority created by the treaty signed by the federal government and the Provinces of Neuquén, Rio Negro and Buenos Aires in 1985 to deal with all matters related to the administration, control, use and development, and preservation of watersheds.
VI.B.2 Watershed Agencies in Process of Being Formed and/or Reactivated.

63. With the intervention of the Bureau of Water Policy, work is being carried out on the formation of the following agencies:

64. **Inter-jurisdictional Commission on the Laguna La Picasa Watershed** with the participation of the Provinces of Buenos Aires, Córdoba and Santa Fe. Its problems stem from the physical features of the zone which accumulates water in the around the lagoon, waterlogging one of the country’s most important productive zones, affecting the road and railway network and placing the region’s inner cities at risk.

65. These problems caused affected parties to develop actions aimed at the establishment of a Watershed Committee comprised of national and provincial agencies. The active participation of NGOs in the region should be noted; they have set up a monitoring committee that makes very useful contributions toward resolving existing problems.

66. The Committee was formed in April 1999. With the signature of the three provincial governors, an energy commission was formed with representatives of all jurisdictions to deal with immediate problems and, to seek a definitive solution, the faculty of Water Sciences of the Universidad Nacional del Litoral (FICH) was asked to perform studies which are currently being evaluated.

67. **Watershed Committee of the Pasaje River-Juramento-Salado** with the participation of the Provinces of Salta, Santiago del Estero, Catamarca, Santa Fe and Tucumán. This watershed is periodically affected by short-term problems that involve conflicts among the provinces involved, especially in periods of shortage, when the lack of water has forced the federal government to intervene on countless occasions in order to ensure a minimum volume at the borders between Salta and Santiago del Estero and between the latter province and Santa Fe; these problems have lately been worsened by the presence of new actors within the upper watershed, including privatized hydroelectric plants.

68. At the request of the most affected provinces, Bureau of Water Resources promoted meetings among the parties. Since 1998, following successive meetings, a draft treaty and statutes have been prepared and are now being considered by all parties concerned.

69. **Watershed Committee of the SALIDULCE River.** This involves, within its territory, the provincial jurisdictions of Salta, Santiago del Estero, Tucumán, Catamarca and Córdoba. The Watershed Committee was created in 1971, but due to budget limitations it only produced concrete works in its first years of operation.

70. The need to deal with erosion problems in the upper watershed, and serious water pollution in the middle watershed, especially from sugar refineries that dump their
waste in the river, particularly affecting the cities of San Miguel de Tucumán and de Santiago del Estero, motivated the intervention of COFEMA in mid-1997. Various meetings, with the participation of parties concerned, produced a draft treaty, now being considered by the parties.

71. **Watershed of the Abaucán-Colorado Salado River.** This involves the provinces of Catamarca and La Rioja. The Committee, created in 1971, was stalled for budget reasons without having achieved any definition on intake works. Through a recent letter of intention, both provinces agreed to reactivate it and reformulate existing legal bases. The level of knowledge about the watershed is very elementary and for this reason it was agreed that the first actions would be aimed at updating information on water supply, availability and demands and make the provincial standardization compatible. The parties are currently studying a draft treaty.

**VI.B.3 Regional Groundwater Center (CRAS)**

72. In 1965, as a result of the international agreement signed by the Argentine Government and the United Nations, the “Research on Groundwater in Northwest Argentina” has begun; as part of this program, it was decided to create the Regional Groundwater Center (CRAS) with initial participation by the Provinces of Mendoza and San Juan, to be joined later by the Province of La Rioja.

73. Under Decree No. 146/98 this Center is now subordinate to the Secretariat of Natural Resources and Sustainable Development, through the Under-Secretariat of Water Resources, and through the corresponding ministries dealing with this subject. Unfortunately, economic and institutional restrictions caused this center to be de-activated, and there is considerable uncertainty on where data and staff will go; the staff is currently underutilized at provincial offices.

**VI.C Institutional Agencies at Provincial Level**

74. In this matter, provinces present a highly varied panorama. Most of their water resources administration agencies are generally branches of different Ministries; these include irrigation administrations, authorities or bureaus or departments of water, irrigation, drinking water and sanitation. Some of them have a Ministry of Ecology and Environment, others approach the subject according to urgent needs and create Secretariats or Bureaus, with a consequent overlapping of functions and actions and the problems stemming from this.

75. Since 1993, when the process of privatizing water sector agencies began, the institutional portion increased in size and complexity with the appearance of private operators and regulatory agencies for public services.

76. The diversity of institutions with direct involvement in water resources has generally been accompanied by a shortage of inter-institutional communication and coordination which has, in quite a number of cases, given rise to conflicts over the requirements (quantity and quality) of water resources demanded for
compliance with specific purposes. There is an inevitable overlapping of missions and functions involving more than two agencies answerable to different Ministries or Secretariats, with consequent uncertainty in the processing of concrete issues.

77. The situation worsens as new operators in the private sector and sectoral regulatory agencies emerge and reach a level of symbiosis among themselves, to the point that they end up defending the same interests as the sector’s concessionaires; added to the absence of a sustainable development plan for water resources, this jeopardizes the availability of this resource, weakens the water authority even more, and control over this resource is gradually lost.

78. Some of these are centralized agencies included in the provincial administrative structure, making their efforts extremely rigid. Others, however, depending on the law that created them, are self-sufficient agencies that operate in a decentralized manner, but whose dependence on the central government is total since their main source of income, fees for services rendered, set in most cases without technical or economic criteria, and the low levels of effectiveness in collecting fees, do not allow them to be self-sustainable.

79. There are other self-sustainable agencies with significant user participation; one of these is Mendoza’s General Department of Irrigation, an agency created by the provincial constitution.

80. The problems stated keep institutions from establishing integrated resource management in terms of market needs. Some regional development corporations such as CORFO Colorado River are on their way to overcoming this stumbling block, but there has been a delay in the adoption of new guidelines by the organizations, essentially due to the slow change in attitude among staff who lead them.

81. The structures of water resources administrations often lack a management focus, many of their essential technical aspects are deficient, and they nearly always have low user participation; in many cases there is not even a proper legal framework to operate with the modern participatory focus. This produces systems that operate in response to an authoritarianism of supply before users’ demands, with administrative structures that are resistant to change and that, with a paternalistic and patronizing focus, generate and retain a political environment that keeps them in power.

82. Contrary to the above, Regulatory Agencies have a modern regulatory framework, a smaller, streamlined structure and a budget suited to their functions which comes from the users themselves.

83. Appendix 2 to this document presents a general overview of institutional organization at provincial level for water resources management.

**VI.C.1 Institutional Structures for Watershed Management within Provinces.**
84. In the development of the Environmental Institutional Development (PRODIA) program, three watersheds were selected as “demonstrative intention” experiences: Province of Buenos Aires, Luján River basin; Province of Córdoba, San Roque Lake; Province of Mendoza, Upper Tunuyán River basin.

85. The introduction of the municipality’s protagonistic consideration in the environmental problems of watersheds was favored, as a decisive actor in what should be considered as the holistic treatment of land. A valuable set of data has been collected which, stored in the component’s database, make informative support elements available.

VII. WATER RESOURCE AND LAND USE PLANNING

86. The preliminary diagnostic of water resources management in Argentina (Laboranti, Malinow 1995) concludes that water development aimed at meeting the requirements of agricultural, energy and industrial activities were generally considered as economic infrastructure and, as such, quantitatively definable.

87. Those slated for drinking water supply and sanitation were considered social infrastructure, frequently subject to short-term political decisions, while little consideration was given to activities to preserve the ecosystem (erosion, sedimentation, flooding, contamination of surface and ground water) and fortunately are now being considered from an economic perspective.

88. This distinct (partial) focus on the activities and processes that condition the water sector have conspired against its comprehensive planning. Added to the above problems is the absence of land use planning in all provinces and, as a consequence, some of them have had to deal with imbalances as seen by such causes as the growing process of urbanization on lands with high agricultural potential, economic and demographic concentration in zones with limited water and soil resources, tourism industries that are not yet well structured in protected areas, etc.

89. In response to the document “Argentina’s Growth 1995-1999” prepared by the Secretariat of Economic Programming and acknowledged in the government’s five-year plan, which proposed as a tool for overcoming restrictions on regional development the implementation of the Water Resources Management Master Plan,” since 1995 the National Bureau of Water Resources has promoted actions that allowed it reach the stage of a Preliminary Diagnostic and the preparation of terms of reference for future contracting of consultants and/or experts to prepare the plan itself.

90. The Master Plan has a scope of 25 years and its objective is the preparation of …” an instrument allowing decisions by the political authorities of different jurisdictions to be oriented towards achieving a balance between the various availabilities of water around the country and the demands of inhabitants and their different productive sectors.” Unfortunately, the different actions carried
out with National Treasury funds allocated to the Under-Secretariat of Water Resources were suspended in hopes of having some line of pre-investment credit.

91. The absence of this master plan has motivated the initiative of several provinces which, like Mendoza and La Rioja, are dealing with the preparation of provincial water plans and programs to modernize water resources management.

**VII.A Resource Allocation**

92. **Water authority.** Considering that much of provincial water legislation is based on the country’s agricultural suitability that has been in evidence since pre-Columbian times and the impetus that the national government gave to the irrigation subsector by enacting the National Irrigation Law in 1909, in most provinces the Enforcement Authority responsible for managing and granting water use concessions to the various social and economic sectors corresponds first to the agency in charge of managing water for irrigation.

64. The double status of regulatory/control agency and agency responsible for managing water infrastructure for irrigation, caused most provincial enforcement agencies to concentrate their efforts on the latter part of their functions, to the detriment of activities aimed at maintaining an efficient water balance.

65. Following the decentralization of irrigation management to users, many of these agencies have been dismantled, provincial governments have considerably decreased their budget support and the possibility of recovering their leadership role as provincial water authorities is unlikely, due mainly to the strong role taken by public service regulatory agencies.

66. Even long-standing authorities such as Mendoza’s General Department of Irrigation have management conflicts with outside institutions that use water resources (OMNSA, Bureau of Water, Environment) and municipalities, i.e., with all those agencies that have a direct interest in water for a certain purpose.

67. **The concession scheme** contemplated by provincial legislation was established essentially to assign water to crops at a time when most of the population grew their own food. It might be said that it was established to assign waters that were being made available and not to assign them to competitive uses. The idea was that there would be water for everyone and, with the construction of new infrastructure, competitive situations would be avoided.

68. This explains in part the inflexibility of most provincial legislation regarding priorities set for water uses, the principle of the inherent importance if water to land, and the lack of concern about keeping water balances duly up-to-date.

69. **Allocated Volume.** Most laws, with the exception of several recent draft laws, allocate volumes that should be granted as concessions to each use. Let us consider a few examples: Mendoza (Art. 122) – the maximum quantity for irrigation shall be one and a half liters per second per hectare; Jujuy (Art. 52) –
The amount allotted for irrigation shall be one liter and a half per second and for residential use 150 liters per inhabitant and per day (art. 30); San Juan (art.125) – Agricultural uses shall have an allotment of one liter and thirty centiliters per second of time and hectare of land, supply to towns one hundred fifty liters per inhabitant and per day as a minimum (art.); Salta (Art. 65) - The entire population shall have the right granted to it for necessary public water use, on a permanent basis and for an unlimited time; the allotment for agricultural use shall be 0.525 liters per second per hectare (art.72).

70. All legislation, in virtue of the Principle of Inherent Importance, requires water concessions to be used only in the registered area; this obligation is not complied with on a high percentage of farms, nor it is feasible to levy sanctions on this.

71. Salta’s new water law (approved in January 1999) recently introduced a margin of flexibility in its article 74 and refers to water saved by the farmer as recovered water; it grants him the right to irrigate larger areas with the obligation of informing the relevant authority for registration purposes. As an encouragement to save, this offers him the opportunity of not being charged new taxes for the larger amount of land, a privilege which, by law, shall last as long as optimum use of the resource is justified or until ownership of the property changes hands.

VII.B. Water Registry and Cadaster

67. Provincial legislation is concerned with legislating water registration, referring to the quantity of water available, according to the corresponding assessed value, as well as the Cadaster where concession titles must be registered. Registration conditions and the security of corresponding record books are established. There is an urgent need to ensure that these are updated and that conditions are created for their safekeeping and for giving them due publicity.

VII.C. Use of Water Resources, Competition for Use

93. Domestic Water Use. This is allowed to all inhabitants, without any other limitation than to respect municipal ordinances which can regulate it but not discontinue it.

94. Municipal Use. This corresponds to drinking water and sanitation services which are regulated in a special manner. In general, the services’ regulatory framework states that, prior to granting the service concession, the enforcement authority should arrange for the corresponding water resources concession.

95. Despite the above provision, it is also a general characteristic, and in view of the preference of water for human consumption established in provincial water legislation, that operators are authorized to extract surface water from rivers and provincial surface and ground waters to provide services, with the sole commitment to use them rationally and efficiently.
96. The interpretation of the above powers is a still unresolved issue and the source of countless conflicts in times of scarcity. The same enforcement authorities, in view of the legal prevalence of water for human consumption, consider that operators may make use of the resource without any type of limitation and without the need for any economic compensation to the economic sectors from which the resource is taken.

97. **Agricultural Use.** The larger volume of water for irrigation used in agriculture is employed in the country’s arid and semi-arid regions. Out of the total water demanded by the agricultural sector, 98% is for irrigation purposes and the rest for cattle to drink. Although irrigation in humid zones represents 14% of the total irrigated area, in recent decades its growth rate has been faster than that of arid zones (Moravito 1997).

98. On the other hand, large private enterprises interested in agriculture are carrying out an expansion of the cultivated area that is irrigated mainly with groundwater. It is worth noting the flow of investments in new undertakings that span various productive categories in the Provinces of San Juan, La Rioja, Catamarca and San Luís, as a result of promotional benefits stemming from national law 22.021 and its modification 22.702 known as the Tax Deferral law.

99. From the document that compiles results of the National Seminar on the Current Status and Prospects of Irrigated Areas in Argentina (Tucumán 1994), it may be concluded that the low level of technical requirements in water administrations and the low value assigned to water as a resource have rendered the maintenance of irrigation systems inadequate.

100. Poor operation caused inefficient use of water, with soil deterioration due to excess water application and deficient maintenance of drainage systems. Limited maintenance led to such a level of deterioration in the works that in many cases their recovery now requires large investments.

101. A highly relevant aspect that discourages water saving and private investment in terms of irrigation infrastructure, is the impossibility of transferring water rights, or, in other words, the actual legal consideration of rights to develop water as things outside trade, in view of the principle of inherent importance which links water to land and causes an asset as precious as water to be fixed. Added to the above issue are difficulties at national level in obtaining proper financing for investments in this sector.

102. Finally, one of the main problems for irrigation system management is outdated cadasters or the absolute lack of cadasters in some of them. As a consequence, the turno is based on historical average values of land area and crops, with cases of water being given for nonexistent crops. Likewise, groundwater extraction is not registered.

103. **Use for Hydroelectricity.** Large-scale undertakings currently in operation on Andean rivers have equalizing reservoirs whose mission is to ease the conflict that
often arises between demands for power generation and for household use and irrigated agricultural production in downstream areas. Frequent institutional conflicts arise between provincial water agencies and power generation agencies with regard to the operation of power plants, due to disagreements over reservoirs (Laboranti, Malinow 1995).

104. The above situation shows the lack of agreement among user sectors; although provincial laws grant concessions for hydroelectric use, they require user preferences established by law to be observed, and on the other hand agreements between the government and provinces, through which the service was transferred as well as installations related to electrical power, state that, for the case of power plants located on irrigation canals, this service will have priority over hydroelectricity, but conflicts remain. An example is the above-mentioned Pasaje River – Juramento – Salado Watershed.

105. **Mining Use.** Provincial water legislation on use of water for mining (except petroleum) is mostly silent. The same is not the case with hydrocarbon regulations, which were directly considered in legislation by the provinces of Chubut, La Pampa, Mendoza, Neuquén, Rio Negro and Salta.

106. At national level, the mining code is in force; in 1995 an additional title was added by law 24.585 which incorporated environmental protection for mining, requiring the presentation of an environmental impact report as a management instrument. There are also special regulations approved for petroleum and nuclear minerals. As an enforcement authority, since 1992 the national Secretariat of Energy has regulated environmental protection in hydrocarbon activities through a series of resolutions.

107. Despite the existing regulation, the preliminary diagnostic of water resources management (Laboranti, Malinow, 1995) informs that, although quantitative data was not available on volumes and/or flow of water highly salinized by secondary recovery of extractive drilling in hydrocarbon operations, there is growing concern about the contamination generated by this use because of dumping in surface and ground waters.

108. The National Mining Code refers to waters required for mining articles in its article 48. The main problem in terms of groundwater consists of determining to whom these waters belong. Although the Code does not expressly say so, it is inferred that the concessionaire who, with his labor, discovers and draws water from within his land, makes them his own by right of occupation and labor.

---

4 Law 6088/93 of the Province of Mendoza on concession for hydroelectric use of water from the Atuel River.

5 Agreement between the Province of Rio Negro and the State Water and Electric Corporation, signed in May 1990.

With regard to surface waters, the matter refers to their use for the operation’s needs; it is important to note that the use of natural waters, when they flow within the concession’s perimeter, is not subject to any restriction, if they jeopardize farms or industrial establishments at the surface. When these waters flow beyond the concession’s perimeter, the principle of article 49 is applied, restricting water use, in case of harm, to the mine’s strict needs, i.e., the needs of the operation per se and not those of mineral processing.

**Industrial Use.** This name usually includes water use in the manufacturing industry, in the production of thermal electricity and in construction. Concessions for water use by industries in most provinces require the same regulated processing as for irrigation, including the principle of inherent importance mentioned previously. Industrial uses raise the issue of conflict mainly over recreational water use, due to the contamination caused by their waste.

**VII.D. Reutilization of Wastewater**

The increase in different uses of water (population, industrial, petroleum, recreational, etc.) have also increased the amount of waste in most of the highly contaminated cases, which do not receive proper treatment for reuse and generally are not being utilized. Provincial legislation contains no regulation on this matter and only a few provinces - Mendoza and Santa Fe – are adjusting legal provisions with a view to reutilization of wastewater.

**VIII. WATER Economy**

**VIII.A Tax Regulations and/or tariff for utilization**

Each province has and regulates its own financial charges, with different modalities according to the importance it places on the resource; the issue is generally treated by all provincial water legislation. General features include:

112. **Types of Taxes:** There are basically three types of taxes paid by public water users: i) Ownership taxes such as the usage or royalty tax and the dumping tax; ii) Tax fees or quotas for services such as channel cleaning, maintenance of works, contributions to users’ organizations to cover administrative costs; iii) Contribution for improvements from the construction of works benefiting farms that have been granted water rights.

113. **Authority to establish taxes** generally corresponds to the Legislative Branch at the request of the Executive Branch, formulated in the draft budget law.

114. Non-compliance by the concessionaire with any obligations stemming from the right, including taxes, are cause for **forfeiture of the concession.**

As a means to obtain tax payment, the laws stipulate:
i) Certificate of Free Debt: This means that a public deed cannot be extended or recorded in the Property Registry unless it is first authorized by a certificate issued by the water authority stating that the bearer does not own any amount for obligations stemming from his water right.

ii) Fines and/or Suspension of Water Supply: Non-compliance with obligations first generates fines and, if it persists, will lead to suspension of water supply.

iii) Administrative Notification: This corresponds to extra-judicial collection as a means of pressure, before resorting to judicial collection.

iv) Judicial Collection: A court order is imposed (fiscal enforcement procedure), with the debt certification issued by the water titling serving as proof.

**VIII.B Enforcement of Legal Provisions**

115. Most enforcement authorities register high amounts of overdue obligations with little possibility of their being recovered. Decrees are frequently issued which consider special and temporary procedures facilitating payment of water tariffs; added to this is a tolerant attitude by authorities regarding debt collection, which allows a good number of users to reach the end of the five-year term considered in various provincial constitutions (for example, Jujuy).

116. It is a widespread practice not to pay obligations for services rendered among provincial public administration agencies. Thus, for example, in Mendoza the General Department of Irrigation’s (DGI) largest debtor for water payments is the Provincial Government’s Central Administration, which at the end of 1994 owed $51.0 million. In compensation, DGI owed it $21.7 million at that date.

117. **Regarding irrigation.** PROSAP documents indicate that tax values and the degree of collectibility of some areas that have answered questionnaires, have the following characteristics: i) it is generally insignificant, both for the amount and for arrears in collection; ii) the low cost of water makes the resources available to agencies responsible for water management insufficient to meet the basic needs of system management; iii) in many cases, tax values were set using political criteria rather than criteria of economic efficiency.

118. In general water volumes are delivered in terms of water availability and the registered surface area, not in terms of the different crops and the area they occupy and in no case is volumetric delivery done.

119. **Drinking Water and Sewerage.** Information from ENHOSA\(^7\) indicates as a specific achievement of privatized or transformed provincial services the setting

---

\(^7\) Document called White Book Survey.
of a tariff scheme based on service costs. The regulatory frameworks consulted (3) indicate the following:

120. **Province of Mendoza**: law 6.044/93: i) Tariffs are set by the Executive Branch and are effective for five years at the proposal of the Provincial Water and Sanitation Agency (EPAS); ii) the Executive Branch may decree water service subsidies for household consumption, compensating the operator for the subsidized amount; iii) for the purpose of settling the Regulatory Agency’s operating cost, the concessionaire shall bill users for inspection, control and sanitation fees.

121. **Decree 911/95**: It is a general rule for the provision of services in tariff matters that: i) operators shall have the right to charge for all works and activities directly or indirectly linked to the service rendered, charge for connection and disconnection fees, and charge for providing block drinking water and sewerage and other items stipulated in the concession contract; ii) individuals and companies, including national, provincial or municipal agencies that will be beneficiaries of the service, are obliged to pay tariffs.

122. **Concession Contract**: The concession granted is acquired by purchase corresponding to the payment of a tax. The annual amount to be paid will stem from the application of the percentage established for the tax to the concessionaire’s operating income during the fiscal year considered.

123. **Province of Catamarca, law 4963**: i) Drinking water and sewerage service providers shall pay the provincial government a tax on the public water they use, which shall be consigned in the corresponding contracts; ii) Tariffs for services supplied to users should reflect the economic cost of services rendered based on the rational and efficient use of such services and the resources used to supply them; iii) The tariff scheme will be revised every five years in the manner and procedure determined by the contract and the Regulatory Agency; iv) Tariff modification is the responsibility of the Regulatory Agency, following a public hearing on the matter.

124. **Province of La Rioja, Law 6.281**: i) All providers of natural water services may request a free or paid special use concession on waters needed for such service; iii) The concession and control over the use of the resource shall be the responsibility of the Provincial Water Bureau; iii) All providers may request free use of receiving waters needed to provide service; iv) Providers may market their surplus production of drinking water or of their sewerage or waste treatment capacity, with prior communication to the Regulatory Agency.

125. **Tariff Regulations**: i) The Regulatory Agency is responsible for determining them as well as enforcing their control; ii) The tariff scheme should be governed, among other principles, by being uniform throughout the province and reflecting the economic cost of providing the service; iii) Service providers may grant direct subsidies on the payment of tariffs by low-income users and such grant shall apply to maintaining the economic and financial balance of providing the service.
126. **Province of Jujuy.** The principles upon which the tariff scheme should be based, for drinking water and sanitation works (Art. 7 law 4090 de 1984), have an eminently social meaning. Currently, the company responsible for providing this service, Agua de los Andes, uses as an argument for not covering the Enforcement Authority a tax for water it distributes.

127. **Hydroelectricity.** The only information available is the Province of Mendoza’s law 6497 of 1997 through which the electrical regulatory framework is issued. Said provision in article 19 states:

i) A royalty for the use of public waters for electrical generation equivalent to 12% calculated over the sale of energy.

ii) The payment of a 2.5% tax for hydroelectric generation, steam production and/or cooling of thermoelectric plants using public waters. The same law states that the tax will be covered by the General Department of Irrigation and its output assigned to carry out irrigation and drainage studies in the water system from which the resource originates, subject to prior, express coordination with the enforcement authority.

128. **Industrial and Other Uses.** No information on this matter is available. The only reference is that stated in the Province of Mendoza’s law 360447 of 1993 which establishes the following as a water service tariff those properties which, depending on their use, are catalogued as Commercial and Industrial:

i) A fixed charged determined in relation to the diameter of the household connection and regardless of consumption, equivalent to twice the value set for family-category properties;

ii) A charge for consumption in terms of that registered by the volume meter whose prices per cubic meter show a 100% increase with respect to those set for household consumption.

**VIII.C. Recovery of Public Investment**

129. Provincial legislation in general determines that investments in infrastructure works be general works that benefit a consortium or works at farm level that benefit private individuals who own them, even if their financing is anticipated by the public authority, and are transferred to beneficiaries through generally deferred payments and with reasonable interest rates.

130. In general the charge is formulated in terms of the user’s economic capacity; nevertheless, when works are common and executed for purposes of general promotion, the public authority usually assumes all or part of their cost. (For example: the system implemented in Mendoza by Provincial Decree-Law 6859 and provincial law 3599).
There was no information on the way that the application of these measures in the provinces has evolved. It may be assumed that, in most of them, said amortization experienced the fate of investments made by the country under law 6.546, called the Irrigation Law. Said law stated that, once the investment is recovered, works came to be owned by the provinces; in the 1980s, this infrastructure finally was transferred without charge by the country’s water and electrical company.

IX. PRIVATE SECTOR PARTICIPATION IN RESOURCE MANAGEMENT

IX.A Drinking water and Sewer Services

The national policy in this sector, led by the National Sanitation Works Company (ENHOSA), seeks to incorporate private capital in the operation of services and the financing of necessary investments. ENHOSA reaches the Provinces and Municipalities, through their centralized or decentralized agencies and/or companies or corporations, community agencies, cooperatives, civil associations, private or joint venture companies or those which, under a different legal set-up, participate in the development, expansion, regulation and control of services.

In the process of transforming the sector, the service provision sector has shown a notable impact: for example, in 1989 the private sector served only 13% of the country’s population, while by 1998 this percentage rose to 57%. In contrast, the public sector served 74% of the population and now serves 14%.

Significant progress has also been achieved in approving provincial regulatory frameworks, with eight provinces currently remaining. This is expected to be completed in the next five years. Appendix #3 presents advanced management in this area at provincial and municipal level.

IX.B Irrigation Infrastructure

Until 1992 the country’s water and electrical power company, together with provincial bureaus, were involved in the development of irrigation works at national level. This responsibility was fully transferred to the provinces as a result of the privatization process that began in 1993. Today, many of them are working on the decentralization of management, and for this purpose they are encouraging user participation.

A good part of provincial water legislation deals with regulating the organization of irrigation users; most legislation considers them as ¿personas de derecho público; a second, minority group considers them as corporations of a joint nature (Mendoza Watershed Inspection Associations); a third group institutionalizes them as consortia with the power to operate in the field of public and private law (Province of Salta); and finally provinces such as San Juan which reduce users’
participation to contingent agreements for carrying out small works in irrigation infrastructure, subject to the transfer of corresponding funds.

137. Besides direct decentralization among organized users, provincial legislation such as that of Salta consider the feasibility of having private firms provide irrigation services. It is currently in charge of a corporation comprised of former employees of the General Water Administration; this corporation, according to law, may receive as a donation assets pertaining to service administration.

138. The transfer of management and infrastructure to users has not been achieved in most provinces with full administrative and financial autonomy. There is a somewhat undefined position regarding the powers transferred to them. This situation is caused in some cases by the lack of political willingness to carry out the actual transfer and, in others, by resistance from users who associate decentralization with the loss of subsidies and other paternalistic, complacent attitudes of provincial administrations, which are particularly related to unenforced payment of tariffs or the setting of sums that do not allow the system to be self-sustainable.

139. There is also the case of provincial administrations which, in view of the loss of subsidies from the public treasury, have opted to get rid of irrigation systems as quickly as possible; these systems, which are generally in an advanced state of deterioration, are transferred to users who in most cases are not prepared to take over such important management duties.

90. Some relatively successful cases of decentralization include:

i) **Valle de los Pericos Consortium in the Province of Jujuy**, with major economic support from the Tobacco Cooperative. This consortium has the concession for irrigation infrastructure and the dike at Los Maderos Reservoir.

ii) **Watershed Inspections in the Province of Mendoza** 157 in total, organized in turn as second-level Associations that bring together nearly 50,000 users in the entire province, distributed over approximately 250,000 hectares.

iii) **Mendoza River Watershed Committee.** This recently formed organization (May 1999), acting as a Consultative Council, is in the process of writing its statutes; it is comprised of 76 users’ agencies that administer the irrigation network of the Mendoza River “oasis.” These in turn are associated with second-level organizations, the Watershed Inspection Associations, which coordinate the management of the secondary canal.

   The Watershed Council is a third-level organization whose initial objective is make all river inspectors agree on coherent, efficient management of the network’s water. A proposed long-term objective is to collect the water
tax, pay the resource to the Department of Irrigation, and transfer the administration of money to the banking system in order to ensure financing.

**IX.C Concession for Construction of Public Works**

140. The incorporation of private capital into the performance of public works and their contracting by the concession system, is one of the instruments utilized by the Argentine Government to encourage private investment. This modality implies direct intervention by the concessionaire in developing the public work.

141. In the province of Mendoza, one of the projects currently contracted under this modality is the construction of the Potrerillos Dam to comprehensively harness the Mendoza River, including the refurbishment of Cacheuta and Alvarez Condarco power plants. The work is currently being carried out and progress is being made on the dam’s environmental impact study.

142. For the execution of this and other planned works such as the Sanitation of the Pescara Collector, under law 6498 of 1997 the province established the **Public Works Trust Fund** which will be administered by a joint agency that will act as an enforcement agency, under the Province’s Ministry of Environment and Public Works.

**X. POLLUTION AND WATER QUALITY REGULATIONS**

**X.A. Regulatory Gap**

143. The regulatory gap regarding pollution and water quality is noted first at national level.

144. The debate on the different projects developed by art. 41 of the Constitution with regard to the regulation of “Minimum prerequisites” is underway. It is still not clear what should be understood by “repairing environmental damage” and whether the repair is physical, pecuniary or both. There is also no consensus on what structure the regulation should have, while some groups think there should be a general environmental law which contemplates all aspects of environmental relations and that sectoral laws should later be prepared; other groups only promote a minimum prerequisite law and provincial laws that will raise the levels of the national law.

145. While this occurs, most provinces have moved to sanction environmental protection laws which, among other issues, regulate pollution and water quality. These legislative schemes will have to be modified once the minimum prerequisite law is enacted, since by constitutional mandate provinces can only legislate on this matter, complementing the national regulation.

146. In addition, each of the laws through which the use of water resources is regulated in a sectoral manner, generally deals with pollution through purely declamatory
provisions. On the contrary, there are regulations, which, as in the case of the Province of Córdoba, contain such strong demands that compliance is impossible, making the regulation inefficient.

147. The Province of Córdoba, by regulating studies of environmental impact assessments, leaves it up to the interested party to appoint an expert who should perform the study; this causes conflicting situations in terms of interests.

148. The regulations of Enforcement Agencies and Municipal Ordinances complement the above situation. The result of the problem described is the crisis of areas of responsibility due to multiple sources and multiple administrative arrangements or management.

149. Special mention should be made of the almost generalized gap in exercising regulations, with respect to the prevention and control of water pollution, due to the definition of agencies historically dealing with water resource activities, new agencies dealing with environmental issues, the recent creation of private operators for the provision of drinking water services, and Regulatory Agencies for public services.

X.B Pollution and Water Quality Provinces in Province of Mendoza

150. Mendoza, through the General Department of Irrigation, has developed a specific regulation for water pollution control. Resolution 778/96, applicable throughout the entire province, establishes the tax scheme to be used, under the concept of a pollution control tax and establishes the quality parameters for all waste dumping, while the Provincial Water and Sanitation Agency (EPAS), under resolution 35/96, regulates drinking water quality and sewage.

151. In terms of controlling the contamination of aquifers, General Department of Irrigation has begun an insecticide control program at the water table level, at the first aquifer level in a pilot watershed on the Tunuyán River. Another campaign is the capping of abandoned wells.

152. The responsibility of administering pollution control in the Pescara collector will be delegated in the Consortium formed by a mixed group of industries that, through self-management, will assume the administration of the collector.

XI. INSTITUTIONAL AND LEGAL STRUCTURE FOR CONFLICT RESOLUTION

XI.A. Inter-Jurisdictional Conflicts

153. The conclusions of regional meetings held in 1994 to prepare the Preliminary Diagnostic on Water Resources Management aimed at formulating the Master Plan, agreed in stating there is an absence of non-contentious mechanisms for resolving differences among jurisdictions over the development of shared water resources.
154. Background on the subject shows numerous recommendations on creating administrative tribunals for arbitration or conciliation which, within Watershed Committees or the national Under-Secretariat of Water Resources, deal with the problem.

**XI.B. Conflicts among Users**

155. It is worth noting an underlying problem that hinders timely resolution of conflicts among users over the use of water resources. Most provincial legislation grants jurisdiction to provincial courts where judges know little or nothing about water rights; this circumstance generates vague lawsuits without contributing concrete solutions. The provinces of Mendoza, Río Negro and recently Salta are excepted; their legislation contemplates “Administrative Water Justice.”

156. In the case of Mendoza, the Administrative Water Justice bureau is located within the General Department of Irrigation, where an Appeals Council comprised of five members representing the province’s five watersheds, and appointed by the legislative panel presented by the Executive Branch, are in charge of resolving conflicts. Their decisions may only be appealed before the provincial Supreme Court.

157. It should be noted that, although the General Department of Irrigation is the province’s sole water authority, the five members of the Appeals Council are representatives of farmers; this situation merits consideration and representation on said Council should be granted to representatives of different sectors in order to achieve a greater level of understanding of the problem in general and to strengthen the General Department of Irrigation as a water authority in the province.

**XII. PRINCIPAL INTERNATIONAL EXPERIENCE**

158. The purpose of this chapter is to ask what Argentina can learn from what other countries have done to deal with their respective water problems. The purpose is not to dwell upon international experience so we shall limit the presentation to a synthesis of three concrete cases: i) the experience of watershed agencies in France; ii) the California Water Decree; and iii) the transfer of Irrigation Districts in Mexico. This synthesis constitutes Appendix #4 of this document.

**XIII. SYNTHESIS OF DIAGNOSTIC AND MAIN PROBLEMS DETECTED**

**XIII.A. Absence of Regulatory Framework at National Level**

159. The constitutional jurisdiction through which ownership of natural resources is granted to the provinces is cause for confusion and has become an obstacle for the existence at national level of a framework law through which the necessary
guidelines can be provided for comprehensive and rational resource management; despite this, authorized spokesmen in the provinces, at different forums and workshops, have quite often expressed the need for a national law to regulate water resources.

160. With the constitutional reform of 1994, this stumbling block appears to have been overcome, since article 41 grants express authority to the federal government to enact regulations that contain “minimum prerequisites for protection” on environmental matters.

161. This provision clearly does not delegate authority on natural resource issues to the federal government but it does allow the National Congress to issue laws that set the minimum conditions to be observed throughout the country with regard to the protection, rational utilization, preservation, information, etc. of natural resources.

162. Despite efforts by authorities, members of the legislature and NGOs, this authority has not yet been exercised and therefore water resources management is legislated independently by each one of the provinces, with territorial and sectoral criteria determined by political-administrative boundaries, openly divorced from regulatory frameworks and other plans existing at regional and national level.

XIII.B. Provincial Legislation Lacking Efficiency and Effectiveness

163. Provincial water legislation lacks legislative systematization, which hinders accurate understanding and creates legal insecurity. In effect, there is a multiplicity of provisions regulating water resources in a sectoral and fragmented manner, often creating an overlapping of functions, a collision of jurisdictions and contradictory rulings that favor non-compliance with the law.

164. Finally, some a regulation that efficiently and suitably regulates the resource and allows the administration to respond to problems that arise.

XIII.C. Principle of Inherent Importance and its Implications on Water Economy

165. The concept of irrigation as an accessory element of farms determines that only land owners and not direct growers may own the concession. By persisting with this principle, provincial legislation determines that the quantity of water concessions allowed to be used is established in terms of the size of the registered area, and its use in adjoining areas is prohibited, even if such areas belong to the same owner.

166. This proposal supposes overlooking the fact that many farms (not only irrigated farms but also rainfed ones adjoining irrigated ones) may be prepared to receive irrigation waters regardless of whether they are actually irrigated in all their fields. Moreover, the investment that the farmer may make in irrigation technology to achieve greater efficiency and water savings, is not only
discouraged but is also scorned by the administration which prohibits it from increasing irrigable surface, in virtue of the principle of inherent importance.

167. But most of all, the principle of inherent importance is associated with the impossibility of partially or wholly, temporarily or definitively transferring water rights (independent from land), causing an asset as precious as water to become immobilized. The concept of water as an economic asset needs to be internalized by water authorities and users, and the establishment of water banks needs to be promoted, a mechanism by which it would be possible to regulate a non-institutional market which has arisen due to the dysfunctions caused by legal provisions.

168. The creation of a water bank would make it possible to allocate available resources to more competitive uses and would contribute toward gradually eliminating unrecommendable practices such as those used by the General Department of Irrigation in Mendoza. In the case of agricultural engineering, this authority, besides organizing distribution by sections and shifts, does it among users whose payments are up to date. Along these lines, water corresponding to concessionaires with overdue payments is simply distributed among the rest of the users, with no consideration whatsoever given to real needs, a procedure that discourages improving efficiency in water use for irrigation.

169. In addition to the above, the principle of inherent importance indirectly determines the water concession scheme currently in effect among the provinces, designed to allocate waters that had been made available due to the construction of new infrastructure, and not to allocate them for competitive uses. In other words, the allocation responds to supply and not to demand; thus, most provinces show an absence of legal provisions requiring waters to be treated for reuse, a more efficient use of this resource and encouragement for those who save significantly through the introduction of technology.

170. From an administrative standpoint, there is a marked indifference to the updating of Water Registries and Cadasters and the monitoring of concessions granted in order to declare the forfeiture of those rights which, due to lack of effective use of the resources during the period determined by law or repeated non-compliance with payments, merit such a sanction. In addition, the insufficient and oftentimes non-existent monitoring of groundwater.

171. Another concept absent from the concession scheme deals with environmental uses; these demands will grow as the process of researching and appraising environmental functions progresses.

XIII.D. Weak Power by the National Authority to Convene Provinces

172. The national water authority’s power to convene provinces, classified in COFEMA as a result of the Federal Environmental Pact, is weakened mainly by several provinces’ non-adherence to the pact, and secondly by the lack of
economic incentives motivating them to participate actively. Nevertheless, we consider it the best instrument of national commitment for agreeing on policies aimed at water resources planning.

**XIII.E. Institutional Fragmentation and Manifest Weakness of Water Authority at Provincial Level**

173. The dominant feature at institutional level is the fragmented public management of water resources and the sectoral management of these resources by institutions with different focuses. There is an overlapping of functions and missions, frequently involving more than two agencies subordinate to different Ministries or Secretariats, and finally leading to an under-utilization of resources, uncertainty regarding the ability to deal with concrete issues or gaps in exercising regulating authority.

174. The negative effects of this fragmentation are evidenced in cases such as the issue of pollution in most provinces, stemming mainly from conflicts over jurisdiction among Enforcement Agencies, Ministries of Environment, Private Operators and Regulatory Agencies, obliging users to spend effort and time, when all these agencies exercise their powers to deal with a large number of inspections that could be minimized if there were an institutional replanning.

175. This situation, worsened by lack of inter-institutional communication and coordination, is considerably weakening the provinces’ control over water resources, with serious danger in the future, should this situation persist, that due to the power gap and the weakness of the Enforcement Agency, control will be assumed by private agencies that operate drinking water, hydroelectricity, irrigation and other services.

**XIII.F. Interprovincial Conflicts Over Water Regulation**

176. Water development in interprovincial watersheds is a source of ongoing conflict. According to constitutional provisions and national Supreme Court decisions, its regulation must be submitted to interprovincial or regional treaties.

177. To overcome these conflicts, inter-jurisdictional agencies known as Watershed Committees were set up. With the support of the national authority, these committees determined the technical and legal mechanisms needed for their operations. It should be noted that in this structure, only national and provincial authorities and agencies participated and now participate, with a notable absence of water users.

178. Although many committees responded in principle to compliance with the objectives for which they had been created, they gradually became weakened due to the inability to resolve larger conflicts over jurisdiction with respect to the administration and auditing of their financial resources and fundamentally due to
the lack of economic and financial autonomy since they lacked their own sources of income.

179. As a result, out of ten agencies created initially, only three remain; these are now directly related to projects carried out through PROSAP, which has strengthened them financially.

180. As one might guess, inter-jurisdictional conflicts remain, some of them causing crises, as in the case of Laguna Picasa (provinces of Buenos Aires, Córdoba and Santa Fé); Pasaje River – Juramento- Salado (Provinces of Salta, Santiago del Estero, Catamarca, Santa Fé and Tucumán); Sali Dulce River Basin (Provinces of Salta, Santiago del Estero, Tucumán, Catamarca and Córdoba); and Abaucan Colorado Salado watershed (Provinces of Catamarca and La Rioja).

181. In order to handle these problems, coordination actions among provinces are currently being promoted by the National Bureau of Water Policy in order to reactivate Watershed Committees; however, in their restructuring, there is a lack of mechanisms granting them financial autonomy and a lack of representation on these committees by watershed users.

XIII.G. Water Management Separated from Land Use Planning and from the Watershed as a Management Unit

178. The polemics over the environment nearly always stem from land use planning problems. Imbalances such as the extensive growth of urbanization on fertile lands, forest soils ravaged by cattle raising, human and industrial settlements in aquifer recharging areas, bring out the need for land replanning in order to conceive water resources management in accordance with political, social, economic and environmental needs, avoid conflicts among users and prevent the effect of natural phenomena that could cause catastrophes.

179. Added to the absence of national and provincial legislation on land use planning is the disjointed management of water resources at watershed level, generally associated with inter-jurisdictional conflicts over the use of these resources in interprovincial watersheds and the limited power of regulation and authority exercised by Watershed Committees (when they are active), due mainly to the lack of autonomous sources of financial resources to provide them with the economic means to carry out management.

180. There is national and provincial awareness that the watershed is the most suitable unit for integrated water management, but conflicts stemming mainly from the provinces’ political-administrative boundaries and agreement on legal principles and organizational agreements to achieve equitable distribution and utilization of resources in terms of quantity and quality, are issues which currently cannot be overcome.

181. The situation described above is repeated within provinces with regard to water development in interior watersheds. The problems are projected to users, causing
recurring conflicts among them and among sectors over water uses, accentuated recently by the incursion of private operators in the drinking water and hydroelectricity sector.

182. One reason for this seems to stem first from the lack of mechanisms to strengthen the country’s power to convene provinces, secondly from the lack of a regulatory framework at national level for water resources management, and finally from the fact that interprovincial water management, according to the National Constitution (Art. 125), is regulated by treaties among provinces which, considering the existence of the first two suppositions, is left rather to the discretion of provinces with ownership over the upper part of the watersheds.

XIII.H. Limited Participation by Users in Resource Management

183. The incorporation of users in water resources management is shown more clearly in the transfer of irrigation districts to users.

184. This process has not yet achieved expected results due to the somewhat ambivalent position of many provinces with respect to granting administrative and financial autonomy to users’ organizations; the resistance by enforcement authorities to undertaking a proper communication and information campaign among users about the merits of such transfer; the lack of training for users to assume new responsibilities; users’ resistance to giving up highly subsidized tariffs with low levels (quite flexible and sometimes nearly nonexistent) of collectibility; non-requirement for recovery of investments in public works in water infrastructure; and the deterioration of irrigation systems. These, among others, are reasons why the process has not progressed.

185. The marked financial dependence of many of the enforcement authorities of provincial treasuries and their non-mandatory self-sustainability with the resources they receive for rendering their services, and political pressure linked to the setting of water tariffs by provincial legislation without meeting technical or economic criteria for providing the service, all constitute, among others, an incentive structure which causes government decision makers not to establish clear rules for the transfer policy.

VX. CHALLENGES AND OPPORTUNITIES FOR REFORM

VX.A. Search for Consensus to Regulate Article 41 of the National Constitution.

186. Article 41\(^8\) of the Constitution gives the country the opportunity to write the national regulatory framework for water resources management. According to the

\(^8\) Art. 41. “All inhabitants enjoy the right to a healthy, balanced environment suited to human development and so that productive activities may meet present needs without jeopardizing those of future
text of the article, Congress has the power to issue a regulation that sets the policies to be followed *without need for ratification by the provinces*.

187. The participation of different stakeholders at the legislative, executive and civil society levels through the Business Council for Sustainable Development, who have prepared and presented various draft laws, now undergoing studies by various groups seeking to prepare the definitive proposal, constitute the raw material for the country, with the leadership of the Under-Secretariat of Water Resources and utilizing as a commitment instrument the **Federal Environmental Pact and/or COFEMA**, subject to the establishment of innovative mechanisms such as mediation and or seeking consensus among national and provincial legislators, to convene the provinces and seek consensus on the final enactment of the law.

188. As expressed in the presentation of main projects (paragraphs 10 to 20), these contribute the legal base from which solutions can be reached on the problems detected; after their analysis, the seeking of unity on criteria, and above all consensus with provinces, present a unique opportunity to begin the process of Water Resources Planning in the Argentine Republic.

189. In the discussion and consensus on the final project, one should keep in mind the new focuses and criteria for the preparation and development of water resources management policies and water planning, formulated at various international forums (OCDE, Rio de Janeiro Summit, International Water Supply Association, European Community, World Bank, etc.). The principles and criteria are summarized below:

i) Water conservation and sustainable use of resources;
ii) Integrated management of demand and supply;
iii) Overall consideration of the quantity and quality of the different phases of the water cycle in the soil and atmosphere;
iv) Precaution and preventive action;
v) **Subsidiaridad and shared responsibility**;
v) Harmonization and integration of various policies related to water resources;
vii) Establishment of proper economic and financial instruments;
viii) Capacity building;
ix) Public information;

---

generations, and have the duty of preserving it. Environmental damage shall generate the mandatory obligation to repair it, as stipulated by law.”

“Authorities shall provide for the protection of this right, for the rational use of natural resources, for the preservation of the natural and cultural heritage of biological diversity, and for environmental information and education.”

“The nation is responsible for issuing rulings that contain the minimum prerequisites for protection, and the provinces are responsible for complementing them, without altering local jurisdictions”……
x) Applied research and development.

**VX.B. Opportunity to Generate Coherent and Homogenous Provincial Legislation**

190. It is really important to keep in mind that the minimum prerequisite law is going to modify provincial legislative schemes since provinces will only be able to legislate, complementing the national ruling, which means that once the minimum prerequisite law is issued, a favorable stage begins in terms of improving and arranging water legislation on an irremovable basis determined by the regulation that places the Minimum Prerequisites Law at national level.

New laws should respond to the concept of the framework law; and among other aspects they should place special importance on making flexible the priority scheme for water use and incorporate environmental uses within these priorities; they should favor the transfer of water rights and the legal framework needed for that to occur; force and encourage efficient water use.

**VX.C. Political Momentum, Opportunity to Favor Institutional Rearrangement**

191. The current change in federal and provincial authorities offers the right environment to propose a deep and urgent reform of provincial and interprovincial organization, directly or indirectly involved in water resources. Consequently, it will be necessary to:

i) Re-propose the economic scheme of administrations related to water and users’ organizations;

ii) Define the mission and functions of the various institutions, which should be redefined under the framework of decentralization of the management of Users’ Organizations;

iii) Strengthen the provincial Water Authority and fill the gap stemming from the administration’s current inability to carry out its regulatory and control function, which has weakened it with respect to Regulatory Agencies and Private Operators;

iv) Set up watershed agencies whose integration involves active representation and participation by watershed users and their own sources of funds that allow it economic autonomy. Many of these sources may stem from the establishment of economic instruments associated with penalization for pollution stemming from dumping and the use of a certain volume of water flow.
Appendix

DECREES MODIFYING THE STRUCTURE OF WATER RESOURCES

Decree 435 dated March 4, 1990: The SECRETARIAT OF WATER RESOURCES becomes an Under-Secretariat.

Decree 479 dated March 14, 1990: The UNDER-SECRETARIAT OF WATER RESOURCES is extinguished, with its functions being passed to UNDER-SECRETARIAT OF PUBLIC SERVICES.

Decree 871 dated May 4, 1990: The NATIONAL BUREAU OF WATER RESOURCES, DRINKING WATER AND SANITATION is created.

Decree 1691 dated August 27, 1991: It becomes the NATIONAL BUREAU OF WATER RESOURCES, a branch of PUBLIC WORKS AND SERVICES.

Decree 1496 of 1991: Structure that lasts until Decree 146/98

Decree 2419/91: Creates the Secretariat of Natural Resources and Human Environment under the scope of the Office of the President, and National Institute of Water Science and Technology, subordinate to the Secretariat of Public Works, is now subordinate to this Secretariat.

Decree 438 3-12-1992: PUBLIC WORKS is now subordinate to the Ministry of Economy, which is now called the MINISTRY OF ECONOMY AND PUBLIC WORKS AND SERVICES.
THE NATIONAL BUREAU OF WATER RESOURCES is subordinate to the SECRETARIAT OF PUBLIC WORKS.

Ley 24190 (Law of Ministries) Accredits the prior Decree

Decree 2786/93: Creates the Bureau of Water Pollution Control, subordinate to Under-Secretariat of Human Environment.

Decree 1492 September 1994: The Under-Secretariat de WATER RESOURCES is created, subordinate to the Secretariat of Public Works of the Ministry of Economy, Public Works and Services.


Decree 1381/96: Creates the Under-Secretariat of Water Policy and Environmental Planning; within it, the National Bureau of Water Resources, subordinate to the Secretariat of Natural Resources and Human Environment.


Decree 146/98: Centralizes en the Secretariat of Natural Resources and Sustainable Development the management of surface and groundwater resources and that pertaining to hydraulic and sanitation works. It creates the Under-Secretariat of Water Resources and is transferred to its scope of action and that of the Secretariat of Natural Resources and Sustainable Development::
- The Groundwater Institute (ex – CRAS), subordinate to the Argentine Geological and Mining Service.
- The Interjurisdictional Committee of the Colorado River (C.O.I.R.C.O.)
- The Regional Commission of the Bermejo River (COREBE)
- The Comahue Regional Agency for Dam Safety (ORSEP-COMAHUE).

Decentralized, subordinate agencies:

- National Institute of Water and the Environment
- National Agency of Sanitation Works (ENHOSA)
- Tripartite Sanitation Works and Services Agency (ETOSS)
- Regional Dam Safety Agency (ORSEP)

**Decree 20/99:** The UNDER-SECRETARIAT OF WATER RESOURCES no longer belongs to the Secretariat of Natural Resources and Sustainable Development, and is transferred to the Secretariat of Public Works of the Ministry of Infrastructure and Housing.
ANNEX C:

GROUNDWATER
1. Objectives and Scope of Study

The objective of this study is to present the problems of groundwater resource management, protection and conservation under the framework of sustainable development. The analysis focuses on aquifer systems in the provinces of Mendoza, Buenos Aires and Santa Fé, which are representative of the country’s overall groundwater issues. It concludes by presenting proposals for the program and actions to be implemented in order to achieve the objective of sustainable groundwater development.

2. The Strategic Role of Groundwater

Due to its large spatial distribution, its seasonal and interannual stability, and especially the high degree of flexibility that allows it to be developed, groundwater is widely used in all socioeconomic sectors. Its use ranges from a small well used for a family’s household needs in a suburb of Buenos Aires, to an array of 118 irrigation wells in the Tulum Valley (Province of San Juan) that can provide a volume of 24 m³/s, to wells drawing water from the Paraná aquifer with highly salinized water but suitable for industrial uses.

An estimate of ground and surface water contributions to meet the country’s total demands for consumption is summarized in table 2.3.

Table 2.3 – Water Extractions
(Period 1993-97)

<table>
<thead>
<tr>
<th>Consumption</th>
<th>Surface Water</th>
<th>Groundwater</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million m³/year</td>
<td>Million m³/year</td>
<td>Million m³/year</td>
</tr>
<tr>
<td>Irrigation</td>
<td>18000</td>
<td>6000</td>
<td>24000</td>
</tr>
<tr>
<td>Livestock</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>Supply</td>
<td>3500</td>
<td>1000</td>
<td>4500</td>
</tr>
<tr>
<td>Industrial</td>
<td>1500</td>
<td>1000</td>
<td>2500</td>
</tr>
<tr>
<td>TOTAL</td>
<td>23000</td>
<td>10000</td>
<td>34000</td>
</tr>
</tbody>
</table>

Source: FAO-Aquastat modified and rounded

The national average of groundwater’s contribution to total coverage of demands, about 33%, does not reflect the importance of the role of these resources. Thus, in the irrigation sector, groundwater reserves ensure a multiannual regulation of resources and make it possible to overcome drought periods, such as that of 1967/1972, compensating for the lack of surface water resources.

3. Issues

Despite the strategic role of groundwater in the management of the country’s water resources, no real integrated surface/groundwater management has been achieved and, moreover, aquifer protection has been overlooked. The degradation of groundwater generally takes years, if not decades, to show. Likewise, it will take a long time to restore it, even with determined efforts.

The issue of groundwater resources in Argentina may be summarized by citing the conclusions of two recent works.
At the National Seminar on the “Current Status and Outlook of Irrigated Areas in Argentina,” organized by INCyTH, INTA and the Government of the Province of Tucumán and held in 1994, one of the main conclusions recommends that “The preservation of groundwater resources, both in terms quality and quantity, requires, in its strategic role for future development, a careful and up-to-date evaluation, at the level of each provincial administration.”

In the World Bank report on “Environmental Pollution in Argentina: Problems and Options” (October 1995), one of the main conclusions is: “Groundwater contamination should be considered the most important pollution problem in Argentina, more than anything due to a large number of households— including a large number of low-income households—who depend on groundwater for their daily needs, being exposed to health risks, and the irreversibility of pollution.”

An outline of the country’s hydrogeological regions is presented below and, through the case of the three provinces of Mendoza, Santa Fe and Buenos Aires, conditions for the occurrence, use and vulnerability of groundwater resources are analyzed.

4. Hydrogeological Regions

The distribution and occurrence of aquifer systems in the continental territory of Argentina are conditioned by the geological structure as well as climate and hydrographic factors. Thus, four large hydrogeological regions are distinguished.

**Intermontane Valley Region.** The essential feature of this region, which includes cordillera and consists of important clastic sedimentary landfills. They constitute aquifer systems with high permeability in the foothills and medium to low in the center of valleys and at depths. The region mainly covers Nuevo Cuyo and the Northwest (Provinces of Jujuy, Salta, Tucumán, Catamarca, La Rioja, San Juan, San Luis and Mendoza), with arid and semi-arid climate.

The operation of aquifer systems is closely linked to the hydrology of rivers, whose runoff constitutes the main natural recharging of systems. The following are distinguished:

- aquifer systems with discharge toward endoreic basins, with evaporation being the only natural component of their outflow. Representative of these systems are those of the Puna, the Tucumán debris cone and the valleys of Catamarca and Tunuyán.
- aquifer systems with discharge toward the alluvial plain, emptying into the Atlantic Ocean. Examples of these systems are those associated with the valleys and alluvial fans of the Mendoza, Atuel, Diamante and San Juan Rivers.

**Region of the Chaco Pampeana Plains.** Aquifers in clastic sediments are found throughout the region. The dominant morphology is plains which vary from undulating to depressed and high. It corresponds to the Litoral-Mesopotamia (Provinces of Formosa, Chaco, Corrientes, Santa Fe and Entre Ríos), the Central-Pampa Gringa (Provinces of Santiago del Estero, Córdoba and La Pampa) and Greater Buenos Aires (Province of Buenos Aires and Federal District). In a predominantly humid climate, the main component of the recharging of aquifer systems is rainfall infiltration.

---

The region’s groundwater resources essentially come from the extensive aquifer system called Puelches which includes three overlapping and interconnected aquifers: Epipuelches or Pampeano, Puelches and Hipopuelches or Paraná.

Region of the Misiones Plateau. This includes the Province of Misiones and part of Corrientes. Aquifers include basalt with low permeability and sandstone in the Misiones Formation. The latter form part of a mega-aquifer, with an estimated extension of 1.5 million km², which occupies part of the territories of Brazil, Paraguay, Uruguay and Argentina. At regional level it is known as the Guaraní Aquifer.

Region of Patagonian Plateaus. Situated in an arid climate, with little or no precipitation, the region extends from Tierra del Fuego to the Colorado River, including the provinces of Neuquen, Río Negro, Chubut, Santa Cruz and Tierra del Fuego. The aquifer systems include the formations of the Rodados Patagónicos (Patagonian Boulders), basalt plateaus, and especially the alluvial valleys of rivers originating in the Patagonian Cordillera.

5. Conditions for the occurrence, use and vulnerability of groundwater

The issue of groundwater resource management and protection is practically limited to the two large hydrogeological regions of Intermontane Valleys and the Chaco Pampeana Plains where over 90% of the country’s population and water demands are concentrated. The issue will be analyzed through three representative cases, i.e., the provinces of Mendoza, Santa Fé and Buenos Aires.

5.1 Province of Mendoza

The role of groundwater in the development of irrigated agriculture in the province of Mendoza is representative of the importance of these resources in all arid and semi-arid areas of the Nuevo Cuyo – Northwest region.

The province of Mendoza has the country’s largest irrigated surface area (360,000 ha, or 25% of the country’s total area). Because of its semi-desert climate, its economic development and the welfare of its inhabitants are essentially due to comprehensive use of its water resources in well-delimited irrigated areas (irrigation districts) locally called “oases.”

A broad hydraulic infrastructure developed on the five rivers (Mendoza, Tunuyán, Diamante, Atuel and Malargue) with 12 diversion dikes and 6 dams (total capacity of 1,400 hm³) allow surface water resources to be harnessed.

Added to this infrastructure are 9,000 operating private wells, out of a total of 18,000 registered, which use five foothill aquifer systems. They are extensive basins with highly permeable clastic sediments, deposited by the rivers themselves. Surface and groundwater systems are therefore closely linked.

With an underground reservoir estimated at 22,000 hm³ (15 times the capacity of constructed dams), aquifers ensure the multiannual regulatory role of water resources, allowing the province of Mendoza to overcome the serious droughts of the 1960s and 1970s as well as that of 1996-97, both
for irrigation and supply to the population and to industry. It is estimated that, out of the 360,000 ha of irrigation in the province, 80,000 ha are irrigated exclusively with groundwater and the rest with surface water and the combined use (conjunctive use) of both resources.

The use of groundwater began significantly in the 1950s and has allowed surface area to be expanded and irrigation efficiency to increase, thereby improving water distribution and farming practices. Unfortunately, the intensive use of these resources has not been accompanied by measures to protect and conserve aquifers in order to ensure sustainable development.

The former CRAS (Regional Groundwater Center) has carried out extensive hydrogeological research in the valleys of the Mendoza and Tunuyán Rivers which form the province’s northern oasis\(^\text{10}\). Research has made it possible to determine:

- **The system’s structure.** This is comprised of alluvial cones formed in a fan at the headwaters of rivers, with highly permeable sediments, ranging gradually to a river flood plain formed by finer material. The system has a total extension of 5,400 km².

- **Operation of the system.** It consists of three sub-systems or interconnected strata. The Mendoza and Tunuyán Rivers, which cross the system, recharge them directly by infiltrations in their channels, and indirectly by canals and in irrigation areas. Using mathematical simulations, annual volumes recharged to the system have been quantified. Annual discharge from pumping varies from 100 million m³ in humid years with abundant surface water resources, and 600 million m³, as occurred during the 1971/72 drought period.

- **The system’s hydrochemistry.** The dynamics of changes in the quality of aquifer strata by different sources of pollution has been determined.

In the Northern oasis, where the city of Mendoza lies, mismanagement of irrigation water and agricultural, municipal and industrial pollution have deteriorated the first aquifer stratum which now has high levels of salinity and nitrates. In the Greater Mendoza area, CRAS has concluded that pollution has taken place, with nitrate values varying between 50 and 100 mg/l and, in a sector with a high concentration of population, there is a high level of contamination with values ranging from 100 to 180 mg/l.

Due to the salinization of the water table, users gradually began to use the second and third aquifer strata, which are deeper and of better quality, abandoning old wells. These wells, due to poor construction and the corrosion of their pipes and filters, place the poor quality water stratum in contact with the second stratum, contaminating it considerably in the central area of the northern oasis. In this area, according to a study by CRAS, 35% of wells are in poor condition, which causes this contamination.

Only the third, and deepest, stratum remains with good quality water. However, it is not completely protected if the degradation process that occurred with the first two water strata is allowed to continue.

\(^{10}\) CRAS, Amilcar A. Alvarez. Water resources in the North Mendoza Watershed. General Information based upon current knowledge. San Juan, June 1997.
The General Bureau of Irrigation (Departamento General de Irrigación) has started a program to clog and seal wells in poor condition, with financial contributions from groundwater users, but the magnitude of the program does not appear to be equal to the objective of protecting aquifers.

5.2 Province of Santa Fé

The entire province of Santa Fé forms part of the Chaco Pampeana Plains, an enormous geomorphological unit that occupies 1 million of Argentina’s 2.8 million km² continental territory.

The hydrographic network is very scarce, with the exception of the Paraná River which borders the province to the east and which is distinguished by the volume and quality of its waters. This river is the only safe source of surface water supply and is widely used by cities located along its banks, including the provincial capital. The province’s other rivers (Salado, Carcarañá) are not permanent and their waters are of poor quality, either because of salinity or contamination. Thus, most of the province’s urban and rural zones need to be supplied by groundwater.

Hydrogeological research in the province of Santa Fe was begun in 1960 by the province’s Department of Hydrogeology and Drilling. Since that time, seven successive studies have been carried out by different national and provincial institutions, with numerous drillings, covering the entire area of the province. A synthesis was made, defining 11 distinct areas in the province with their own problems in terms of use of groundwater in its quantitative and qualitative aspects, with risks of salinization and natural contamination.

The availability and distribution of the province’s groundwater resources are related to two aquifers called Puelches and Pampeano or Epipuelches and vary from the eastern zone, with greater precipitation and more recharging, to the western zone, more arid and with less recharging. The main limitation to the use of these resources is water quality.

The Puelches in the province of Santa Fé forms part of the country’s largest and most used aquifer system. It supplies the main urban and industrial centers of the central part of the province, as well as several western cities such as Rafaela which is supplied by an 100 km aqueduct whose intake is at Esperanza. The use of the Puelche aquifer requires a careful analysis of the performance of the intake works in order to avoid brackish water from the Paraná (or Hipopuelches) formation which is below Puelches.

In the past ten years, there was a significant increase in the extraction of groundwater by the agricultural sector for complementary irrigation of grains. Fertilizers and pesticides widely used to increase production constitute a serious risk of contamination to the aquifer. In addition, irrigation wells, often poorly constructed, are direct means for the infiltration of contaminants.

In the western zone, the Pampeano aquifer is essentially used. It corresponds to a free water table that lies directly above strongly salinized water levels. The sources are difficult to exploit because

---

12 Phenomenon observed in various parts of Europe and particularly in France, resulting from an abuse of agrochemicals over two or three decades for complementary irrigation of grains, and constituting one of the most serious environmental threats because it directly threatens the population’s principal water supply source.
any over-extraction causes salinization and contamination from arsenic and fluor. This limitation has halted the growth of various industrial-type populations in the zone. However, recent experiments on artificial recharging with permeable-bottom dams have allowed the problem of supply various centers to be solved.

5.3 Province of Buenos Aires

With 17 million inhabitants, the population of the province of Buenos Aires and the Federal Capital represents 46% of the country’s total population. The Capital and the Buenos Aires metropolitan area have 12 million inhabitants and the country’s largest industrial concentration. The province is the second largest in irrigated area, with 180,000 ha, and complementary irrigation continuess growing at an accelerated pace. These few synthesized figures show the challenge of water resources management in the province.

The province of Buenos Aires forms part of the humid Chaco Pampeana Plain, except the western strip and the southwest which are located in arid and semi-arid zones. Groundwater resources are exploited mainly from the Puelches aquifer as well as from the Pampeano (or Epipuelches) situated above and the Paraná (or Hipopuelches) aquifer situated below the Puelches; the three aquifers are interconnected through semi-permeable geological levels.

The history of the use of these aquifers is an example of serious environmental deterioration in an urban area due to the lack of integrated management of the system of harnessing, sanitation, protection and conservation of resources.

The free aquifer of the Pampeano is little used because of its low productivity, the poor natural quality of its water and especially because of chemical and bacteriological contamination caused by household septic tanks and industrial filter wells. Instead, due to its easy access, its high productivity and the quality of its water, the Puelches aquifer has been used intensively to supply the Buenos Aires metropolitan area. Usage grew to the point of over-exploitation, causing a generalized reversal of the natural flow of groundwater. In the mid-1980s, the resulting situation translated into a saline intrusion along the coastal zone of the River Plate and phenomena of vertical filtration of contaminated waters from rivers and valleys with sewage water from the metropolitan area on the one hand, and on the other, waters with elevated contents of nitrates and arsenic, from the Pampeano to the supply source, the Puelches aquifer.

In the past 30 years, over 500 drillings for water supply to the current area of Aguas Argentinas’ concession\(^\text{13}\) had to be removed from service because of quality problems (among others, nitrates in wells located in the urban zone, salinization caused by over-use and industrial contamination); most of them had not yet reached the end of their useful life.

The replacement of groundwater with water from the River Plate to supply the metropolitan zone, although partial and gradual\(^\text{14}\), has brought about the reverse phenomenon: the reappearance of the water table where it had practically disappeared, with levels rising to less than 1m deep, creating the saturation of household septic tanks, the waterlogging of basements, garages, tunnels and storage areas, as well as possible damage to foundations.

\(^{13}\) The concession began in May 1993.

\(^{14}\) There are still around 250 wells being used by Aguas Argentinas in its concession area.
The management of an aquifer system such as Puelches needs careful medium- and long-term planning as well as scheduling of operations based on advanced analysis techniques (mathematical simulations of aquifer strata in terms of quantity and quality) and ongoing monitoring. This is what Aguas Argentinas is doing in its concession area.\textsuperscript{15}

The environmental costs created by overuse of groundwater, following by the abandoning of wells and the rise in the water table, have not been estimated.

In the agricultural sector, there has been a rapid expansion in complementary irrigation, using the Puelches and Pampeano aquifers which are easily accessible. It is even being promoted by official agencies.\textsuperscript{16} Socioeconomic development is not incompatible with the protection and conservation of water and soil resources, provided that necessary measures are taken to avoid widespread contamination of aquifers caused by the abuse of fertilizers and pesticides used to increase production. These aquifers are the main, if not the only, source of drinking water for the province’s urban and scattered rural population.

6. Conclusions and Recommendations

Despite the strategic role of groundwater in socioeconomic development and its vulnerability to environmental degradation, in the most recent reports on the country’s water resources, overall understanding of this phase of the hydrological cycle is considered to be still in a state of development\textsuperscript{17} and data on the quantification of groundwater reserves and their use is variable and incomplete because of the lack of proper nationwide control and inventory\textsuperscript{18}. In fact, available data varies greatly from one region to another. Understanding is more related to the level of use of these resources, i.e., their level of importance for different sectors of use in each region of the country. As these reports note, progress has been made in knowledge of groundwater in the central Andean subregion, in various zones or valleys in the provinces of San Juan, Mendoza, Catamarca, Jujuy and Salta. These are arid and semiarid areas that strongly depend on groundwater. In the humid region, with needs for supplying drinking water to the population and the accelerated growth of complementary irrigation, progress has also been made in understanding the potential of the principal aquifers as well as their vulnerability to contamination.

Thus, there is now a sufficient database for planning and implementing the necessary measures aimed at halting the deterioration of resources and gradually restoring their quality. Supported by a proper data base and monitoring system, these are actions that will allow progress to be made in understanding these resources. Actions should be part of a strategic, comprehensive vision of the role of aquifers in overall water resources management and the application of a rational, voluntary policy to protect and conserve water and soil resources.


\textsuperscript{16} Secretariat of Agriculture, Livestock, Fisheries and Nutrition. Complementary Irrigation in sustainable productive systems in the Pampas region.

\textsuperscript{17} Preliminary diagnostic of water resources management in the Argentine Republic. C. Laboranti, G.V. Malinow. Enero 1995

\textsuperscript{18} FAO/CP. Argentina. Provincial agricultural development. Summary of the irrigation sector. May 6, 1996
One of the priorities for the protection and rational management groundwater resources should be to address the following key issues:

✓ Delays in the technology of analyzing and managing aquifer systems together with the overall management of water and soil resources; and
✓ Accelerated deterioration in the nation’s strategic groundwater resources.

Specific objectives could be: the strengthening of INA (former CRAS) Regional Centers with accelerated training of its technicians and transfer of technology, the implementation of an emergency program to clog and seal contaminating wells in Mendoza; the creation of buffer zones or perimeters to protect aquifers reserved for water supply to the population; the recharging of aquifers (Mendoza, San Juan, Santa Fe); awareness of the prevention of widespread agrochemical contamination aquifers; and support for the creation and strengthening of coordinating structures for the management of aquifers.

REFERENCES


ANNEX E-1: WATER QUALITY PROBLEMS IN THE PROVINCE OF CÓRDOBA

(June 5, 1999 final version)

Objective and Content

1. The objective of Annex C is to make a preliminary assessment of problems related to the quality of water resources in the Province of Córdoba. The Annex begins with a general overview of the Province’s territory, with brief descriptions of terrain, rainfall, the water network, urban grid and distribution of productive activities. This is followed by a brief description of problems identified in water resources, organized into six topics (see problem chart, Figure 1), which are presented in order of importance. Each problem is then evaluated from the viewpoint of possible solutions (challenges and opportunities), from three perspectives: (i) the nature of the problem and corresponding means of dealing with it; (ii) related economic aspects; and (iii) institutional variables, with the exception of limits placed by observations made during field visits and information collected at that time.

Brief Geographic Overview of the Territory of Córdoba

2. The Province of Córdoba is located in the central part of the Argentine Republic, in a transitional zone near the eastern region, with a semi-humid to semi-dry regional climate and water availability relative to proximity to the Paraná River (average rainfall of around 800 mm/year), ranging from semi-dry with a minor water deficit in the central part to a semi-desert climate in the Northwest (Salinas Grandes), with annual rainfall decreasing to levels near 200 mm. In general, rain in the Province of Córdoba is concentrated between the months of October and April, when nearly 80 percent of annual precipitation falls.

3. A similar transition occurs in terrain from the eastern plains, which are subject to recurring floods (altitudes below 100 m, in the Fosa de San Antonio), to mountainsides near the western provincial border which accompany the final stretch of the Andes in a predominantly north-south direction (altitudes of 1,200 to 2,200 m, with the highest peak being the 2,790 m Cerro Champaqui).

4. These slopes contain the sources of the Province’s water network, located in valleys which give rise to the main bodies of water, all flowing in a predominantly west–east direction. Starting in the north, there is the Primeiro (or Suquia, draining from the city of Córdoba), Segundo (or Xanaes), Terceiro (or Ctalamochita), Quarto (or Chocancharava) and Quinto (or Popopís) Rivers, the latter in the southern part of the Province. This water network, complemented by the lower Dolce River, gives the Province an aggregated flow rate of around 100 m$^3$/s from isolated systems and flows from the western watershed. Due to the rugged terrain, the western portion is characterized by small watershed divisions, with sources, streams and tributaries of minor length and flow, while to the east the basins of the main rivers mentioned above open along vast plains. The Primeiro and Segundo Rivers flow slightly to the northeast, emptying into the depression of the Mar Chiquita Lagoon. The Terceiro and Quarto Rivers, the latter after passing the Bañados del Saladillo, meet to form the Carcarañá River. Table 1 presents data on area and annual availability of the these watersheds:

Table 1: Principal Watersheds
### Watershed Area and Annual Flow

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Area (km²)</th>
<th>Annual Flow (Hm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primeiro River</td>
<td>1,350</td>
<td>284</td>
</tr>
<tr>
<td>Segundo River</td>
<td>980</td>
<td>309</td>
</tr>
<tr>
<td>Terceiro River</td>
<td>3,300</td>
<td>854</td>
</tr>
<tr>
<td>Quarto River</td>
<td>1,450</td>
<td>145</td>
</tr>
<tr>
<td>Quinto River</td>
<td>4,500</td>
<td>137</td>
</tr>
</tbody>
</table>

Source: Gianoni, Marta Elena Mercado de, Scholarship Subject: Evolution of Legislation on Water Resources in the Province of Córdoba (1994)

5. To handle water use demands, the Province of Córdoba stores a volume of 1,540 Hm³ in reservoirs. A large part of this is for power generation in the Terceiro River (560 Hm³), the Los Molinos dam on the source of the Segundo River (307 Hm³), and for the San Roque reservoir (201 Hm³), a supply source built on the Primeiro River upstream from the city of Córdoba.\(^{19}\)

6. Regarding spatial distribution of the Province’s population, with the exception of Greater Córdoba there is a large rural population (820,000 people), which is equivalent to 29 percent of the 2.76 million total inhabitants (1991). A significant number (approximately 450,000 inhabitants) also live in countless small cities and communities.

7. Thus, the urban network is marked by the central location of the city of Córdoba, whose population exceeds 1,179,372 inhabitants (1991). This is followed by the Province’s central zone with another 10 population centers of between 10,000 and 41,000 residents, located mainly in the departments of Colón, with 77,000 inhabitants in the north, Punilla, with 72,000 inhabitants in the west (including Villa Carlos Paz, with 41,000 residents at a water source of interest to the city of Córdoba), and Segundo River and Santa María (16,000 and 37,000 inhabitants, respectively). Moreover, in Greater Córdoba’s central zone of influence (80 km radius), there are another 16 centers with populations ranging between 2,000 and 10,000 (aggregate total of 83,000 inhabitants), as well as 54 communities (population centers with fewer than 2,000 residents) totaling 27,000 people.\(^{20}\)

8. With regard to production, the city of Córdoba’s central location makes it a prime industrial site. Of particular note is its automotive park and respective chain of suppliers. It is also worth noting the existence of significant industrial factories, as well as the harnessing of hydroelectricity in the upper part of the Terceiro River basin. Extensive agricultural crops are developed along Córdoba’s eastern border on the plains near the place where the middle and lower stretches of the Terceiro and Quarto Rivers join to form the Carcarañá River, on a strip formed from the northern to southern part of the Province.

9. Irrigated areas total around 60,000 Ha, including 700 km of primary, secondary and tertiary canals, of which about 20 percent are lined. The principal irrigation systems are those of the Primeiro River, with canals north and south of the city of Córdoba, and that of Cruz del Eje, with damming prior to infiltrations from bodies of water in the region of Salinas Grandes in the northwest of the Province. Groundwater is used separately by farmers to complement surface

---

\(^{19}\) Gianoni, Marta Elena Mercado de, Scholarship Thema: Evolution of Legislation on Water Resources in the Province of Córdoba, mimeograph, Catholic University of Córdoba (1994).

\(^{20}\) Strategic Plan for the City of Córdoba – PEC (1996)
water, but no information is available on the amounts of groundwater extracted or on the capacity and conditions of aquifers to be recharged, which could result in scenarios of future shortages.

**8.6 PROBLEM 1: SHORTAGE OF WATER RESOURCES IN THE NORTHWEST**
(SALINAS GRANDES)

10. The Salinas Grandes are a flat depression with minimal slope, between mountains in the northwest of the Province near the border with Catamarca. The rivers flowing into this region (Cruz del Eje, Soto and Pichanas) filter and feed the water tables. The total area of tributary basins exceeds 2,100 km², with available flow limited to 64 Hm³ per year. However, there is little information on the actual availability of water resources in this region, which is marked by seasonal precipitation averaging a little over 200 mm, and by the presence of high levels of salinity in groundwater.

11. A problem of economic depression stems from such natural conditions, which requires the possibilities of regional development to be adjusted to compensate for seasonal climate conditions. Despite other alternatives, the high costs of providing the region with water transfer infrastructure constitutes a limiting factor and calls for restricted options, the expansion of which will be quite dependent on compensatory mechanisms made available either by the Central Government or by the Province.

**8.7 PROBLEM 2: SEASONAL NATURE OF WATER RESOURCES IN THE QUINTO RIVER BASIN**

12. The sources of the Quinto River lie in the Province of San Luis, to the west, which follow a southeasterly direction until emptying into the lagoons and wetlands of La Amarga, in Córdoba, 110 km from the border. Due to low precipitation in its western sources and to seasonal climate problems, the Quinto River faces problems of prolonged drought when wetlands turn into dry stubble fields (pajonales), or of floods that spread due to the flatness of La Amarga’s lands.

13. There is no information on studies aimed at providing for greater regularity of flow rates, to reduce flooding and mitigate the effects of droughts. It should be noted, however, that such challenges must necessarily be linked to the interprovincial management of this river basin, which is shared by San Luis and Córdoba. In terms of possible economic potential, it should be recognized that these areas are not well linked to the dynamic centers of the Province of Córdoba, either in terms of industrial location or agricultural production, even though the regional road network circles southern Córdoba, linking San Luis and Mendoza.

**8.8 PROBLEM 3: FLOOD CONTROL AND SILT RUNOFF IN THE QUARTO RIVER BASIN**

**8.8.1 a) Definition of the Problem**

14. The sources of the Quarto River lie on the steep slopes along the borders of western Córdoba. It flows southeast until reaching the plains, where it has much lower slopes, low drainage velocity and little natural flood retention, which are characteristics of the territory’s vast size, particularly in the southern part of this river basin (bordering on the Quinto River basin near the
stream of Santa Catalina, El Gato, Sampacho, Las Cortaderas and others). As these floods spread, they affect neighboring Provinces and are favored by the depression of the Fosa de San Antonio, when water tables increase during periods of heavy precipitation. At mid-course, the Quarto River feeds the wet lands of the Bañados del Saladillo, the name it keeps until it meets the Terceiro River to form the Carcarañá River, which flows in the direction of the Province of Santa Fé on the eastern border of Córdoba.

15. Extensive farming is predominant in the basin, carried out with little concern for soil management or planting on level curves, due to the few slopes there. This results, first, in a relative acceleration of surface runoff, which is facilitated by furrows made in the soil for planting, and which amplifies flooding by reducing the time for concentrating and directing rural runoff flows.

16. At the same time, greater runoff speed facilitates the carrying off of soils, with negative consequences for the quality of surface water, both in terms of solids in suspension associated with the loss of upper layers of fertile soil, and the consequent need for greater use of agricultural inputs (fertilizers and pesticides). This fact can be verified by the probable increasing presence of nitrogen and phosphorus in bodies of water.

17. On this subject, as an example of the general situation of developing countries, existing data is insufficient to establish correlating factors among levels of nitrogen, phosphorus and even solids in suspension with geophysical and hydraulic features in the basins in question. It should thus be noted the above statements on causes and effects are predominately speculative.

18. Groundwater, in turn, is used separately by farmers who drill wells, by the rural population, and to complement surface water in supplying communities. It should be noted, however, that data available from the Province of Córdoba’s Ministry of Health indicate the presence of arsenic in these water tables is higher than the acceptable level of 0.05 mg/l. These concentrations increase towards the plains in the eastern part of the Province (in the lower stretches of the Quarto, Segundo and Primeiro Rivers), with values ranging from 0.08 mg/l in the Quarto River basin to extreme levels of 0.13 mg/l in the Department of Marcos Juarez and of 0.18 mg/l in San Justo.

8.8.2 b) Problem-Solving (Challenges and Opportunities)

19. The challenges and opportunities concerning the above-mentioned problems are related to the organization of rural extension programs for the dissemination of microcatchment management practices, according to examples already financed by the World Bank in other countries of the region. Along with reducing the speed of surface runoff and serving to control floods through aggregated retention of water flows in each microcatchment, planting on level curves tends to maintain the soil’s surface layer, and consequently the inputs that were applied to it. This, in addition to longer-term economic benefits, justifies such rural extension programs in financial terms.

---


20. With more specific regard to flood control, there may be a need to build successive small dams on rural properties to hold back part of the non-filtrated excess water and to help farmers develop complementary economic activities. In terms of water quality, such actions will result in reduced incremental indices of solids in suspension, nitrogen and phosphorus.

21. Inter-institutional linkage between agricultural development agencies and environmental control agencies should be foreseen and considered by the above-mentioned program, and take on a key role. In the context of the program implemented in the State of Paraná, the enactment of legislation containing the necessary enforcement to encourage farmers to adopt such practices is worth noting, as is the necessary lines of credit to finance management actions and the installation of proposed small rural dams.

22. Finally, these programs must include the installation of a proper network to monitor bodies of water (with hydro-meteorological and water quality data), and inspect producing agents so that monitoring and results assessment indicators can be established, foreseeing the ongoing operation of the installed network by competent agencies upon completion of the programs.

8.9 **Problem 4: Treatment of Industrial Waste; Power Generation and Public Supply from Terceiro River**

8.9.1 a) Definition of Problem

23. Replicating the typology of the main bodies of water in the Province of Córdoba, the sources of the Terceiro river lie on the high slopes in the west, where the Santa Rosa, Amboy stream, Grande, Quillinzo and Sauces – La Cruz Rivers meet, all of which directly flow to the Terceiro River dam. Thereafter, the Terceiro river flows first to the east, then to the southwest, until it empties into the formation of the Carcarañá river. This river basin is individually responsible for the Province’s major surface water availability, corresponding to an average flow rate of 27 m$^3$/s, around 30 percent (thirty percent) of the total.

24. In view of this availability, there are multiple uses of water from the Terceiro River, characterized: (i) in its upper and middle stretches by power generation (5 power plants) and the presence of complexes linked to the petrochemical and military industries, including a nuclear power plant using intakes (low consumptive uses) and draining effluents; (ii) in its middle and lower stretches by intakes to supply a population of around 55,000 inhabitants in cities and communities in the southeastern region; and (iii) in its lower stretch, near the Carcarañá river, by extensive irrigated crops, carried out along the eastern border of Province, as previously mentioned in characterizing activities in the Quarto River basin.

25. In terms of its spatial location, water availability in the Terceiro River, in addition to its proximity to the main regional transportation routes—especially from the highway junction at Villa María (midway) toward Rosario and Greater Buenos Aires—give this river basin strategic importance among regional development alternatives. It is reasonable to foresee that future industrial development will occur between the city of Córdoba and the nation’s capital. This coincides with the installation of the automotive park of Greater Córdoba, south of the city.
26. Despite multiple and regionally well-distributed uses, water problems in the Terceiro River appear to be concentrated from industrial pollution of petrochemical and military complexes installed along the middle and upstream portions, possibly from before the environmental requirements stipulated by current legislation could be imposed. These problems affect the possibilities of upstream use, especially human supply.

8.9.2 b) Problem Solving (Challenges and Opportunities)

27. There is no lack of legal instruments to settle problems. First, there is a profusion of regulatory instruments, many of which overlap and are extremely demanding, but all of which lack the means to be effectively applied. This lack is due either to weakness of responsible institutions (from an absence of basic information, technical instruments and staff, and professional motivation), or to a lack of even minimal levels of inter-institutional linkage, particularly concerning environmental and water resources management, which is even separated in ranking on the provincial administration’s general organizational chart.

28. Thus, industrial pollution problems in the Terceiro River could be mitigated as available command and control instruments are applied before requiring sophisticated (and sometimes costly and ineffective) management instruments such as the installation of a Watershed Committee; however, it will likely be necessary to establish a feasible timetable of industrial investments to pre-treat waste and rationalize productive processes that use water as an input, making standards stipulated in current legislation flexible so that the objectives of abating pollution loads can be negotiated and implemented realistically.

29. In summary, current conflicts regarding the Terceiro River, which underlie both present and potential future conflicts, do not appear sufficient to sustain the greater institutional sophistication which has already been pursued in various Argentine river basins. There is also a notable lack of an economic base to support the decision-making process on the use of water resources, either in the short term, with a preponderance of industrial pollution problems, or (especially) for outlining future scenarios, when the current situation could be worsened by effective disputes over multiple water uses.

30. There are three relevant points here. First, it is worth repeating the need for greater rationality in the environmental licensing process. This not merely a matter of conferring feasible bases (both economic and financial) for legal requirements, as mentioned above. Duplications and internal contradictions must be avoided, overcoming, for example, the possible conflict of interest present in the preparation of environmental studies. These studies are the subject of the “Regulation on the Environmental Impact Assessment” (Decree No. 3290), and are contracted and conducted by the entrepreneurs themselves, despite its (sometimes formal) review and subsequent approval by the Provincial Environmental Council.

23 The recent enactment of the “Rules for the Protection of Surface and Ground Water Resources” (Decree No. 415, dated 12/April/1999) reproduces the extremely strict requirements for obtaining grants with gaps remaining between Command and possibilities for Control. Note the exception of undertakings installed in Córdoba, where a supplementary effort by the City’s Secretariat of the Environment, with more available resources, is trying to fill some of the gaps identified in the process.
31. The isolated treatment of these businesses, even though they are geared towards environmentally suitable production and avoid the defect in the beginning of the process (as mentioned above) does not provide for local-level decision-making instruments involving water availability (water is the planning factor for the territory) since it does not consider the aggregate loads already installed nor the receiving capacities of bodies of water as a mandatory element of analysis. Thus, paradoxically, various industries may be legally licensed in a particular river basin—even effectively dumping loads in accordance with their emissions licenses—despite the fact that these bodies of water are jeopardized since their flow and purification features may be incompatible with aggregate dumping.

32. These observations lead to the second point. No water resources management will be carried out without a minimum basis of information which should include proper cadastres of water uses and users, and data of the pluviometric, hydrometric and water quality network. These should be submitted for proper processing to contribute to decision-making support tools, including hydrodynamic models. This concern should also cover the use of underground aquifers, not only in light of natural contamination by arsenic, fluorides and salts, but also to check their recharge velocity and effective potential.

33. Finally, an analysis of the alternative of using the Terceiro River as a source of public water supply should first be made. With regard to cities and communities in the southeastern region, about 55,000 inhabitants are served by an aqueduct that is currently being expanded with provincial funds of the Bureau of Water and Sanitation (DAS). For this population, intake demands may be estimated at no more than 250 l/s, a modest flow rate compared to the Terceiro River’s availability in its middle and lower stretches. No problems are anticipated except those of the quality of water contaminated by upstream industrial complexes. With regard to the city of Córdoba, which lies quite a distance from the Terceiro River, consideration should be given to concerns about maintenance of nearby sources (Primeiro and Segundo Rivers), whose potential is far from depleted, provided that pollution problems (dealt with in this Annex) are duly settled.

8.10 PROBLEM 5: CONSERVATION AND USE OF THE SEGUNDO RIVER AS A WATER SOURCE FOR GREATER CÓRDOBA

34. The Segundo River arises from the confluence of numerous small watersheds lying on the slopes of western Córdoba which are the origin of its main body, the Los Molinos River, where an important dam was installed (307 Hm³ reserve). The Los Molinos is named Segundo after meeting the Anizacate River, downstream from the town of Los Despeñaderos. From there, it flows in a predominantly northeasterly direction until it empties into the depression that gives rise to La Laguna Mar Chiquita, about 70 km from the border with the Province of Santa Fé, in the east.

24 Information collected from the Bureau of Water and Sanitation (DAS), Department of Water resources, indicates about 40 pluviometric posts operating in the Province and an undetermined number (fewer than 70) of flow measurement stations. As an exception, records on water quality data collection are kept by the Secretariat of Environment of the City of Córdoba, involving OD, DBO, N and F, with analyses performed at its own laboratory.
35. Today, nearly thirty percent (or somewhat less than 2 m³/s) of flows collected to supply Greater Córdoba, are transposed from Los Molinos reservoir, whose water quality should, in principle, be better than that of San Roque (see next chapter), and which constitutes an alternative to meet future demands. However, it should be noted that the results of the monitoring program, conducted by the Provincial Scientific Laboratory (CEPROCOR), indicated the presence of high levels of thrihalomethanes (average variations of 80 to 200 mū/l, with a recommended limit of 100 mū/l) resulting from reactions of organic material present in intake waters (toxic blooms of cyanobacteria) with chlorine added for drinking water.25

36. Since urban centers upstream from the reservoir are new, as are crop activities that might need fertilizers, water quality problems in Los Molinos and sources of the Segundo River may possibly stem from natural conditions, which increase the need for actions and care regarding its conservation. In any case, due to limited data and specific studies on this reservoir, it is recommended that monitoring campaigns be carried out until the relationship of cause and effect on the above-described results is understood with greater certainty.

37. Downstream from Los Molinos, beginning at the middle stretch of the Segundo River and especially after it spreads out on the plains near La Laguna Mar Chiquita, water quality problems become similar to those found in the Terceiro and Quarto Rivers, meaning the presence of arsenic, fluorides and salts, especially contaminating the water tables. In these stretches, however, demands are low for irrigation and supply to the small resident population.

38. To conclude the definition of problems in the Segundo River, one of the vectors of industrial expansion in Greater Córdoba is towards the south (as previously noted). This could advance, in the future, onto a stretch of the land of this river basin downstream from Los Despeñaderos, repeating the issue of industrial waste disposal present in the Terceiro River. For this possibility, the same observations contained in paragraphs 27 to 32 apply, concerning the effectiveness of Command and Control instruments stipulated in current legislation.

8.11 PROBLEM 6: (6.1) WATER POLLUTION IN SAN ROQUE LAKE
(6.2) URBAN ENVIRONMENT OF THE CITY OF CóRDOBA

8.11.1 a) Primeiro River Basin

39. In accordance with the typology common to other bodies of water in the Province, small watersheds lying on the slopes of western Córdoba give rise to the Cosquín (average flow rate of 4.5 m³/s) and San Antonio (average flow rate of 5.5 m³/s) Rivers, the main tributaries of San Roque Lake, into which the Chorrillos River also empties (although with a lesser flow). This reservoir—built about 35 km upstream from Córdoba—constitutes, as the source of the Primeiro River, both the main water source for Greater Córdoba (70 percent of demand or 5 m³/s) and a regional recreation area, due to its great natural beauty and strong potential for tourism (1.750 km² surface area).

25 Medeiros, Kátia (FAO); it is worth noting the observation that the concentration of thrihalomethanes usually increases with distance and the time it remains in the treated water distribution system, which could indicate even higher levels at intermediate reservoirs and therefore in households.
40. Upstream from Córdoba, an additional $5 \text{ m}^3/\text{s}$ of water from the Primeiro River are drawn to feed irrigation canals that go to the north and south along the border of the urbanized area for vegetable production aimed at consumers in the capital. In the recent past, the significant inclines in this initial stretch favored power generation on the Primeiro River, now reduced to a small-scale power plant.

41. After Greater Córdoba, the Primeiro River passes through the eastern plains until it empties into winding streams in the depression of La Laguna Mar Chiquita, following a course and natural conditions nearly parallel to those of the Segundo River.

8.11.2 b) Definition of Problems in San Roque Lake

42. The ascertainment of cyanobacteria in the reservoir, as well as of thrihalomethanes in (principally) the Upper Alberde Water Treatment Plant (average variations of 40 to 200 mµ/l, with a recommended limit of 100 mµ/l)\textsuperscript{26}, arises directly from the urban settlement process around the reservoir, which is the product of its attraction for tourism, exercised in the regional sphere. Table 2 below lists the set of cities and communities that developed along the the regional roads built in valleys along the Cosquín, San Antonio and Chorrillos Rivers, with the respective populations and annual growth rates observed from 1980-91. In addition to the data presented, it should be added that growth rates have been higher in the 1990s, with a significant seasonal fluctuation in population. There are around 13,794 leisure homes in neighboring areas, and a potential of up to 62,000 additional residents during peak season.\textsuperscript{27}

<table>
<thead>
<tr>
<th>River Basin</th>
<th>Cities and Communities</th>
<th>Population (1991)</th>
<th>Average Growth Rates (80-91)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cosquín River</td>
<td>- Cosquín</td>
<td>16,866</td>
<td>1.91</td>
</tr>
<tr>
<td></td>
<td>- Santa María</td>
<td>6,119</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>- Bialet Massé</td>
<td>2,338</td>
<td>2.98</td>
</tr>
<tr>
<td></td>
<td>- V. Sta. Cruz Del Lago</td>
<td>863</td>
<td>s/d (3)</td>
</tr>
<tr>
<td></td>
<td>- San Roque</td>
<td>364</td>
<td>S/d</td>
</tr>
<tr>
<td>Chorrillos River</td>
<td>- Villa Parque Siquimán</td>
<td>447</td>
<td>S/d</td>
</tr>
<tr>
<td></td>
<td>- Tanti</td>
<td>3,323</td>
<td>4.40</td>
</tr>
<tr>
<td></td>
<td>- Estancia Vieja</td>
<td>318</td>
<td>S/d</td>
</tr>
<tr>
<td>San Antonio</td>
<td>- Villa Carlos Paz</td>
<td>40,912</td>
<td>3.09</td>
</tr>
<tr>
<td></td>
<td>- Cabalango</td>
<td>63</td>
<td>S/d</td>
</tr>
<tr>
<td></td>
<td>- San Antonio</td>
<td>703</td>
<td>S/d</td>
</tr>
<tr>
<td></td>
<td>- Tala Huasi</td>
<td>37</td>
<td>S/d</td>
</tr>
<tr>
<td></td>
<td>- Mayu Sumaj</td>
<td>560</td>
<td>S/d</td>
</tr>
<tr>
<td></td>
<td>- Cuesta Blanca</td>
<td>151</td>
<td>S/d</td>
</tr>
<tr>
<td></td>
<td>- Icho Cruz</td>
<td>646</td>
<td>S/d</td>
</tr>
</tbody>
</table>

\textsuperscript{26} Medeiros, Katia (FAO), report cited, with monitoring data collected by CEPROCOR.

43. Two types of problems occur from the location of these urban centers in the basin contributing directly to the Lake. The first pertains to cities with a larger population and density (particularly for Villa Carlos Paz), several of which have some service from sewage collection networks but no sewage treatment. The second is associated with the technical and financial difficulties of providing services to the scattered population for which, due to the lack of concentration, conventional sewer drainage systems do not apply.

44. In both cases, natural downsloping and soil conditions contribute negatively to worsen the pollution problem. San Roque Lake, with an average depth of only 13 m, lies between steep slopes to the east (altitudes of 1,200 m), even though these have some plant cover, and even steeper (though less accentuated) slopes to the west (up to 2,200 m), with only incipient vegetation. In both watersheds, soil has a rocky substratum with shallow depths, appearing on banks to the west of the reservoir.

45. By reducing concentration times and possibilities for filtration, these natural conditions contribute to other sources of pollution associated with rudimentary agricultural practices (without soil management), slash-and-burn of plant cover, as well as disposal of solid waste (trash) in small creeks and streams, or even at the banks of the reservoir (noted during field visits). With regard to the occurrence of more intense rains, surface runoff contributes additional sediments and nutrients to San Roque Lake.

46. Initial academic studies performed in the reservoir made data available to quantify the situation described above. Countless water samples collected in different parts of the reservoir allowed analyses to be made of physical-chemical and microbiological parameters (OD, DBO, DQO, phosphates, nitrates, nitrites, solids in suspension, total and fecal coliforms and salmonella, among others). Obtained results indicated higher concentrations of nitrogen and phosphorus in the lake’s water and sediment than those recommended by international agencies. Paradoxically, DBO results were lower than expected, which might indicate only a small organic load in the lake; according to experts, this could be “from the greater difficulty in applying tests on a sheet of water where microbial oxygen is proportionate to the carbon remaining in the final carbonaceous stage of DBO.”

47. Despite the DBO results, Part II of the studies, which dealt with histological lesions in teleostean fish attributable to organic pollution, confirms repercussions stemmed from high levels of

---

28 Ibidem, doc. cited.
30 Ibidem, Tables I to IV, pgs. 32 to 35, doc. cited.
31 Ibidem, pg. 36, doc. cited.
nitrogen and phosphorus in the waters of San Roque Lake, as well as the presence of cyanobacteria, mentioned in paragraph 42.

8.11.3 c) Definition of Problems in the Urban Environment of the City of Córdoba

48. It appears evident that the details described above have repercussions on water supply to the City of Córdoba, at least implying higher costs for drinking water (transferable to tariffs) and, more seriously, the potential (as warned) of thrihalomethanes generated from reactions between cyanobacteria and elevated doses of chlorine. Even though these water supply services are under the private responsibility of Aguas Cordobesas\textsuperscript{32} through concessions from the Provincial Government, residents in Córdoba must understand that water consumed during the week contains their own liquid waste dumped into San Roque on Sundays, and a more significant volume on holidays and in the summer. This is a relevant problem.

49. Moreover, with specific regard to the City of Córdoba, there are typically urban environmental issues related to the phenomenon of heat inversion during the winter, caused by the convergence of low temperatures and humidity, for which the municipal government has made efforts to rationalize traffic and reduce vehicular circulation on the narrow streets of the City’s historic center.

50. With regard to solid waste, services appear to be well balanced, serving nearly ninety five percent of the population of Córdoba (some even with selective collection), as well as Alta Gracia and Los Despeñaderos, where the controlled Sanitary Landfill is located and privately operated at the Provincial Capital’s expense, at a complex that includes an incineration plant for hospital waste.

51. Mention should be made here of the good structure of the Secretariats dealing with these issues: Urban Development (responsible for the preparation of the PEC – Strategic Plan for the City of Córdoba) and Environment, the latter of which has its own laboratory and network of environmental indicators (including water quality data). Both have experienced, qualified staff which allows the City to complement and fill gaps observed in the performance of provincial agencies responsible for water and environmental issues.

52. These qualifications reflect the Municipality’s environmental control over its 2,470 industries (predominantly metal-mechanical products and foodstuffs), 49 of which are of medium and large size,\textsuperscript{33} including units in the automotive park which were installed more recently (Chrysler, Volkswagen and Fiat), and respective second- and third-level suppliers. On this subject, it is worth mentioning that the efforts of the Secretariat of Environment of the City of Córdoba make it possible to have environmental feasibility studies to complement those mentioned in paragraph 30 of this Annex (p. 7), after which the proper municipal adjustment and subsequent operation of these enterprises can then be carried out.

\textsuperscript{32} International consortium with a majority (29 percent) ownership by the French company Lyonnaise d’Eaux, for a 30-year concession restricted to provision of treated water, which calls for an Investment Plan that could reach US$100 million in 5 (five) years, of which US$30 million is shareholder contribution, US$45 million is credit from the European Investment Bank and the balance is from its own funds.

\textsuperscript{33} Companies with over 250 (two hundred and fifty) employees.
53. However, several observations should be made concerning the provision of sanitary sewage collection and treatment services. These services reach forty-seven percent of residents in Córdoba, and are provided directly by the City Government, which operates its own Secondary Treatment Station south of the urban area. Theoretically, the costs (including investments) are sustained by municipal taxes, particularly urban charges (building and land tax, lighting taxes, trash collection and street cleaning), defined proportionately for constructed and undeveloped areas, with the taxes collected forming part of the municipality’s general revenue.\textsuperscript{34}

54. Although the expansion of these services has been observed (from 13 percent in 1978 to the current 47 percent), particularly in recent years, the issue is the absence of clear economic incentives so that important investments can be made to increase indices of sanitary sewage collection and treatment, either from the restricted perspective of financial tax collection (services as a profitable business), or from a broader economic and environmental standpoint since potential beneficiaries of these investments are the scattered, small populations downstream from Córdoba. It appears evident that the Municipality of Córdoba is in a rather comfortable position to transfer revenues associated with sanitation services, according to its own reading of priorities.

55. Issues such as these, however, may take on increasing importance as Córdoba begins to face a recurring problem of other Latin American urban centers: improper settlements, promoted by low-income inhabitants, in risky or unsuitable areas for urbanization. In the case of Córdoba, this location is principally along the banks of the aforementioned irrigation canals that encircle the City to the north and south.

56. Thanks to the attraction of its automotive park, migrant populations—including Paraguayan and Bolivian families—have flocked to Córdoba in search of jobs and income, but they lack the qualifications needed for such jobs. The by-products of these jobs are well-known and constitute a serious, complex urban environmental problem: increased population density, difficult access and traffic, lack of basic sanitary infrastructure, direct contact with bodies of water used for final disposal of liquid and solid waste, and matters of social marginalization and insecurity.

57. It is worth noting that the relative growth of these types of settlements have occurred despite the noted drop in annual population growth rates for the City of Córdoba (see Table 3). Information gathered from interviews indicates that the contingent living in sub-normal urban areas rose from 3\% to nearly 10\% percent, exceeding 100,000 residents in the past decade. Of the population statistically considered poor, 47\% live in unstable settlements.\textsuperscript{35}

<table>
<thead>
<tr>
<th>Table 3 – Population Growth Rates of Greater Córdoba</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual growth of the Department of the Capital (*)</td>
</tr>
</tbody>
</table>

\textsuperscript{34} According to information collected from interviews, it is estimated that residences measuring 150 m$^2$ contribute for these services an average monthly amount of US$10.00 (ten dollars), bringing municipal coffers an annual revenue of slightly less than US$20 million.

\textsuperscript{35} PEC, \textit{doc. cited.}
58. In view of this type of urban problem, not only the supply of sanitation services, but also principally their financing matrix (cross-subsidies among classes of consumption and income, and among regions – center/outskirts) and compensatory policies will now form part of the agenda of priorities in Córdoba.

8.11.4 d) Solving Problems in San Roque Lake (Challenges and Opportunities)

59. **Engineering of Solutions.** To reduce eutrophication of San Roque Lake, it will be necessary to implement a program with integrated actions for water quality recovery and environmental protection in the reservoir, carefully contemplating not only the disposal of sewage, but also the collection and disposal of solid waste, the recomposition of plant cover, fire control and dissemination of proper agricultural soil management practices.

60. The principal component of sanitary sewers should seek the interaction of two types of solutions. First, in areas of greater density (Villa Carlos Paz and nearby areas), a conventional system of waste water collection and treatment should be installed, and it should be expanded towards vectors of human settlement. Conventional systems, whether isolated or joint, should also be implemented in Cosquin, Santa Maria and Bialet Massé (lower basin of the Cosquin River). The technical challenge will be the establishment of zones circling the system(s), to be defined in terms of their financial viability. As urban density decreases, individual, diverse treatment alternatives should be considered, other than the simple septic tanks and cesspools now existing in most dwellings and isolated communities, which are unsuitable for the rocky substratum and the above-described steep slopes. In this second option, it will be essential for cities and communities to accept and effectively enforce the application of the “norms” proposed for individual treatment (note 15) in their respective legal regulations, setting in motion a process of progressive improvement of conditions caused by the filtration of effluents into soil.

61. Studies already available for conventional systems indicate investments that vary, according to alternatives, from US$93,000,000 to US$121,000,000, plus corresponding annual operating expenses estimated between US$1,000,000 and US$2,300,000. These amounts appear high at first glance, due to the preponderance of limited concepts on systems engineering, without properly checking financial viability, compared to the above-mentioned alternatives of individual treatment which are quite relevant when one considers the scattered settlement of the watershed in question.

---


38 The interesting work of Giménez (1998) is applied for selection among various studies already carried out on the engineering of possible sanitary sewer systems (DAS, Betchell International Inc. and PRODIA – Ing. Miguel A. Potel Junot).
62. **Economic Variables.** Whatever the relative composition of both of these sanitary solutions (individual disposal or conventional, collective systems), it should be stressed that the principal beneficiaries of the proposed integrated program will be the residents of the City of Córdoba. Therefore, the arbitrary cut in PRODIA’s area of studies,\(^{39}\) limited to the contributing basin upstream from the reservoir, does not allow the specification of economic benefits directly affecting the issue of San Roque Lake.

63. Possible arguments about making upstream cities separately responsible for treating their solid waste could also be applied to Córdoba regarding the waste it dumps downstream, despite the absence of a larger number of activities and beneficiaries in the lower portion of the Primeiro River. This being said, it might be interesting at the same time to explore general concerns about (i) responsibilities for downstream environment, and (ii) possible resistance to cost distribution for the upstream protection of San Roque, carrying out research on willingness to pay for both of these objectives, and presenting it to residents Córdoba in this way.

64. Besides being illustrative, this methodological procedure could provide an economic sub-layer, currently absent, for essential negotiations among populations upstream and downstream from San Roque. These negotiations would focus on investments to be made and respective cost distribution equations, giving a new quality to the process which currently seems limited to its political dimensions and institutional volunteerism.

65. **Institutional Arrangements.** Finally, some considerations are needed on the institutional arrangements needed to implement the proposed integrated program. The solution developed, and moreover negotiated, by PRODIA-sponsored studies appears to be a good example\(^{40}\). It is the establishment of an Inter-Municipal Community Agency for the Environmental Management of the San Roque Lake Watershed (EIMAC – SAN ROQUE LAKE),\(^{41}\) which was set up to resolve a concrete problem without the artificial features present in some previous attempts to set up Watershed Committees in Argentina. In the present case, the establishment of EIMAC could serve as a solid foundation for the future establishment of a Watershed Committee, provided it proves effective in solving the regional problem of San Roque Lake, enabling the progressive expansion of duties assigned to it for such purpose.

66. However, it should be noted that the City of Córdoba must be included as a participant in this management agency; otherwise, the solutions foreseen will be unstable in terms of their sustainability, since important external factors are found downstream from the basin contributing directly San Roque.

---
\(^{39}\) Documents cited in notes 8, 17, 18 and 21.


\(^{41}\) *Act of Agreement*, signed on February 3, 1999, by the municipalities of Villa Carlos Paz, Cosquín and La Falda (copy provided by Ing. Bruno V. Ferrari Bono – Coordinator of PRODIA).
8.11.5  e) Solving Problems in the Urban Environment of the City of Córdoba (Challenges and Opportunities)

67. **Engineering of Solutions and Economic Variables.** The environmental sanitation of sub-normal urban areas (slums, illegally occupied areas and similar areas) is of course a problem with a complex solution. Initially, it requires political definitions of the level of composition, including alternatives for keeping disadvantaged populations where they are or resettling them. These definitions simultaneously include: (i) physical variables; (ii) urban and environmental planning variables; (iii) social variables; and (iv) economic-financial variables.

68. Physical variables (i) deal with the feasibility of installing required urban infrastructure systems and the selection of both conventional and alternative suitable technologies. They also refer to risk levels associated with the settlement of areas in question, with respect to the period of recurring floods, landslides, etc. It should be noted that, even in cases when irregular settlements are allowed to remain and are urbanized, a certain number of resettlements will take place to open up roads and other spaces needed for sanitary infrastructure.

69. With regard to urban and environmental planning (ii), care must be taken that the systems installed in irregular urbanized areas or—by the same token—the housing developments offered to resettled families “fit” properly into (or are compatible with) the general urban grid, as well as with the large infrastructure grids already installed or planned.

70. Social variables (iii) refer to concerns about the ties of family, neighborhoods or employment and income, which may be broken due to resettlements. Thus, interventions for urban environmental sanitation should always be accompanied by competent social assistance work, either for the re-adaptation of resettled families or to facilitate the physical and operational introduction of infrastructure and urban service networks. Provisions must be made for Sanitary and Environmental Education programs.

71. With regard to economic-financial aspects (iv), broad consideration should be given to the costs and benefits involved, without overlooking, for example, the purchase of lands for resettled families, the definition of financial mechanisms or subsidies to affected populations, operational and systems maintenance expenditures, urban (and real estate) interests involving occupied areas, and consequent environmental impacts, among others. It is necessary to apply currently available methodologies to assess economic and social benefits that do not involve direct monetary expression (property prices, avoided costs or contingent assessments).

72. **Institutional Arrangements.** In light of the above, urban environmental sanitation efforts may be expected to require inter-institutional linkages insofar as they encompass responsibilities assigned to different agencies. The relative complexity of necessary Institutional Arrangements corresponds to similar problems that need to be addressed. To mitigate inherent managerial and operational difficulties, the experiences of implementing efforts in this field seem to indicate the following scenario: integrated concept and centralized implementation, with a clear definition of the agent responsible for coordinating the program whose general design should be previously established.
8.12 COMMENTS AND FINAL OBSERVATIONS

73. It is undeniable that initiatives of a national nature, in the area of new environmental regulations, may contribute toward solving problems related to water resources observed in the Province of Córdoba. However, the current predominance of a tangled set of concurrent and duplicate laws and regulations, at the different municipal, provincial and national levels, reveals a legislative inconsistency common to Latin countries, the effectiveness of which, however, is doubtful whenever environmental degradation is observed and available water is jeopardized.

74. With this in mind, in the case of the Province of Córdoba, and more broadly when one considers the structure of water resources management systems (including successful international experiences), effective solutions to analyzed problems appear to have greater dependence and potential in light of endogenous local variables. In this regard, both the challenges and opportunities of issues involving the Province’s surface and ground water sources call for the signing of local agreements as a first step and essential basis for building progressive consensus, upon which provincial water resources management may be built. The principles to be pursued are those of decentralization, flexibility and alternatives, according to which anything that can be resolved at levels closest to water users should not “go up” to higher echelons of the system.

---

42 Draft Law on Minimum Environmental Budgets for Water Preservation and Minimum Budget Scheme for Water Resources, both being processed.

References

*Act of Agreement*, signed on February 3, 1999, by the municipalities of Villa Carlos Paz, Cosquín and La Falda (copy provided by Ing. Bruno V. Ferrari Bono – Coordinator of PRODIA).

*Draft Law on Minimum Environmental Budgets for Water Preservation and Minimum Budget Scheme for Water Resources*, both being processed.


Strategic Plan for the City of Córdoba – PEC (1996)


ANNEX E-2: WATER QUALITY PROBLEMS IN THE PROVINCE OF CATAMARCA

Objective and Content

1. The objective of this Annex E-2 is to make a preliminary assessment of problems related to the quality of water resources in the Province of Catamarca. Brief readings of territories in the province are presented, with mentions of aspects dealing with relief, rainfall and hydrographic network, urban grid, and distribution of productive activities. According to regional readings, the main problems concerning water resources are focussed, for Catamarca from the standpoint of possible types of resolution (challenges and opportunities), and from three perspectives:- (i) the nature of the problem and the corresponding approach; (ii) related economic aspects; and (iii) intervening institutional variables, with the exception of limits pertaining to an initial approach and to observations made during a field visit.

Brief Geographic Review of the Territory of Catamarca

2. The Province of Catamarca, measuring 102,602 km2, is located in the northeast of the Argentine Republic, in a zone with a semi-arid climate and limited available water (total flow rate of around 22 m³/s), with rainfall indices of around 380 mm per year, and with limits of less than 100 mm, in the Andean Altiplano of the extreme Northwest and in regions where salinas (salt marshes) occur, as observed on the border with the Province of Córdoba, in the extreme southeast (Salinas Grandes). According to the typology of the other provinces in western Argentina, rainfall in Catamarca is concentrated in the period between November and March, when nearly 80% of annual precipitation falls (monthly averages of 75 mm in January, compared to 5 mm in July).

3. For the purpose of analyzing problems related to water resources, the Province of Catamarca was divided into three distinct, large regions and two sub-regions, i.e.: the western region; the center-south sub-region defined by tributaries of the Pipanaco salt marsh; the central region, where the capital, San Fernando del Valle de Catamarca, is located; the southeastern region, dominated by salt marshes, on the border with Córdoba; and finally the center-east sub-region, on the eastern edges of mountain ranges extending above the central region to the Department of Santa María, along the border with the Province of Tucumán. Table 1, below, shows the relative shares of regions throughout the Province.

---

44 See Annex III – Water Quality Problems in the Province of Córdoba.
Table 1 – Areas of the Province’s regions, sub-regions and total

<table>
<thead>
<tr>
<th>Regions</th>
<th>Participation %</th>
<th>Approximate Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Region</td>
<td>50</td>
<td>51,300 km²</td>
</tr>
<tr>
<td>Center-South Sub-region</td>
<td>23</td>
<td>23,600 km²</td>
</tr>
<tr>
<td>Central Region</td>
<td>12</td>
<td>12,320 km²</td>
</tr>
<tr>
<td>Southeastern Region</td>
<td>10</td>
<td>10,260 km²</td>
</tr>
<tr>
<td>Center-East Sub-region</td>
<td>5</td>
<td>5,122 km²</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>102,602 km²</strong></td>
</tr>
</tbody>
</table>

4. The **western region** corresponds to the entire Department of Antofogasta de la Sierra, the dominant western portion of Tinogasta and the northern portion of Belén and the western portion of Santa María. It occupies nearly 50% of the province’s territory, and is characterized by the plateaus of the Andean Altiplano, with altitudes increasing (up to 4,500 m) toward the Andes, with special mention of the Galán volcano, at 5,920 m, situated north of Antofogasta de la Sierra. In this northern zone of the region, due to the rigorous conditions of relief and desert climate, economic activities are only incipient (limited to tourism and isolated mining operations) and consequently the rural population and small urban centers are scattered, including the capital, Antofogasta, which has fewer than 1,000 inhabitants\(^{45}\). Available water is comprised of bodies of surface water, formed by melted snow and ice from the mountain ranges and from the Andean Cordillera, and characterized by their small size, with flow rates between 30 and 120 l/s and draining into salt marshes (Salar del Hombre Muerto, de la Mina and de Antofalla, the largest of these); mention should be made of the Punilla River which runs out after bordering Antofogasta de la Sierra. Little information is available, and the contributions of underground springs are insignificant.

5. To the south of the western region, past the slopes of the Cordillera de Buenaventura, crossing the Andes, the panorama becomes diverse, although adverse climate conditions remain. This area is notable for the sources of the Abaucán – Colorado– Salado river basin; these are the Grande River which, as it flows into the Chaschuil, creates the Abaucán, and the Tamberia, a tributary flowing eastward that empties nearly 20 km above the capital, Tinogasta. Parts of the volumes of all these sources of the Abaucán come from melted snow and ice, and stem from dozens of small streams and creeks formed by the rugged topography of the Andean zone. This available surface water has favored the development of agricultural activities which are characterized by inefficient use of water resources; the use of underground aquifers is only beginning (and consequently their potential is still unexplored).

6. Downstream from Tinogasta – the capital of this Department and principal urban center of the entire western region, with a population of around 9,000 - the Colorado River turns initially toward the east, running nearly parallel to the province’s border; then to the southeast, penetrating the Bañados del Pantano, in the territory of La Rioja; and finally to the south, until it drains into La Antigua salt marsh.

7. The **center-southwest sub-region** is formed by the basin contributing to the Pipanaco saltmarsh. This is an isolated sub-region, bordered to the north and east by high mountains, and to

---

\(^{45}\) Agreed Strategic Plan of the Province of Catamarca – Documents I, II and III – December 1996.
the south and southeast by a plain that blends with the northern part of the Abaucán – Colorado – Salado river basin. This area is comprised of portions of the extreme east of the Department of Tinogasta, center-south of Belén, and by nearly all of the Departments of Andalgala and Pomán, totaling nearly 23,500 km2, i.e., 23% of the entire territory of the Province of Catamarca. The northeastern, northern and northwestern perimeter of the sub-region, which represents about 60% of the area in question, acts as an active contributing basin to the Pipanaco salt marsh, since it is formed by the edges of mountains and rugged terrain where nearly a hundred small rivers and streams originate and converge into the remaining 40%, formed by the cones where these bodies of water scatter, by large desert areas and by the salt marsh itself, which measures about 600 km2.

8. In both parts, physical aspects and those of human actions are totally distinct. In the mountainous portion, countless small towns are concentrated along the banks of rivers and streams: Belén, Londres, Andalgala, Saujil and Pomán, with populations between 5,000 and 9,000. These residents have traditional crops (grapes, fruits and olives) accompanied by small complementary industries (wineries, alcohol distilleries, candies and handicrafts), with a more recent emphasis on new projects utilizing modern irrigation technologies, as well as large mining operations. The other zone, in contrast, shows few vestiges of human occupation, with a predominance of low forests and sandy plains. Regional rainfall varies between isohyets of 100 to 320 mm per year, with no record of contributions from melted snow or ice.

9. With regard to the hydrographic network, the Belén River is noteworthy (average flow of 2.3 m3/s, with maximums of around 236 m3/s and minimums of 0.25 m3/s), which flows in a predominantly north-south direction, stemming from the contribution of countless tributaries (rivers and streams) (2,145 km2 of basin area), irrigating a fertile, productive zone near the city of Belén, until turning southeast and emptying into the Campos de Belén, where its volume becomes intermittent before draining into the Pipanaco salt marsh. The Andalgala River, next to Belén, is this area’s most important water asset. It originates from the merging of the Candado and Blanco Rivers, tributaries located to the north, flowing south until it borders the city Andalgala, after which it becomes intermittent and later empties into the Pipanaco salt marsh. Despite its small contributing basin (only 2,338 km2), favorable rainfall conditions (annual averages of 295 mm) and the rugged terrain of its surrounding area grant the Andalgá River average volumes of 880 l/s (minimum flow of 310 l/s). Finally, mention should be made of the Quimivil River (no reliable information available on flow rates), located south of the cities of Belén and Londres, flowing in a predominantly southeast direction, practically parallel to the final stretch of the Belén River, until it also becomes intermittent and empties into the Pipanaco salt marsh. In addition to surface springs, the use of groundwater is relevant, particularly for irrigated crops, with significant potential and demands for use in new undertakings based on high levels of efficiency.

10. The central region, with only 12% of the surface area, but with 61% of the population and the main activities of the Province of Catamarca⁴⁶, has the approximate form of a cone with its apex toward the north, defined by its proximity, on a sharp angle, to the Ambato and Manchao ranges (to the west, with altitudes above 3,200 m) and the Anticasti or Alto range (to the east, with altitudes of around 1,600 m). These ranges run nearly parallel, becoming more distant in a north-south direction. Between them is the Sierra de Graciana range, near and parallel to that of Anticasti,

⁴⁶ The province’s total population reached 264,234 inhabitants, according to the 1991 Census, and was projected to reach a little over 300,000 inhabitants in 1998.
comprising two valleys with altitudes decreasing from 1,400 m, in the north, to 450 m, in the south. In the former, which is broader (30 to 60 km), the Río del Valle flows; in the latter, which is much narrower (15 km), the Paclin River is formed. The region, with annual rainfall between 330 and 450 mm, includes the Departments of Ambato, Paclin, Fray Mamerto Esquiú, Capital, Valle Viejo and Capayán.

11. The population distribution is characterized by its concentration (85%) around the Capital (San Fernando del Valle de Catamarca, San Isidro, Villa Dolores and San José de Piedra Blanca) and along the Río del Valle (La Merced, La Puerta and El Rodeo). The remainder (15%) live in the so-called Serrano Belt; mention should also be made of the cities of Huillapima and Cumbicha, the latter farther to the south, near the border with the Province of La Rioja. This population concentration stems from economic activities that are strongly conditioned by water available from the Río del Valle. In San Fernando del Valle de Catamarca and nearby areas, nearly the entire service and commercial sector of the Province was installed, an industrial park is starting up, and more importantly a significant portion of the 45,000 ha of crops irrigated by small farmers (average area just over 1 ha).

12. With approximately 1,600 km2 of the estimated area, the lower basin of the Río del Valle has Los Nacimientos and Huañomil Rivers as its sources, the latter flowing into the Río de las Juntas, all with springs in the mountains. Also in the upper stretch, the Río del Valle receives contributions from the Río del Rodeo or Ambato. In the mid-1950s, about 30 km upstream from the capital, the Piriquitas Dike was built (storage capacity of 63 Hm3), with the objective of regulating volumes of around 4.5 m3/s, utilized downstream, principally for irrigation and household supply. Both of these uses are complemented about 15% by underground water extractions. Regarding the melting of mountain ice and snow, there are no data or correlation to determine available volumes during the winter, carried by the rivers and streams that come down from the eastern flanks of the Sierra del Ambato.

13. In addition to these contributions, downstream from Greater Catamarca, with a sandy riverbed and dry during the winter due to volumes extracted from it, the Río del Valle receives contributions only available because of flooding in the Tala and Paclin Rivers. The Tala River flows along the right bank, at the level of Catamarca, with an average daily flow of 0.45 m3/s. About 18 km below, the Paclin River flows into it (average volume about 0.40 m3/s), after turning to the southwest. It should be noted that the Paclin lacks important regulation works, despite its significant contributing basin, estimated at 700 km2. In its lower portion, without receiving any other important contributions, the Río del Valle continues in a southerly direction until emptying on large plains covered by vegetation typical of salt deserts.

14. The southeastern region occupies about 10% of the province’s territory (11,000 km2), and is comprised of the Departments of Santa Rosa, El Alto, Anticasti and La Paz. It holds an equal proportion (10%) of Catamarca’s population, with greater numbers located on the plains of the extreme east (altitudes of around 500 m), in San Antonio, the region’s main urban center and capital of La Paz, and in Bañado D. Ovanta, capital of Santa Rosa. Toward the slopes of the Sierra de Anticasti (maximum altitudes between 1,600 and 1,840 m), to the west of the region, land occupation becomes more scattered due to rugged terrain, with smaller populations in El Alto and

Anticasti. The region’s principal activities, along with traditional crops, include cattle raising, with a significant use of underground springs to water the herds. Industrial production tends to be concentrated in the departments of the northern part of the region, Santa María and El Alto, with a cement factory in the latter. However, the region suffers from the polarization exerted by the city of Frías, along the border of the Province of Santiago Del Estero, surrounded by small factories and an active commercial and service sector.

15. In terms of the availability of water, which is acknowledged to be scarce in the Province of Catamarca, the southeastern region is relevant because it has higher indices of precipitation than provincial averages, varying from 745 mm per year in the north, 400 to 500 mm in the southern zone, dropping to 300 mm and close to 200 mm in the south, in the Salinas Grandes. Added to this factor is the fact that the region’s topography gives rise to countless similar bodies of water, nearly all flowing in a west – east direction and with significant torrential flows, which provide the region with a significant potential for reservoirs.

16. The first of these is the San Francisco River, which is of interprovincial jurisdiction since it forms the northern border with Tucumán until penetrating the plains of the neighboring Department of Granadero, in a predominantly northeasterly direction. The San Francisco has average volumes of 500 l/s which are extracted by a series of small dikes (300 to 400,000 m³ of storage) constructed by the Province of Tucumán, despite the jeopardization of this available water during the dry season. In geographical terms, this river belongs to the Sali – Dulce river basin since it flows toward the Hondo River reservoir.

17. From north to south, the following river basins are formed: Sumampa River (100 km²), on which a dike was constructed with a 16 Hm³ capacity, regulating average volumes of 260 l/s; Alijilán River (108 km²), where La Cañada reservoir is located, storing 8.7 Hm³, to make available flows of 160 to 400 l/s; Río de las Tunas (145 km²) with average volumes of 100 l/s, considerably more significant during the flood season; and the Guayamba River, which began to be harnessed in 1939 and with a current average availability of 380 l/s, regulated by a dam with an 11 Hm³ capacity.

18. Near the southern portion of the southeastern region, the Albigasta River basin is noteworthy, with an area of around 800 km² and flow rates which, during the period of violent floods, exceed 2,200 m³/s (the minimums are around 0.40 m³/s), and can cause serious problems of flooding and riverbank erosion. On the Albigasta is located the Sotomayor dam (dating from 1888), which ensures average flows of 1.92 m³/s. This is, therefore, the region’s most important river, and it is under interprovincial jurisdiction, as in the case of the San Francisco, with its final portion in Santiago del Estero, on the plains of the San Bernardo salt marshes, in the northern part of the Salinas Grandes.

19. Further to the south, the following also deserve mention: the Ipzca River, formed by the confluence of the Calancates and Las Bateas Rivers (respectively, 86 and 94 km² of river basin areas), the latter containing a reservoir with an 8.2 Hm³ storage capacity, to regulate average volumes of 400 l/s downstream; the Icaño River(with 160 km² of river basin area), one of the most important since it has an average flow of 300 l/s and flood volumes of around 500 m³/s, justifying the construction of the Motegasta dam which stores 7.0 Hm³; and finally Los Bazanes River, with a 180 km² basin, flood volumes reaching 340 m³/s and an average flow rate of 260 l/s.
20. It should be noted that the average of all available water in these and other small bodies of water in the southeastern region exceeds 5.3 m³/s, i.e., something like 25% of the total (22 m³/s) for the entire Province of Catamarca. In the south, available water decreases toward the desert region of the Salinas Grandes, on the border with the Province of Córdoba.

21. Finally, the center-eastern sub-region was delimited because it reproduced geographic aspects similar to those of the southeastern region, i.e., skirting the northern portion of the central region and heading up almost in parallel with the Tucumán border. The eastern slopes of the Narváez Peaks, the Sierra del Aconquija and later the Sierra de Quilmes or del Cajón, favor the formation of various bodies of water, some of which end up constituting important tributaries to the Sali – Dulce River, whose basin, of great relevance in the Argentine context, includes nearly all problems related to water resources in the Province of Tucumán (see the following analysis in this Annex).

22. With this delimitation, this sub-region occupies nearly 5% of Catamarca’s surface area, including portions of the extreme east of the Departments of Paclín, Ambato, Andalgalá and especially Santa María, and contains the capital of the latter Department. From south to north, the principal rivers thus formed are: the San Ignacio and Singull Rivers, both with sources in the north of the central region and the sources, in Tucumán, of the Marapa River which empties directly into the Hondo River reservoir; Las Cañas River, included among the sources of the Chico River, whose final stretch ends in the same reservoir; and especially the Santa María River, with springs in Catamarca and which, after draining near the capital of the Department of Santa María, enters the Province of Tucumán, and then Salta, flowing in a northerly direction. With regard to these rivers, despite the difficulties in measuring volumes that may be available in Catamarca’s territory, it should be noted that there is no reliable data on the possible harnessing of their reserve potential.

An Overview of Water Resources Problems and Water Quality in the Province of Catamarca

23. In general, problems related to the quantitative supply of water resources predominate in the Province of Catamarca. A brief geographical review of Catamarca’s territory reveals a great diversity of micro-regional characteristics, underlying discreet levels of dynamics in regional development, not including observations of situations in which there is certain stagnation. Moreover, there are no great demands for water supply, which results in the lack of serious potential conflicts among user sectors. Nevertheless, it is difficult to ensure that the supply of water resources is the main limiting factor in the Province’s regional development.

24. It is worth recalling that, historically, Catamarca’s presence in the national context is being marked by the loss of its relative position, having represented over 4.3% of the country’s population at the end of the 19th century, compared to its current 0.8%. On a par with the national context, more recently there has been an intraprovincial migration movement toward the departments of the Capital and Valle Viejo, notably around Greater Catamarca, whose annual population growth was nearly 3% in the last decade. Santa María and Santa Rosa, located in the extreme east, also experienced growth, contrasting with a loss of up to 14% during this period, which occurred in Anticasti and El Alto, while the remaining departments to the west remained stable. Table 2, below, shows the composition of the Gross Geographic Product (PGB) for fiscal 1997.

Table 2 – Percentage composition of PGB for the Province of Catamarca
<table>
<thead>
<tr>
<th>Sectors Comprising PGB (by large divisions)</th>
<th>Share %</th>
<th>Annual Product (US$1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agriculture, Forestry, Hunting and Fishing</td>
<td>6.44</td>
<td>95,698.40</td>
</tr>
<tr>
<td>2. Mining and Quarries</td>
<td>14.24</td>
<td>211,606.40</td>
</tr>
<tr>
<td>3. Industries and Manufacturing</td>
<td>20.31</td>
<td>301,806.60</td>
</tr>
<tr>
<td>4. Electricity, Gas and Water</td>
<td>0.77</td>
<td>11,442.20</td>
</tr>
<tr>
<td>5. Civil Construction</td>
<td>2.48</td>
<td>36,852.80</td>
</tr>
<tr>
<td>6. Commerce, Restaurants and Hotels</td>
<td>8.40</td>
<td>124,824.00</td>
</tr>
<tr>
<td>7. Transportation, Storage and Communications</td>
<td>2.32</td>
<td>34,475.20</td>
</tr>
<tr>
<td>8. Finance, Insurance, Real Estate and Services</td>
<td>13.93</td>
<td>206,999.80</td>
</tr>
<tr>
<td>9. Community, Social and Personal Services</td>
<td>31.11</td>
<td>462,294.60</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100.00</strong></td>
<td><strong>1,486,000.00</strong></td>
</tr>
</tbody>
</table>


Obs.: The province’s per capita income is **US$4,944.28**, compared to the national average of **US$9,183.79**

25. Thus, considering the situation of fiscal restrictions on large public investments in Argentina, eventual water resource problems in Catamarca may be limited to private undertakings and/or to partnerships thereof, with emphasis on: (i) mining, located predominantly in the western region, where localized conflicts and problems may arise stemming from the practices and technologies used; and (ii) agricultural projects favored by the National Tax Deferral Regime (Law No. 22.702), with 250,000 ha of potential expansion and already demonstrated demands for irrigation based on the exploitation of aquifers, principally in the northeast – north – northwest band contributing to the Pipanaco salt marsh (center-south sub-region), in the Departments of Pomán, Andalgalá, Belén and Tinogasta, as well as northern Santa María, near the Tucumán border.

26. Despite these possible vectors of conflicts, particular attention should be paid to the process of concentration around the capital, whose magnitude may give rise to so-called urban environmental problems, including the contamination of local, surface or underground water resources. In the following paragraphs, the general nature of water resources problems in Catamarca is analyzed, according to their growing order of importance.

**Problem 1: Natural Quality of Available Waters**

27. Sources of consultation and available data made it possible to note problems associated with the natural characteristics of water resources in two areas. First, in the center-south sub-region, where the surface waters of some of the rivers (as in the cases of the Quimivil and the Fuerte de Andagá) which drain toward the Pipanaco salt marsh, require filtration before they can be used for human consumption. Moreover, it should be remembered that this available surface water, sufficient for current demands, enabled the unexplored potential of underground sources to be maintained, favoring the present opportunity for new cultivated irrigation operations.

28. The second case deals with the quality of groundwater in the southeastern region, particularly farther to the south, without keeping it from being used to water cattle, an important economic activity in this region.

**Problem 2: Shortage of Water Resources in Salt Marsh Areas**
29. The Province of Catamarca has significant occurrences of salt marshes: Antofala, la Mina, Hombre Muerto, situated to the northwest; the Laguna Verde salt marsh to the southwest; the Pipanaco in the center-south; and the Salinas Grandes, in the extreme southeast. Rivers flowing into these areas filter and feed water tables, but there is little data on the effective availability of water resources which are most often jeopardized by high levels of salinity.

30. Problems of economic depression stem from these adverse natural conditions, linking the possibilities of regional development to the adjustment of activities in light of climate seasonality. Despite other alternatives, the high costs of providing these areas with infrastructure to transfer water constitute a limiting factor and indicate restricted options; their expansion will be quite dependent on compensation mechanisms, made available either by the Central Government or the Province.

Problem 3: Water Reserve Potential in the Southeastern and Center-East Regions

31. Although it does not constitute a problem with regard to water quality, the water reserve potential presented by the southeastern and center-east regions of Catamarca, only 30% of whose capacity is used, is worth mentioning. It should be noted that the Province’s last dam was built in 1963, and no other significant interventions have taken place in the field of water resources that would favor the use of large volumes during the flood season, particularly in the cases of the Santa María River and of various bodies of water described in paragraphs 16 to 19 of this Annex.

Problem 4: Mining and the Jeopardization of Water Resources

a) Definition of Problem – Principal Operations:

32. The principal mining operation in the Province of Catamarca is that of Bajo de la Alumbrera, begun in October 1997 and located in the volcanic complex of Fallarón Negro, at an altitude of 2,600 m, in the district of Haulfin, in the south of the Department of Belén, in the center-south sub-region, formed by tributaries to the Pipanaco salt marsh. This is Argentina’s most important mining project which is expected to last 20 years, with investments totaling US$2.0 billion, of which US$1.2 billion are under the responsibility of a consortium comprised of Australian companies (with 75% of stock) and a Canadian company (holding the remaining 25%), with the US$800 million balance under the provincial government’s responsibility.

33. An annual production of 730,000 tons of concentrate is expected, with a content of 190,000 tons of fine copper and the recovery of 710,000 ounces of gold. It is an open-pit mining operation, with primary crushing on site. The concentrate is obtained by means of a hydro-metallurgical flotation process, quite intensive in the use of water extracted from the Campo del Arenal basin. After flotation, this concentrate is transported by means of a 330 km mineral pipeline to Cruz del Norte, in the Province of Tucumán, where the filter plant is located. The resulting sterile material,

48 A similar observation on the Salinas Grandes is contained in the Annex on the Province of Córdoba.

deposited in pits prepared for this purpose, next to the “Dique de Colas,” may potentially generate acid drainage, in terms of its mineral content (pyrite, principally) and of heavy metals which are deposited in the Vis Vis – Amanao river basin, which flows north to south until draining in the Pipanaco.

34. The **Fallarón Negro** vein belongs to the same volcanic complex, located only 10 km to the southeast. It is mined underground, with average contents of gold (6 grams/ton) and silver (100 grams/ton), currently from a parallel vein called Alto de la Blenda, with characteristics similar to those of the original vein, now depleted. The operation belongs to Yacimientos Mineros Agua de Dionisio, a public enterprise whose board of directors is comprised of two representatives from the Province of Catamarca, two from the National University of Tucumán and one president appointed by the country’s chief executive. The recovery of these metals is done by means of a method of cyaniding, at a treatment plant that currently processes about 350 ton/day. To recover low-grade minerals, the intention is to use leaching beds in piles.

35. Nearby is the **Agua Rica** vein, located 35 km from the Bajo la Alumbrera operation, but in the neighboring Department of Andalgalá, at an altitude of 3,100 m on the western flank of the Nevados de Aconquija. According to recent evaluations, conducted by the Australian firm BHP Minerals, its copper and gold reserves, also including molybdenum, still under exploration, are greater than those of Alumbrera.

36. Finally, we should note the so-called **Proyeto Fénix (Phoenix Project)**, belonging to FMC Corporation Lithium Division, which is contemplating investments of around US$110 million, applied through its Argentine subsidiary, Minera del Altiplano S.A., responsible for processing saturated brine found in the Hombre Muerto salt marsh, at altitudes of around 4,000 m, in the extreme north of the Department of Antofogasta de la Sierra, almost on the border with the Province of Salta. This saturated brine contains sodium, potassium, magnesium, calcium, sulfates and, of special interest, lithium in proportions of 690 ppm. Through this selective absorption process, most other components are eliminated and lithium carbonate is obtained. In the city of Guemes, Province of Salta, a new processing method generates lithium chloride. The operation’s useful life is estimated at 75 years.

b) Resolution of the Problem (Challenges and Opportunities)

37. Mining operations are subject to specific legislation. These are National Laws No. 24.196, on mining promotion in the Republic of Argentina, and No. 24.585, on environmental protection for mining activities. In the context of these legal documents and of national environmental legislation, the Government of the Province of Catamarca created, in July 1996, the State Secretariat of the Environment which has the responsibilities of enforcing and monitoring the operations described above and which are being carried out systematically by the Institute for Management and Coordination of Natural Resources Research.

38. For the **Bajo de la Alumbrera** vein, the Government of the Province of Catamarca, upon granting mining rights and the concession for water extraction in the Campo del Arenal, stipulated, under Decree 062/96, the company’s obligation to perform periodic hydrometric and hydrochemical analyses, through which the static levels of the aquifer would be evaluated, including Campo del Arenal, Sotio de Mina and "Dique de Colas" Vis Vis-Amanao, as well as pH parameters, electrical conductivity and temperature, and the same parameters for surface waters, as well as measurements...
of volumes of the Santa María, Los Nacimientos, Las Cuevas and Vis Vis-Amanao Rivers. Analyses have been performed in different qualified laboratories.

39. Reports prepared by the State Secretariat of the Environment affirm that, to date, “no chemical changes have been detected that would indicate contamination processes created by the operation,” despite several temporary variations, in some parameters, considered “normal and historically recorded in the region”\(^{50}\). With regard to deposits of sterile material, located over a complex system of geological faults that converge up to the Vis Vis-Amanao River basin, the need to expand the network of monitoring and sampling percolated waters was identified. Moreover, mining operations are subject to provisions in National Law No. 24.051, on Toxic Waste, to which the Province of Catamarca adhered. In light of this legal document, various inspections were made of all waste generated by the treatment of extracted minerals and their related activities, when “various anomalies were detected in the treatment given to this waste, first classified as hazardous, a fact that is being detected over time”\(^{51}\).

40. In Fallarón Negro, monitoring is concentrated in the Aguas de Dionisio River, where waste containing cyanide waste settles. The results obtained identified levels of free cyanide and of heavy metals (Mn, Fe and Cu), but below limits for human consumption\(^{52}\). For this operation, however, agreements are projected, aimed at compliance with provisions of the Hazardous Waste Law, particularly in terms of the above-mentioned intentions to recover low-grade minerals, using leaching beds in piles. With regard to Agua Rica, the active participation of the Secretariat of Environment in planning and decision-making on the operation should be noted, particularly in view of its proximity and the impacts it could have on the city of Andagalá. Finally, for Minera del Altiplano, in the Proyeto Fénix, inspections were determined at five principal points, including waters of the Trapiche River, although until now no impacts have been identified that are above limits permissible by Law 24.585, on environmental protection for mining activities. Similar to recommendations established for La Alumbrera, instructions were determined with regard to the handling and transportation of hazardous waste.

**Problem 5 – Urban Environment of Greater Catamarca**

a) Definition of Problem:

41. The urban region of San Fernando del Valle de Catamarca with neighboring centers, in the Departments of Valle Viejo and Fray Mamerto Esquiú, could result in the formation of so-called urban environmental problems, particularly involving, in the case under analysis, services of household water supply, collection and treatment of waste water, treatment and disposal of industrial effluents, as well the collection and final, proper disposal of urban solid waste.

42. With regard to water treatment services, the current picture has major distortions, beginning with high per capita consumption, which varies between 600 and 1,200 liters per inhabitant/day, the

---

\(^{50}\) Environmental and Mining Quality Control in the Province of Catamarca, State Secretariat of Environment, mimeo, 1.999.

\(^{51}\) Idem.

\(^{52}\) Idem
latter verified in the outskirts of the city, where drinking water ends up being used to water family gardens and crops grown on small farms and larger lands. Naturally, this paradox — extremely generous per capita consumption compared to international averages, in a region known for its shortage of water resources — is the result of high levels of non-compliance with payment for services, offered to 94% of the capital’s urban population. In fact, it is estimated that less than 20% of potential revenue is actually collected, out of a current total of nearly 50,000 connections. Added to this important revenue evasion are the system’s physical losses, but there are no reliable indicators that would permit a proper assessment.

43. With respect to the wastewater collection network, local information indicates coverage of slightly less than 70% of the capital’s population, with a repetition of the same revenue evasion problem. The billing system for both services is based on presumed consumption in terms of the size of the edified area, using property records as a basic source of information. Average bills total US$20.00 every two months. The sewage collected is treated at a single plant with a system of stabilization pools. No data was obtained in the eventual re-use of treated sewage.

44. According to data available in the State Secretariat of Environment, problems related to industrial effluents are concentrated more around the capital and along the Río del Valle, from Las Pirquitas dike to the district installed south of San Fernando53. This industrial district, which was the subject of a field visit, is still in its beginning stages, with no more than 30 factories, and with certain emphasis on agroindustries: (02 vegetable canneries), meat packing plants (02) and slaughterhouses (04, only one of which uses technology), as well as metal-mechanical factories and a chemical laboratory. No data was obtained on the effluents generated there.

45. Regarding urban solid waste, a field visit allowed me to observe, on the one hand, the building of new installations and of sheds used to separate recyclable material and to maintain the fleet of collection trucks. The system should be operated by third parties. On the other hand, I noted the current system’s precarious nature, in view of the disposal of plastics and packaging strewn among the weeds encircling the city. Moreover, at the back of the industrial district, between it and the bed of the Río del Valle (dry and sandy at this time of year), there was a large area in which waste of all sorts was dumped in the open, which emphasizes the need for better handling of these services.

b) Resolution of the Problem (Challenges and Opportunities):

46. Water supply and sewage collection and treatment services are in the process of being awarded to third parties, as a means of promoting the resolution of the problems described above. By awarding these services, the Province’s objective is to promote private investments and ensure access to the resources of ENOHSA — the National Sanitation Works Agency, with contributions slated for the construction of the east and west interceptors, part of the structure of Greater Catamarca’s sewage collection system. In view of what occurred in the Province of Tucumán54,

53 Said report, "Control of Environmental and Mining Quality in the Province of Catamarca," mentions in its final topic on "Control of Industrial Contamination" recent agreements with the business sector on the resolution of problems identified by the monitoring implemented this year.

54 The concession of water and sewer services in Greater Tucumán was suspended and underwent intervention (see specific items regarding this Province).
however, the future concessionaire should take some precautions, since changes in the current situation may demand a defined strategy and a longer period of time, in light of local habits and customs.

47. In any case, it will be necessary to organize a good commercial registry that will make it possible to understand the spectrum and profile of consumers. Likewise, it will be essential to define a new tariff structure, based on the establishment of consumption bands (albeit presumed), with increasing staggered prices, making it possible to start a process of demand management. As a result, it is recommended that, as a medium-term target, the reduction of demands for urban water supply be established, with an amount of nearly 60% of current consumption, sufficient to generate surplus that can be put to other uses, especially irrigated crops.

48. Similar recommendations should be applied with regard to the organization and modernization of solid waste collection and disposal. One should remember that separation for the recycling of household trash should preferably be done before compaction in collection vehicles, which makes the yield of recycled materials and their final price more attractive. Prior separation of household trash, however, requires intensive campaigns of social communication and sanitary and environmental education. For both services, the greatest institutional challenges will be centered on the organization and operation of a regulatory entity that can verify whether public interest is being met, in terms of the quality of services offered to the population and the correction of tariff policies applied.

49. With regard to the other economic aspects involved, it should be noted that transporting raw water and making it available merit remuneration, at least for the maintenance and cleaning of the system, in the present case, comprised of volumes carried by gravity, along a lined canal, from the Pirquitas Dike. Just as it would be right for irrigators and especially for new operations to start contributing toward sustaining the installed infrastructure, the same contribution should come from the concessionaire responsible for public supply. It should be noted that, in conceptual terms, the amount to be charged for utilizing raw water resources should refer not only to the costs of services that make them available, but also, in a broader sense, to the opportunity cost of utilizing and replacing water as a scarce natural resource. Finally, with regard to the control of industrial waste, the following are final comments and observations.

**Comments and Final Observations**

50. It cannot be stated that, in Catamarca, there is a systematic management of water resources, in general, and of aspects related to their quality, in particular. The efforts of responsible entities may be characterized as spotty and fragmented. The size and organization of the hydrometeorological data collection network, for example, as well as its processing, were larger in the past (until the mid-1960s), when the absence of a responsible sector or entity, in the general context of the public sector’s fiscal and institutional crises, favored the lack of maintenance and the scattering of the historical series available until then.

51. Thus, there is a certain pragmatism in the current situation, with data being collected to face specific problems and situations. On these occasions, a significant local response capacity is

---

55 See observations in this regard, treated in greater detail in the Annex on the Province of Mendoza.
revealed, as in the notable case of demands for decisive action on enforcement and monitoring of mega-mining operations, where interlocutors and large installations to be monitored were identified. Likewise, in prospecting for available groundwater requested for new irrigated crop operations.

52. The agglutination of this endogenous local capacity, however, tends to be hindered, often in the case of urban environmental problems due to their own characteristics: urban pollution stems from multiple, scattered sources and from the different public services involved, requiring a systematic and persistent management to deal with it effectively, translated into plans with medium- and long-term measures. To deal with these problems, it will be essential to promote institutional development efforts and to provide technological equipment in the Province of Catamarca.
ANNEX E-3: WATER QUALITY PROBLEMS IN THE PROVINCE OF TUCUMÁN

Objective and Content

1. The objective of this Annex E-3 is to make a preliminary assessment of problems related to the quality of water resources in the Province of Tucumán. Brief readings of territories in the province are presented, with mentions of aspects dealing with relief, rainfall and hydrographic network, urban grid, and distribution of productive activities. According to regional readings, the main problems concerning water resources are focussed for Tucumán from the standpoint of possible types of resolution (challenges and opportunities), and from three perspectives:- (i) the nature of the problem and the corresponding approach; (ii) related economic aspects; and (iii) intervening institutional variables, with the exception of limits pertaining to an initial approach and to observations made during a field visit.

Brief Geographic Review of the Territory of Tucumán

2. In contrast to the micro-regional diversity observed in Catamarca, the Province of Tucumán has great geographic homogeneity and may be divided, for purposes of analysis, into two large portions. The first constitutes almost a mountainous arc beginning on the border with Catamarca, in the southwest, in the Sierra de Humaya and the Narváez Peak, following westward along the Nevados and the Sierra de Aconquija, including the parallel massifs of the Sierra de Quilmes, in the far west, and of the Calchaquies and Santa Barbara Peaks, in the northwest, until reaching the Sierras de Carahuasi and Medina, in the north, where Tucumán borders the Province of Salta. This set of mountains and successive cliffs, with altitudes varying between 3,000 and 5,000 m and in a general south – north direction, favors the formation of countless bodies of water that spread out toward the second region, defined by an extensive sedimentary plain (altitudes from 500 a 300 m), drained by the sources and tributaries of the Sali-Dulce River, whose basin is a dominant and determining factor in the distribution of the activities and population of the Province of Tucumán.

3. Another important contrast in relation to Catamarca is shown in terms of rainfall, with Tucumán having indices higher than 1,100 mm per year, especially on the eastern flanks of the Nevados del Aconquija, with averages between 700 and 1,000 mm in its southern portion, to lesser rainfall ranging in amounts from 400 to 600 mm, in the far eastern part of the province. Precipitation of this sort, or somewhat less (300 to 600 mm per year), is also observed in the Santa María River valley which crosses the far western portion of Tucumán, continuing northward, between the Sierra de Quilmes (or del Cajón) and the Calchaquies Peaks. The dry season occurs more noticeably in August, September and October, with more intense rains predominating between January and March. All these factors, relief and rainfall, results in the formation of diverse rivers that flow into the Sali-Dulce River along the right bank. Mention needs be made of only two tributaries of lesser importance on its left bank.

4. Land occupation in the Province is somewhat conditioned by the natural factors mentioned above, and activities and population are scarce in the mountainous region. In contrast, the principal urban centers are located along the course of the Sali River, strongly polarized by the central location of the capital, San Miguel del Tucumán. With an area of only 22,524 km2, the Province of Tucumán, with the exception of Greater Buenos Aires, has the greatest population density compared
to all other Argentine provinces (50.7 inhab/km²), with a total of 1,142,105 inhabitants, of whom 622,324, or 54%, reside in Greater San Miguel del Tucumán. The cities of Tafi Viejo, Yerba Buena, Banda del Sali (on the left bank of the Sali River) and even Lules, only 10 km away from urbanized areas of Greater Tucumán, may be included as being directly integrated with the capital.

5. The other urban centers lie along highways (Route 38, principally). We should mention the following cities toward the south, below the capital: Bella Vista (with nearly 25,000 inhab.), Famailla (25,000 inhab.), Monteros (30,000 inhab.), Concepción (the province’s second largest city, with nearly 60,000 inhab.) and Alquilaires (25,000 inhab.). However, it may also be mentioned that the location of the service sector and of other complementary industries reinforces the central position and polarization exerted by Greater San Miguel del Tucumán.

6. Favorable soil conditions, rainfall and the generous hydrographic network – characterizing the Province of Tucumán almost as an oasis carved into western Argentina -, has allowed the development of significant crops, without the need to use intensive irrigation, administered during the dry months of August to October. Even now, sugar cane still predominates, accompanied by around 15 (fifteen) important processing plants and alcohol distilleries, in scattered locations but not too far from the capital. Recent problems of competition, especially in light of Brazilian production, have brought this agroindustrial sector certain difficulties, with the substitution of areas planted with citrus (lemons), also accompanied by their respective processing industry. It should also be noted that all these crops occupy available plains between the tributaries of the Sali River, which run parallel from mountain slopes, on the border with Catamarca, in a west-east direction.

7. It is timely to note that practically the entire territory of Tucumán is delimited by the basin contributing to the Sali River, as it is called in the upper portion of the Sali-Dulce until it reaches the point where the Gastona, Chico (or Medina) and Marapá (or Granero) Rivers meet. In this region, after turning from south to southeast, the Sali’s contributing basin narrows considerably (at this point, only 1,000 to 1,500 m wide), used to “fit” and construct the important Frontal dam on the Hondo River (storage of 1,050 Hm³), after which the Sali is called the Dulce, in the territory of Santiago del Estero.

8. With this peculiar geographic formation, the Frontal de Río Hondo reservoir – into which the above-mentioned Gastona, Chico (or Medina) and Marapá (or Granero) Rivers, as well as the Sali itself, flow -, becomes the final depository for all loads from the province, brought by surface dragging or by direct dumping, into the tributaries or main body of the Sali River. Consequently, the characterization of problems related to the water quality of this reservoir, allows a rather precise reading of its origins and principal sources of contamination.

56 1991 Census Data.

57 Brazilian agroindustry associated with sugar cane has specific incentives offered by the National Alcohol Program, utilized with automotive fuel, directly or mixed in variable percentages with the gasoline consumed in Brazil.
Characteristics and Availability of Water in the Sali-Dulce River Basin

9. The Sali-Dulce River begins with the name Tala, at altitudes of 5,000 m observed in the Sierra de Carahuasi, on the northern border between Salta and Tucumán. It then becomes known as the Sali at the point where it meets the Candelaria River, 55 km from its origin. From this point, it moves south, crossing the entire southern portion of Tucumán, on a 225 km course, during which it receives, along the right bank, countless contributions that originate on the eastern slopes of the mountains and cliffs that mark its borders with Catamarca, until turning southeast, toward the border with Santiago del Estero, where the Frontal de Río Hondo reservoir is located.

10. The upper course of the Sali, from its sources to La Aguadita dike, has slopes of around 4.5°/oo, with a predominant substratum of round pebbles, an even more notable feature in its tributaries. In its middle stretch, near Greater Tucumán, the Sali River has lesser slopes, around 2.5°/oo, decreasing to 1.0°/oo in its lower stretch near the Frontal de Río Hondo reservoir. Along these stretches with lesser slopes, the round pebbles disappear, gradually replaced by average, and then fine, grained sand. This same typology is observed in its principal tributaries, presented according to their principal characteristics in Table 1, below.

Table 1 – Characteristics of the Principal Tributaries of the Sali-Dulce River

<table>
<thead>
<tr>
<th>Direct Tributaries</th>
<th>Area of Contributing Sub-basin (km²)</th>
<th>Observed Flow Rates (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average</td>
</tr>
<tr>
<td>• Tala (1)</td>
<td>930</td>
<td>3.13</td>
</tr>
<tr>
<td>• Candelaria (1)</td>
<td>580</td>
<td>0.58</td>
</tr>
<tr>
<td>• Acequiones</td>
<td>650</td>
<td>4.27</td>
</tr>
<tr>
<td>• Choromoro</td>
<td>650</td>
<td>1.55</td>
</tr>
<tr>
<td>• Vipos</td>
<td>840</td>
<td>3.98</td>
</tr>
<tr>
<td>• Río Loro (2)</td>
<td>80</td>
<td>0.16</td>
</tr>
<tr>
<td>• Tapias</td>
<td>225</td>
<td>0.58</td>
</tr>
<tr>
<td>• Calera (2)</td>
<td>460</td>
<td>1.46</td>
</tr>
<tr>
<td>• Sali (3)</td>
<td>(partial)</td>
<td>16.93</td>
</tr>
<tr>
<td>• Lules</td>
<td>800</td>
<td>5.48</td>
</tr>
<tr>
<td>• Balderrama (4)</td>
<td>2,770</td>
<td>11.79</td>
</tr>
<tr>
<td>• Seco</td>
<td>560</td>
<td>1.52</td>
</tr>
<tr>
<td>• Gastona</td>
<td>1,060</td>
<td>12.38</td>
</tr>
<tr>
<td>• Chico (or Medina)</td>
<td>2,080</td>
<td>9.15</td>
</tr>
<tr>
<td>• Marapá (or Granero)</td>
<td>1,830</td>
<td>3.91</td>
</tr>
</tbody>
</table>

Sources: Comparison of historical series of the Department of Irrigation of the Province of Tucumán and Information on Sanitation Works in Tucumán (mimeo - 1999)
(1) – Rivers forming the Sali River;
(2) – Tributaries on the left bank of the Sali River;
(3) – Estimated flow rates at La Aguadita Dike;
(4) – The sub-basin of the Balderrama River includes the following tributaries: Aranilla, Colorado, Pueblo Viejo and Romano;
(5) – Flow regulated by the Escaba Dam;
(6) - ( - ) Data unavailable or omitted due to inconsistencies among different sources;
(7) – Minimum historical rates of flow observed, or dry season averages

11. According to the different sources consulted and to data from the above table, the basin actively contributing to the Sali River, within Tucumán, is between 10,500 and 12,700 km². In
light of the above-mentioned features of its formation, many of its 40 (forty) secondary tributaries, or of its 118 (one hundred eighteen) tertiary tributaries have more important flow rates and regional significance than some of the direct tributaries listed. Comparing data on area of contribution, rainfall and available flow, one may note that, in its middle and upper portions, the Sali and its tributaries have a runoff factor of between 3.8 l/s and 4.3 l/s per km2 of river basin. When the entire Sali-Dulce basin is observed, i.e., including the entire lower portion, in which the Sali becomes known as the Dulce River, in the territories of Santiago del Estero and then Córdoba -, average water availability exceeds 90 m3/s, of which over 65% is contributed only by the Balderrama, Seco, Gastona and Chico (or Medina) tributaries. Adding to these generous available flow rates are the seasonal contributions of snow and ice coming mainly from the Nevados de Aconcagua. However, no systematic measurements were found that would allow the establishment of factors to correlate the volumes that become available.

12. Two additional mentions are important with regard to water availability in the Sali River basin. The first deals with the economically usable potential for power generation, estimated at around 250,000 KW, possibly reaching 340,000 KW, with regulated flows. These include, on the Sali River itself, El Cadillal (used for power and supply) and Frontal de Río Hondo reservoirs (used for power and irrigation), as well as Potrero de las Tablas, Angostura River, Potrero del Clavillo (with a significant potential of 120,000 KW) and the Escaba Dam, on the Marapá or Granero River.

13. The second refers to groundwater reserves, located in aquifers formed by filtration along the left bank of the Sali River, in the eastern region of the province, in which good water quality is obtained, especially in the third layer of the water table. As seen in greater detail below, Greater San Miguel del Tucumán utilizes these aquifers, supplying drinking water from over 140 wells, with a total extracted flow of around 1.5 m3/s, with the largest individual contribution being 250 m3/hour.

Water Resources Problems in the Province of Tucumán

Problem 1: Natural Quality of Available Waters

14. It may be stated that water in the Province of Tucumán is generally of good quality, especially in tributaries originating on the eastern slopes of the borders with Catamarca and, according to the previous paragraph, in the underground springs in the eastern part of the province. With regard to the Sali River, two problems related to the natural quality of its waters should be noted. The first refers to the slightly saline level observed in its middle portion, where values of around 2 gr/liter (sodium chloride and sulfate) have been noted, during more critical dry periods.

15. The second is more alarming: it refers to high percentages of manganese, present in significant quantities in El Cadillal reservoir, located around 15 km north of the provincial capital, whose storage capacity (300 Hm3) is used to generate electricity and as the principal source of drinking water supply for Greater Tucumán. According to information from the concessionaire, the concentration of manganese (and of iron, in smaller quantities) accumulated at the bottom of the reservoir may reach 600 mg/m3, often making the necessary potabilization difficult. On these occasions, operating agreements signed with the power operator enable pumping to be done automatically by equipment on the lake surface, in order to mitigate the problem. This concentration is caused by natural silting, particularly during critical floods, resulting in an accumulation in El Cadillal reservoir. Since there are no upstream, man-made sources of nutrient
generation, the eutrophication observed in the reservoir is also caused naturally by silting, facilitated by the more elevated slopes of the Sierras de Curahuasi and Medina, where the sources of the Sali River are found.

**Problem 2: Silting and Contamination from Surface Runoff of the Sali River, its principal tributaries and the Frontal del Río Hondo Reservoir**

a) Definition of Problem – Main Indicators:

16. Silting is clearly a relevant problem in the Province of Tucumán. The intense rains and elevated slopes at sources, followed by sandy riverbeds that develop in low-sloping plains in the middle and lower portions of the Sali and its principal tributaries, not only favor the occurrence of seasonal floods but especially a significant level of silting. The result of this process may be seen at the Frontal reservoir for which silt build-up was estimated at around 28% in the mid-1970s, with an average of 0.8% per year. From information gathered at interviews with the State Secretariat of Environment of the Province of Tucumán, it is estimated that loads contributed to the Frontal reservoir would have the following composition: 83% from rural runoff, 11% from industrial waste, 4% from solid urban waste and 2% from household sewage. The graph below shows a typical section of the Sali’s tributaries, seen in its middle sections, during the dry season.
17. Systematic measurements made in the 1950s, in the Sali’s secondary and primary tributaries, allowed the establishment of an average surface runoff of 2.70 kg/m³, which results in a solid volume at the Frontal reservoir of 170 kg/s, i.e., 255 tons per year and per km² of river basin. In light of intensive soil use in the crops mentioned (sugar cane, etc.), in which agrochemicals and fertilizers are applied in considerable quantities, it is expected that this runoff of solids will be accompanied by significant quantities of compounds and nutrients. In fact, recent studies (August/98 to March/99) found the presence of organochlorate pesticides (PO), especially lindane (concentrations of up to 2 µg/l) and methoxichlorine (up to 1.3 µg/l), increasing with greater volumes in the Sali. It is worth noting that common features of these compounds are “low solubility in the water and high solubility in most organic dissolvents, which makes it possible to anticipate that […] they will tend to accumulate in the fatty tissues of living organisms,” as well as being “included among the most persistent compounds in the environment.”

18. In addition to the above-described effects of contamination, the runoff of solids and the consequent silting in bodies of water favors the occurrence of floods, which are especially notable during the months of November, December and January, and which take place with greater intensity in the Sali’s more abundant tributaries:- Medina, Gastona, Romano and Mandolo. In addition, localized flooding problems affect lower-lying areas adjacent to the capital, in the Lules River zone of influence, affecting inhabitants along riverbanks and vegetable and fruit crops.

19. Finally, in addition to water quality problems in the Sali River basin, we should mention industrial waste. The Secretariat of Environment of the Province of Tucumán has listed as sources of relevant effluents: 16 sugar refineries, 03 autonomous distilleries, 08 citrus processing plants, 06 meat packing plants, as well as 07 other diverse industries, including a paper mill, all in a single row, according to their location in the sub-basins contributing to the Sali, in the section between El Cadillal and the Frontal del Río Hondo reservoirs. In order, let us consider the following priority:

---

58 Similar estimates, with a total of 3,325,000 tn/year (255 x 12,700 km²), are contained in the document by TETRA TECH Argentina S.A. – Propuesta Técnica para Elaborar el Estudio Integral de la Conducción y Tratamiento Conjunto de Desagues Industriales y Cloacales de la Cuenca del Embalse Termas de Río Hondo (Technical Proposal for the Preparation of the Comprehensive Study of Joint Conduction and Treatment of Industrial and Sewage Waste from the Termas de Río Hondo Reservoir) – mimeo (1999).

59 Chaile, Adriana P. et alli – Plaguicidas Clorados en El Sali River (Chlorinated Pesticides in the Sali River) – Tucumán/Argentina - mimeo; Department of Chemistry, Faculty of Natural Sciences, National University of Tucumán (1999).

60 Idem.
solids and pesticides, sediment from wine and distilled alcohol production; effluents from citrus processing (whose volume is high and whose biological treatment is acknowledged to be difficult, including waste from the production of oil made from lemon rinds; and waste from the paper mill (540 l/s), dumped after only primary removal.

20. With regard to the sugar-alcohol industry, note Table 2, which lists the principal sugar refineries and alcohol distilleries, with their respective production and effluent dumping capacities\(^\text{61}\). The comparison of these values (Table 2) with historical data collected in the 1950s makes it possible to note a certain stagnation (with indications of some decline) in sugar-alcohol production in the Province; this fact is mentioned as a justification for difficulties in modernizing productive processes, rationalizing consumption and reducing dumping by this industrial sector. It is estimated that current water consumption by these factories could be reduced by 70%, as well as the possibilities of resolving the final disposal of sediment, which is highly relevant due to its high DBO potential – Biochemical Demand for Oxygen, as well as nutrients.

21. Added to this waste is that stemming from the processing of 550,000 tn/year of citrus, as well as the previously mentioned 540 l/s of effluents from Tucumán’s paper mill, dumped with only primary removal. Localized problems also occur due to waste from meat packing plants and, to a lesser degree, from beverage

Table 2 – Principal Sugar Refineries and Alcohol Distilleries

<table>
<thead>
<tr>
<th>Name of Refinery and/or Distillery</th>
<th>Sugar production (tn/year)</th>
<th>Effluent volume (m³)</th>
<th>Alcohol production (m³/ano)</th>
<th>Volume of waste produced (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. La Flórida (Balcanes)</td>
<td>60,000</td>
<td>4,800,000</td>
<td>72,000</td>
<td>720,000</td>
</tr>
<tr>
<td>2. Concepción</td>
<td>250,000</td>
<td>20,000,000</td>
<td>300,000</td>
<td>3,000,000</td>
</tr>
<tr>
<td>3. San Juan</td>
<td>60,000</td>
<td>4,800,000</td>
<td>72,000</td>
<td>720,000</td>
</tr>
<tr>
<td>4. Cruz Alta</td>
<td>40,000</td>
<td>3,200,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5. Bella Vista</td>
<td>60,000</td>
<td>4,800,000</td>
<td>72,000</td>
<td>720,000</td>
</tr>
<tr>
<td>6. Leales</td>
<td>30,000</td>
<td>2,400,000</td>
<td>36,000</td>
<td>360,000</td>
</tr>
<tr>
<td>7. Fronterita</td>
<td>90,000</td>
<td>7,200,000</td>
<td>108,000</td>
<td>1,080,000</td>
</tr>
<tr>
<td>8. Nüñorco</td>
<td>80,000</td>
<td>6,400,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9. Santa Rosa</td>
<td>60,000</td>
<td>4,800,000</td>
<td>72,000</td>
<td>720,000</td>
</tr>
<tr>
<td>10. La Providencia</td>
<td>90,000</td>
<td>7,200,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11. La Corona (Lapataia)</td>
<td>60,000</td>
<td>4,800,000</td>
<td>72,000</td>
<td>720,000</td>
</tr>
<tr>
<td>12. La Trinidad -Trial</td>
<td>90,000</td>
<td>7,200,000</td>
<td>108,000</td>
<td>1,080,000</td>
</tr>
<tr>
<td>13. Aguilares - Nasa</td>
<td>40,000</td>
<td>3,200,000</td>
<td>48,000</td>
<td>480,000</td>
</tr>
<tr>
<td>14. Santa Bárbara</td>
<td>90,000</td>
<td>7,200,000</td>
<td>108,000</td>
<td>1,080,000</td>
</tr>
<tr>
<td>15. Marapá</td>
<td>50,000</td>
<td>4,000,000</td>
<td>60,000</td>
<td>600,000</td>
</tr>
<tr>
<td>16. Química Leales</td>
<td>-</td>
<td>-</td>
<td>36,000</td>
<td>360,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,150,000</strong></td>
<td><strong>92,000,000</strong></td>
<td><strong>1,164,000</strong></td>
<td><strong>11,640,000</strong></td>
</tr>
</tbody>
</table>

Source: TETRA TECH Argentina S.A.

Obs: (1) Sugar refineries operate between May and November (7 months), with total effluents equivalent to a flow rate of 5.07 m³/s;
(2) Alcohol distilleries operate between March and December (10 months), with sediment dumping equivalent to a flow rate of 0.45 m³/s;

b) Resolution of Problem (Challenges and Opportunities):

22. Despite its lesser importance from a biological standpoint, there is no question that sediment erosion constitutes, by far, the main problem in this river basin, especially due to the drastic and continuous reduction in the reserve volume of the Frontal Dike, as well as the drainage and runoff capacity of the principal tributaries and that of the Sali River itself. There are no immediate, definitive structural solutions to this problem, although the potential of several civil works (dams to regulate flow rates) should not be overlooked, whose location and, moreover, operation and maintenance may contribute to reduce the amount of sediments. However, the actions that could offer a better result will be those related to soil management in micro-catchments and especially the recovery of vegetation, totally nonexistent along riverbanks as noted during a field visit.

23. With regard to industrial waste, although in lesser volumes, it is necessary to stress that it has a high potential for contamination, and very likely constitutes the principal cause of the eutrophization seen in the Frontal reservoir. Since the problem is relatively well known (and estimated), it is hoped that public authorities will work for the application of legal provisions on effluent disposal, whenever possible having them go hand-in-hand with the implementation of incentives for the modernization of productive processes, in order to reduce extraction demands and consequently the related dumping. However, interviews made it possible to identify that the environmental enforcement exercise also needs to overcome another type of obstacle. Along with the usual lack of means that recurs in environmental secretariats, authorities expressed great concern regarding the difficulties and the viability of the region’s sugar-alcohol sector, doubly recognized as the Province’s principal economic (and historically dominant) activity and the major source of water pollution, both in light of waste from refineries and distilleries and of soil management in planted areas associated with them.

24. Thus, in a national context of economic difficulties and depression, it seems difficult to ensure priority for investments aimed at improving the environmental performance of this productive sector, especially when negative externalities are making themselves felt downstream, far from the activities that generate them. In this regard, the recent (three years ago) reactivation of the Sali-Dulce River Basin Committee – in the context of which the possibility of charging for the use of water resources is being negotiated, with amounts around US$25.00/ha -, may constitute an external factor that could impose positive measures within the Province of Tucumán.

Problem 3: Environmental Problems in Greater San Miguel del Tucumán

a) Definition of Problem – Principle Intervening Variables:

25. The urban environmental problems of Greater San Miguel del Tucumán remain to be dealt with, since this is the province’s largest city, with a current population of over 650,000 inhabitants. The issues requiring certain attention are well-known: (i) guaranteed supply of drinking water; (ii) sewage collection and treatment services; (iii) collection and proper final disposal of urban solid waste; and (iv) the growth of irregular land occupation, promoted by low-income families, particularly in inadequate areas, along rivers and streams that flow through urbanized areas.
26. Greater Tucumán is supplied mainly by extractions from El Cadillal Dike, which is responsible for a flow rate of potable water of 1.61 m³/s, sent exclusively to San Miguel. Another 0.70 m³/s are conducted 40 km away, at the Vipos River, plus another 1.24 m³/s from the Muñecas Plant and water from 140 wells (average depth of 150 m and pumping possible, starting at 70 m), making a total of around 3.55 m³/s. This flow rate allows minimum indices of supply to close to 90% of Greater Tucumán’s population. A comparison of water conducted and population serviced shows a high per capita consumption of 550 to 590 l/inhab./day, similar to the situation observed in Catamarca.

27. In fact, it should be acknowledged that the recent cases of vulnerability in the commercial system and incipient tariffs imply the absence of mechanisms to promote the administration of demands for water consumption. Information collected during interviews assure that, in neighborhoods with greater purchasing power, and with larger lands and constructed areas, unit costs reach 900 l/inhab./day. In Greater Tucumán, just over 3,000 (or 2.5%) of 122,103 accounts are micro-metered, while the consumption of others is presumed in terms of the constructed area. In the province’s other departments, the concessionnaire’s service index is just over 63%, serving 330,000 inhabitants and 74,252 accounts, in 1998, the results of the recent effort to register and expand service. Current average tariffs are around US$25.00 per connection/every two months.

28. With regard to household sewage, sewer service is concentrated in San Miguel de Tucumán, with an index of around 75% of homes served, dropping to 55% in Tafi Viejo and just over 10% in Yerba Buena. Of all sewage collected, only 20% is treated; thus, just over 12% of Greater Tucumán, with the largest plant equipped only for primary treatment. The resulting effluents are dumped into the Sali River.

29. During the field visit, deficiencies were observed in collection services for solid waste which accumulates (plastics, glass, papers, cans and metal) along the streams and creeks that flow through the capital. These focuses of local contamination may become a relevant and growing problem as low-income populations, migrating toward larger urban areas, begin building ramshackle houses, especially along drainage canals in areas subject to frequent flooding. In these locations, the supply of sanitation services (water, sewer, trash collection and drainage), in general, is hindered by variables of geography and accessibility.

30. Finally, another issue that merits attention is the final disposal of collected solid waste, done by a private concessionaire in a controlled sanitary landfill; its substratum, according to local data, is waterproofed in the water table and clay layer. However, at first sight, the location of this landfill appears too close to the Sali River, less than 1 km from its banks, in a zone with potential infiltration of surface waters that flow along the right bank of the Sali, toward the aquifers that form under lands on its left bank. Thus, it is worth noting that the combination of geological formation and the slope of inner soil layers favors the infiltration of percolates that are formed by decomposed solid waste (chorume), in the direction of aquifers.

b) Resolution of Problem (Challenges and Opportunities):

---

62 In 1995, only 65,997 accounts were registered in the interior, according to data by Obras Sanitarias Tucumán (OST).

63 Source: TETRA TECH Argentina S.A., Proposal cited. The indices provided by the concessionaire for sewage collection and treatment services are even lower.
31. Problems pertaining to water supply and sewage collection appeared to have a quick and definitive solution when services were privatized and placed under the responsibility of a French-Spanish consortium, led by General des Eaux. However, this concession is now under intervention, and the contract has been suspended and submitted for legal claims. The episode is mentioned frequently by segments resistant to the privatization of basic sanitation services, along with others (including Brazil), as a good example of failure.

32. Without disregard to the investigation of reasons for the failure of the privatization experience in Tucumán, several statements deserve mention and aid in elucidating the facts. First, it should be acknowledged that indicators of service, and especially of the company’s commercial and financial efficiency, were extremely shaky, which implies an admission that, although services were supported by significant subsidies, a situation of insufficiency remained and worsened, in terms of population served and of the maintenance of available assets. Testimonies about the advanced deterioration of installed infrastructure, more specifically with regard to waste collection and treatment – socially less visible services – may be obtained from the technical staff that continues working during the current period of intervention.

33. Investments for the recovery and maintenance of assets, and especially for treatment and disposal of effluents, are not readily perceived by consumers, except by the incremental population contemplated by the expansion of drinking water supply. On the other hand, the wearing-out of essential readjustments for the recovery of tariff levels occurs widely and immediately, even though, in the case in question, the imperative of such readjustments has been recognized and approved by the provincial legislature, but not implemented. This being said, the importance of debates on the opportunity of private concessions is highlighted, in circumstances where there is a great distance between the actual and future sustainability of services – either prior investments are used, or a transition phase is begun which diminishes the expected public reactions stemming from the impacts of tariffs on household accounts. Both of these alternatives were absent in the case of Tucumán, both from the viewpoint of the grantor or in the strategies adopted by the concessionaire.

34. Despite its high level of proficiency in the matter, the provisional nature of the current situation is acknowledged by the Board of Directors in charge of managing the intervention period. A challenge to the regular order of business in Tucumán, is the organization of regulatory instruments suitable for administering a second – and inevitable – procedure for awarding services to third-parties, to be carried out possibly within the next two years. Similar care should be taken with regard to urban solid waste collection and disposal services, which should eventually be included within the context of a provincial regulatory framework.

Comments and Final Observations

36. Problems related to the quality of water resources in the Province of Tucumán are easy to diagnose. One need only read the signs of environmental imbalances demonstrated by the Frontal del Río Hondo Reservoir, where waters that flow through most of the province’s territory converge, not only in rural areas, dominated by extensive sugar cane and citrus crops, but also in the urban areas that formed around the capital, San Miguel de Tucumán.

37. These imbalances, however, require joint (integrated) solutions by the different variables involved, implying structural actions and, just as importantly, non-structural actions.
management of agricultural soil and recomposition of “gallery forests” (riverine forests), to the
technologies and processes employed by agroindustry and concessionaires of services related to
urban environmental sanitation. It is estimated that direct investments in sewage collection and
treatment may reach US$200 million. Even greater values, around US$700 million, are mentioned,
in favor of macro-interventions for the regulation of flow rates and hydro-power, all of which will
certainly have positive repercussions on the serious problem of silting. Despite the prospect of such
investments, it should be stressed that there is a vast field of less onerous actions, possible and
essential under any scenario, in favor of which institutional strengthening initiatives and the
building of partnerships with private agents are required.
ANNEX E-4: WATER QUALITY PROBLEMS IN THE PROVINCE OF MENDOZA

Objective and Content

1. The objective of this Annex E-4 is to make an initial assessment of problems related to the quality of water resources in the Province of Mendoza. Thus, we begin by presenting a brief reading of the province’s territory, mentioning such aspects as relief, rainfall and water network, urban grid and distribution of productive activities. According to the regional reading, the main problems concerning water resources are focused from the viewpoint of possible means of resolution (challenges and opportunities), from three perspectives: (i) the nature of the problem and the corresponding approach, (ii) related economic aspects, and (iii) intervening institutional variables. Due to the acknowledged institutional progress of the Province of Mendoza in the field of water resources management, it is worth noting that the main information presented in this Annex is contained in the recent version (August 1999) of the Water Plan for the Province of Mendoza, complemented by observations made during a technical visit.

Brief Geographical Reading of the Territory of Mendoza

2. Reproducing the dominant geomorphological features in provinces of western Argentina, two main regions and one subregion may be distinguished within Mendoza. The first region is mountainous and occupies the entire western border and nearly one-third of the province’s area, comprised of three subsequent orographic units lying in a north-south direction: the main body of the Andean Cordillera with high altitudes over 4,000 m; a frontal, intermediary and interrupted portion at lower altitudes; and the pre-Cordillera, with even lower altitudes. Due to adverse climate and relief conditions, all of these mountains have insignificant occupation and human activities; their importance lies in their touristic attraction and the water reserves made available by snow melt and snow falls.

3. The second region lies toward the East, from the pre-Cordillera, with decreasing slopes, constituting a broad plain that covers the remaining two-thirds of the province’s territory, with an average altitude of 720 m above sea level. This plain contains Mendoza’s principal activities and human settlements, marked particularly by concentrations around the so-called irrigation oases, defined as “green agro-urban-industrial complexes, fed by surface and ground water, inserted in an endless desert”.

   In fact, the process of land occupation in Mendoza, which accompanies and shapes its entire history and its economic and social development prospects, is linked to the problem of water supply and use, which gives the province unique features, particularly its notable technical and institutional progress in the management of provincial waters. Also noteworthy is the third portion located in the southern part of province, differentiated as a subregion due to its volcanic plateaus and plains with isolated volcanoes. As a whole, the total area of the Province of Mendoza is 150,839 km², about 5.4% of Argentina’s territory.

---

64 Special mention of Aconcagua, highest point in Latin America, with an altitude of 6,962 m.


66 Idem.
4. In the central and eastern plains region, rainfall indices vary from 192 mm, in the north, to 343 mm, in the south, falling between the months of September and March. An average of 278 mm was obtained at ten weather stations scattered throughout different departments of the province, concentrated on 51 rain days. In the mountainous zone, the rainfall pattern “depends on the closeness of low pressure centers along the central coast of Chile, which generate snowfall, increasing from north to south and varying from 300 mm, on the border with San Juan, to 1150 mm in water equivalent, recorded at the source of the Rio Grande.”

5. The climate is predominantly arid (western and southern portion), becoming temperate (extreme east) with average annual temperatures between 7.6 and 21.3°C, with several critical events recorded such as the occurrence of hail that accompanies summer and spring precipitation (August to April), winter frost (March to November, with greater concentration in July and August), as well as the "zonda", a regional wind that causes humidity to drop from an average of 53% to 10% (August to November), affecting not only the season when crops bloom but also the well-being and health of the regional population.

6. The above-mentioned set of relief and precipitation factors causes the formation of dozens of important tributaries in the west, mainly fed by melted snow and ice, which in turn form the province’s six main bodies of water, successively from north to south, the Mendoza, Tunuyán, Diamante, Atuel, Malargüe and Grande Rivers. In addition to these, another eight secondary basins complement the province’s water network: in the south, those that flow directly to the Barrancas - Colorado River and a large area of infiltration to the Salado River; along the province’s eastern border, the sub-basin flowing directly into the Desaguadero River and contributing to the Guanacache Lagoon, that of the Vilariru creek and that emptying directly in the Salado River; in the north, the basin of the Valguari Lagoon, as well the large interior infiltration basin of Las Huayaquerias.

7. The total availability of the main bodies of water mentioned is around 285 m³/s, of which 170.5 m³/s are exploited in the first five, with the exception of the Rio Grande basin, located at the extreme southern end of the province, although it has a significant average flow of 114 m³/s. Table 1, below, presents data regarding contributing basins, average flows, storage capacity of dams constructed on these main rivers and annual volume of potential contribution of available water through the harnessing of underground springs.

---

67 Idem, doc. cited.
Table 1 – Principle Sources of Available Water in the Province of Mendoza

<table>
<thead>
<tr>
<th>Principal Rivers</th>
<th>Surface of Contributing Basin (km²)</th>
<th>Average Flow (m³/s)</th>
<th>Annual Volume (Hm³)</th>
<th>Underground Availability (2) (Hm³)</th>
<th>Storage in Dams (Hm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total 18,484</td>
<td>50.1</td>
<td>1,585</td>
<td>800.00 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Partial (1) 9,040</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mendoza</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunuyán</td>
<td>33,563</td>
<td>42.0</td>
<td>1,046</td>
<td>221.39 (3)</td>
<td>Carrizal ........344</td>
</tr>
<tr>
<td>Diamante</td>
<td>12523</td>
<td>37.4</td>
<td>1,182</td>
<td>85.80</td>
<td>A. del Toro.........376</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L. Reyunos.........255</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malargüe</td>
<td></td>
<td>9.4</td>
<td>305</td>
<td>0.45 (3)</td>
<td></td>
</tr>
<tr>
<td>Grande</td>
<td></td>
<td>114.0</td>
<td>3,345</td>
<td>0.34 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30,376 (3)</td>
<td>287.0</td>
<td>8,554</td>
<td>1,107.98</td>
<td>1.395</td>
</tr>
</tbody>
</table>

Sources: Water Plan for the Province of Mendoza and Information Bulletin of the General Irrigation Department (August 26, 1999).

Notes: (1) Area of actively contributing basin upstream.
(2) Average volume that can be extracted in terms of existing infrastructure.
(3) Basins without reservoirs to regulate flow.

8. Besides the available water mentioned above, it should be mentioned that a dam (Potrerillos) is under construction on the upper section of the Mendoza River, to regulate and optimize the harnessing of its flows which reach a maximum of 125 m³/s. With regard to other unregulated rivers, the length of the Malargüe is very short and it empties quickly in the Llancanelo Lagoon, a natural reserve for flora and fauna. The Rio Grande, in turn, has peak, maximum flows of around 200 m³/s, minimum flows of 70 m³/s, of which 34 m³/s are "reserved" for use by Mendoza, according to agreements (“compact”) negotiated in the context of the Colorado River Basin Committee, of which the Grande is one of the major tributaries.

9. With regard to groundwater, also considered in table 1, it may be said that Mendoza has two large aquifer regions, used to supplement surface water sources and, in the case of the industrial sector, as the main source of supply. The northern region corresponds to the hydrogeological region cut by the Mendoza and Tunuyán (in its lower section) Rivers and by the Carrizal Creek, in an area of influence of approximately 22,000 km², of which 12,000 km² are located in the eastern part of the province. The stored volume in this northern zone is around 150,000 Hm³, and it is estimated that 8,000 Hm³ may be extracted at low cost. Currently, the average annual use is around 380 Hm³, and in years of surface drought may reach 600 Hm³. Of the total 11,078 wells in operation throughout the province, approximately 8,680 wells (78%) are located in this northern zone.

---

68 Terms of construction planned for 2003, with storage capacity of 400 to 450 Hm³.
Another 3,200 km² of areas of influence, with 1,703 wells in operation, are in the valley on the lower portion of the Tunuyán.\(^{69}\)

10. In the southern region, corresponding to the hydrogeological basin cut by the Diamante and Atuel Rivers, the harnessing of groundwater is much less significant, with a total of 680 wells in operation, in an area of influence measuring 13,500 km². It is important to state that, in both zones, there are four levels of aquifer exploitation, with the first two (surface, from 10 to 40 m, and first watertable level, from 60 to 120m) subject to elevated levels of salinity, which is difficult to avoid due to rapid percolation of excess irrigation. The second groundwater layer (150 to 200 m), although more protected, shows indications of contamination from salinization in the first layer, due to the large number of wells already drilled, many of which were taken out of operation without being properly capped\(^{70}\) (sealed and properly clogged to avoid vertical contamination). In the third layer of groundwater (240 to 350 m in depth), water characteristics are predominantly determined by natural variables\(^{71}\).

The Northern and Southern Oases

11. With regard to the distribution of population and activities throughout the province, the water problem and the resulting concentration of its use around the above-mentioned irrigation oases, crystallize a duality of distinct cultures and economies in Mendoza:- the first being that of an essentially agro-industrial and urban market; the other of subsistence based on small mining operations and cattle raising, carried out in the pre-Cordillera area and scattered throughout the desert region. 95% of Mendoza’s population is located in these oases, which represent only 2.5 to 3% of the province’s total surface area, while “depressed desert areas do not receive surface water contributions, used wholly for irrigation in the cultivated zone and for consumption by human settlements”. Of the 5,300,000 ha suited for agricultural use, most of it dominated by pasture and natural hills, nearly 360,000 ha are currently systematized and under irrigation use\(^{72}\). Table 2 shows population distribution by principal river basins.

<table>
<thead>
<tr>
<th>River Basin</th>
<th>Population (1991)</th>
<th>%</th>
<th>Density (inhab/km²)</th>
<th>Rural Population (% Total Pop.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mendoza River</td>
<td>911,907 (2)</td>
<td>65</td>
<td>36.6</td>
<td>12</td>
</tr>
<tr>
<td>Lower Tunuyán</td>
<td>185,995</td>
<td>13</td>
<td>10.0</td>
<td>39</td>
</tr>
<tr>
<td>Upper Tunuyán</td>
<td>82,232</td>
<td>6</td>
<td>4.7</td>
<td>48</td>
</tr>
<tr>
<td>Diamante and Atuel</td>
<td>200,804 (3)</td>
<td>14</td>
<td>4.4</td>
<td>32</td>
</tr>
<tr>
<td>Malargüe</td>
<td>21,743</td>
<td>2</td>
<td>0.5</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total (1)</strong></td>
<td><strong>1,412,481</strong></td>
<td><strong>100</strong></td>
<td><strong>9.5</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

Source: Water Plan for the Province of Mendoza, DEIE.

Obs.: (1) The Province’s current population is estimated at 1.6 million inhabitants.

---

\(^{69}\) Water Plan, doc. cited.

\(^{70}\) 18,344 wells were registered since 1954, most with average flows of 150 to 200 m³/hour.

\(^{71}\) See Annex C - Groundwater

\(^{72}\) Water Plan, doc. cited.
(2) Major concentration in Greater Mendoza, now surely in excess of one million inhabitants, including the Capital (121,620 inhab.), Godoy Cruz (179,588 inhab.), Guaymallén (221,904 inhab.), Las Heras (156,545 inhab.), Lavalle (26,967 inhab.), Luján (79,952 inhab.) and Maipú (125,331 inhab.), with an average growth rate of 22% in the 1980-91 period.

(3) Special mention of San Rafael (91,519 inhab.), situated in the basin of Diamante River, and General Alvear (26,609 inhab.), in the Atuel basin.

12. The **Northern Oasis** covers two contiguous sub-regions. The first stretches along the foot of the pre-Cordiller, upstream from the Carrizal Dike, on the upper stretch of the Tunuyán River and spread along its tributaries, to take advantage of its available waters. The second includes the sub-region where the middle stretches of the Mendoza and Tunuyán Rivers meet (around 80 km), the former after tracing its course in an arc, beginning after it turns southeast, then east, then turning northeast and finally north until emptying in the Guanacache Lagoons. The Tunuyán, in turn, initially flowing toward the northeast, also turns east after nearing the Mendoza River, then turning southeast until emptying in the Desaguadero – Salado River, on the province’s extreme eastern border. As a whole, the **Northern Oasis** contains 84% of the province’s population, including zones with urban densities of over 2,300 hab/km², accounting for 87.3% of the Gross Geographic Product (PGB).

13. Similarly, the **Southern Oasis** is located in the zone near the Diamante and Atuel Rivers, with the latter’s course bending in an arc, in the opposite direction as that of the Mendoza River, heading northeast then moving east in the zone closest to the Diamante, until turning in a southeasterly direction which continues throughout its long final stretch. The **Southern Oasis** contains 14% of Mendoza’s inhabitants and 9.9% of the PGB, complemented by 2.8% of relative contribution to the Malargüe basin, which alone represents over 50% of the volume of petroleum drilled in the province.

14. The regional economy clearly has the agroindustrial sector as its dynamic nucleus. It is worth mentioning the production of wine and juices which occupies 53% of areas planted with grapes. Another 32% of crops include fruits and olives, and the remaining 15% are vegetables. In terms of exports, besides the 19.8% represented by wine and juice production and the 18% by fruits, garlic, olives and oils, mention should be made of petroleum and its by-products (gasoline, oil, liquefied gas and polymers) representing a significant 23.9%. Sectors related to water availability also include power generation, whose production by thermal power or hydroelectric plants is equally divided between the northern (Mendoza and Tunuyán) and southern (Diamante and Atuel) basins. Finally, note that herd creation is an economic activity that is little developed in Mendoza.

Table 3, below, lists annual volumes of water consumption by basin and user sector.

<table>
<thead>
<tr>
<th>Uses</th>
<th>River Basins</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mendoza</td>
<td>Upper</td>
<td>Lower</td>
<td>Diamante</td>
<td>Atuel</td>
<td>Malargüe</td>
<td></td>
</tr>
<tr>
<td>Drinking Water</td>
<td>191.88</td>
<td>2.75</td>
<td>0.00</td>
<td>28.53</td>
<td>0.00</td>
<td>0.20</td>
<td>223.36</td>
</tr>
</tbody>
</table>

73 The reservoirs mentioned in table 1 are also used for power generation.
An Overview of Water Resources Problems and Water Quality in the Province of Mendoza

15. Water resources management in the Province of Mendoza is at varying levels when compared to other Argentine provinces and even to most systems in Latin America. Based upon the “Hispanic-Arab water management tradition and on the Mediterranean model of crops based on grapes and vegetables,” water management in Mendoza has over a century of successful operation, institutionalized in 1884, with the enactment of its Water Law and subsequent creation of the former General Water Department, later called the General Irrigation Department (DGI), in charge of the administration, preservation, distribution and regulation (including policing power) of the use of provincial water resources.

16. Over the years – notably since the 1916 Provincial Constitution -, other complementary legal documents, such as the Groundwater Law and Resolution No. 776/96, allowed DGI to consolidate efforts characterized by technical proficiency and political-administrative independence, using a model that ensures user participation and pursues the self-financing of water management, including matters related to the construction, operation and maintenance of water supply infrastructure, focused particularly on crop irrigation in the Northern and Southern Oases. For this institutional progress to take place, it has been essential for public and private agents involved to recognize that the characteristics of shortage and of diversified needs imply the need for a process of planning and managing the province’s water resources as a strategic and crucial task. This awareness is demonstrated by the differentiated economic and social development of Mendoza in relation to other neighboring provinces with the same adversities with regard to water supply.

17. Material proofs of this progress include the management of DGI’s autonomous budget, of around US$18.6 million (fiscal 1997), as well as the preparation of the Water Plan for the Province of Mendoza, foreseen as a strategic document (the driving force of an interactive planning process) and a summary of information and inventory of problems, duly seconded by extensive diagnostics performed in the province’s principal river basins.

18. A review of these documents makes it possible to verify not only the systematization of data, historical series and the profusion of other data needed for ongoing water resources

---

To support the Water Plan, documents were prepared with comprehensive, specific diagnostics for the Mendoza, Upper Tunuyán, Lower Tunuyán, Diamante and Atuel river basins.
management, but also an inventory of the natural hydrographic network, with its countless principal rivers and tributaries, as well as the complex network of canals, spans, and ramifications for irrigation, which are also used for public gardens and trees, and for household and industrial water supply. For each segment, either a natural course or distribution infrastructure, the above-mentioned diagnostics deal with details of problems and corresponding interventions needed, and are quite exhaustive in this regard.

19. Thus, it may be stated that all the main issues involving the qualitative and quantitative management of water resources in Mendoza are, in some way, contemplated in the Water Plan, although mentioned briefly, such as the possibility of refining the application of economic instruments for management. The main problems now being faced certainly have a far more complex matrix than those faced until now, which consequently require the corresponding sophistication of the set of instruments that should be handled by DGI. From a general standpoint, the systematization of these problems may be organized as follows:

Problem 1 – Natural Quality of Available Waters

20. In general, surface waters in Mendoza are scarce but are classified as being of good quality. A review of the diagnostics of the principal river basins makes it possible to identify the occurrence of relatively significant variations of hydrochemical features, according to available flows, especially with regard to salinity. In most rivers, for samplings taken under medium flow conditions, compositions from calcium sulfate to calcium sodium sulfate predominate. These changes in characteristics, according to surface flows, have an effect on the chemical composition of underground aquifers and accentuate conditions of salinity, hardness and the presence of nitrates, sulfates and metals. However, these natural conditions are constantly monitored, with DGI maintaining an extensive network and an important series of samplings, some dating back over 80 years.

Problem 2 – Conveyance of Solids, Silting, and Reduction of Storage Capacity in Provincial Reservoirs

21. The above-mentioned relief features in Mendoza, with strong slopes at headwaters, together with the sources of the main river basins already identified (altitudes between 3,000 and 5,000 meters above sea level, or higher), due to steep slopes, favor the conveyance and later dumping of solid materials, particularly important in the Carrizal (Tunuyán River) and Agua del Toro (Diamante) reservoirs. In the former, the volume of sediments deposited is estimated at 46 Hm3, with an average of 2.3 Hm3 (or 0.6%) per year.

22. Studies carried out for the Agua del Toro Dam (1995) pointed out a reduction in its storage capacity of 14% of the original volume, in a proportion of 49 Hm3 in 18 years, or 2.7 Hm3/year. Studies of similar dams indicate that 95% of the solids conveyed are retained in reservoirs, allowing one to infer that the specific erosion in this river basin is around 905 ton./km2, per year. In both

---

75 The Lower Tunuyán, for example, has variations in salinity between 992 and 1,520 micromhos/cm, according to the Preliminary Description of the Lower Tunuyán River – General Irrigation Department (DGI/1998).
76 Preliminary Description of the Mendoza River Basin – General Irrigation Department (DGI/1998).
reservoirs, natural siltation predominates; it was not possible to identify human actions as being responsible for the acceleration of this process. In any case, careful operation and maintenance of reservoirs become relevant, as well as future structural interventions in contributing sub-basins upstream.

Problem 3 – Localized Water Pollution from Mining and Oil Drilling Activities

23. In the pre-Cordillera, in a region of headwaters, the Sierra Pintada uranium mining and processing complex is located (Department of San Rafael); this process requires the elimination of 1,000,000 m³ of so-called aguas de cantera (quarry water). The possible alternatives for recovering these effluents (containing radium, uranium and other heavy metals) may be: “the use of resins of anionic and cationic interchange and/or the accumulation over a determined period of time for the loss of radiation of previously treated water poured into waterproof pools”78.

24. Oil drilling, with greater concentration in the upper portion of the Malargüe basin, however, disseminated in various departments of the province, occasionally sends effluents to the water network, containing hydrocarbons and cleansing waters (highly saline), as well as potential contamination from the petroleum itself, spill drilling (formation) water, chemical products used in the refining process or by its by-products. In both cases (mining and oil drilling), the monitoring and enforcement efforts of the Water Policing Bureau, linked to DGI, through direct agreements, may achieve the improvement needed for the environmental performance of such undertakings.

Problem 4 – Contamination of Underground Springs and Improvement in the Efficiency of Irrigation Systems

a) Definition of Problem(s):

25. Strong concerns about contamination problems in underground aquifers are contained in the Mendoza Water Plan as well as in diagnostics carried out for Mendoza’s principal river basins. Although the contamination of the first level of the water table is difficult to avoid, due to rapid percolation of excess irrigation, the capping by sealing and clogging of hundreds of inactive wells and proper isolation of drillings in operation constitute urgent tasks insofar as they should halt the vertical filtration of salinized water to the second and third layers of the water table79.

26. With regard to the efficiency of irrigation systems, this is one of the actions chosen by DGI’s Board. It was identified that inadequate agricultural practices, together with excess irrigation and deficiencies in the drainage system, are causing soil depletion and the consequent increase in the use of agrochemicals and fertilizers80, with greater risks of contamination and swiftness in the processes of soil and aquifer salinization. Data contained in the Water Plan indicate that, with the

78 Water Plan, Doc. cited.

79 More in-depth analyses of this issue are contained in Annex C – Groundwater. These contamination processes were detected in areas of the departments San Martín, Junín and Rivadavia. To deal with this problem, the Technical Regulation on Drilling, of the Registry of Drilling Directors and Construction Companies (DGI/Res. No. 229/94 HTA) has been in effect since 1994. .

80 The most common are nitrogen (N), phosphorus (P) and organo-chlorate and –phosphorate compounds.
irrigation methods practiced, efficiency levels in the province may vary from 20 to 40% (see Box 1). The principal causes identified by DGI for these low levels of efficiency include:

- “Low percentage of canal lining;
- High filtration due to predominant light soils and clear waters, with low sediment content;
- Inadequate flexibility of distribution systems that deliver large allotments of water to the user for application in a short period of time;
- High costs of new irrigation technologies, with scarce financing for small- and medium-sized producers;
- Tariff and concession system based on surface served and not on the volume actually consumed (low incentives to save water);
- Poor/incomplete maintenance of the main irrigation and drainage networks; and
- Unawareness of a crop and irrigation plan by those in charge of water distribution”.

**Box 1 – Overall efficiency of the irrigation system – Atuel River**

If we consider the overall efficiency of the entire system, said values are lower since the efficiency of conduction is 70%, that of application 50% and efficiency of distribution 80%, giving a final overall efficiency result of 28%. In summary, we may state that only 28% of water entering the Actuel River system is used, with 72% being lost for different reasons (filtration, evaporation, overflowing of canals, gates and works in poor repair, ruptures, poor operation, deep percolation, surface runoff, etc.).


27. This set of factors is particularly relevant for the segment of small- and medium-scale rural producers. Of the 360,000 irrigated ha in the province, it is estimated that only 14,000 ha correspond to modern, capital-intensive irrigation systems, although this participation has grown significantly in recent years (in 1997, there were only 4,470 ha). Table 4 illustrates this problem, presenting the typology of farm sizes in the Diamante River basin.

28. It may be noted that the large majority of rural producers (nearly 95%) hold properties of less than 20 ha. Moreover, the predominant crops in Mendoza (grapes, fruits, olives and vegetables) are suited to smaller-scale production (family farming, in many cases), hindering the financial viability of absorbing modern irrigation practices. There may potentially be a serious socioeconomic problem, in that the desired expansion of capital-intensive agricultural undertakings may be accompanied by increased migration from the countryside to the cities, especially around the capital, which would imply settlement in peri-urban areas by workers and/or former rural farmers, on lands with high agricultural potential and with good soil conditions and irrigation infrastructure; “these soils cannot be reproduced in other areas of the province, even if the necessary water resources were available to irrigate lands now used for

---

81 **Water Plan**, Doc. cited.

82 **Preliminary Description of the Actuel River Basin** – General Irrigation Department (DGI/1999).
rainfed farming”\textsuperscript{83}. However, this movement appears to be unrelenting, even though its consequences will amplify the so-called urban environmental problems, to be discussed later.

Table 4 - Typology and Number of Farm Owners – Diamante River Basin Case

<table>
<thead>
<tr>
<th>Typology of Farm Sizes</th>
<th>Share in Total (%)</th>
<th>Number of Farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smaller than 5 Ha</td>
<td>66.66 %</td>
<td>7,457</td>
</tr>
<tr>
<td>5 to 10 Ha</td>
<td>20.44 %</td>
<td>2,287</td>
</tr>
<tr>
<td>11 to 20 Ha</td>
<td>7.30%</td>
<td>817</td>
</tr>
<tr>
<td>21 to 50 Ha</td>
<td>3.67 %</td>
<td>410</td>
</tr>
<tr>
<td>51 to 100 Ha</td>
<td>1.17 %</td>
<td>131</td>
</tr>
<tr>
<td>Larger than 100 Ha</td>
<td>0.76%</td>
<td>85</td>
</tr>
</tbody>
</table>

Source: Preliminary Description of Diamante River Basin (DGI/1998)

b) Resolution of Problem(s) (Challenges and Opportunities):

29. First, nothing needs to be added regarding measures proposed to avoid the contamination of underground aquifers\textsuperscript{84}. With regard to the process of modernizing irrigation, it is worthwhile to transcribe the objectives and strategic actions proposed by the Water Plan (pg. 8-2), reclassifying them according to their distinct natures, insofar as they generally cover all the recommendations that could favor a better resolution of this process:

(a) physical actions (systems engineering):

- “Implement a joint-use pilot project for pressurized irrigation and ferti-irrigation, which will stem from the preparation of plans, works and studies on the regulation of rivers and aquifers; and
- Redesign the irrigation network with a view to increase efficiency through piped systems and pressurization, promoting the purchase of machinery and equipment suitable for their efficient maintenance and operation”.

(b) institutional actions (dissemination and training):

- “Promote the use of new technologies through expositions, courses and pilot demonstration projects; and
- Provide technical assistance, information and training to irrigators [..]”.

- Increase the level of commitment of water user organizations.

(c) economic and credit actions (financing of systems and management):

\textsuperscript{83} Water Plan, Doc. cited.

\textsuperscript{84} See proposals contained in Annex C – Groundwater.
• “...facilitate access to credit, so that (irrigators) can modernize their irrigation techniques and raise their volumetric productivity;
• Promote sustainable water fees (for irrigation, industrial, urban, public and other uses) that can comply with a “service concept” for operation and high standard maintenance;
• Obtain, in the short term, measuring in the entire system and volumetric delivery; and
• Progressively implement over the long term a system of distribution and charges for free or restricted demand, according to economic characteristics and availability of water in the zones, with user participation\(^\text{85}\).

30. In fact, the simple delivery of water volumes according to standard demand curves by re-censused surface, may generate situations of inequity and inefficiency in the allocation of available water, since some areas have different degrees of use or neglect, as in the notable case of concessions now corresponding to urbanized areas. To facilitate the rearrangement of current water use rights, DGI obtained the sanction of Law No. 6.105/94, which allowed it to modify, cancel or reassign concessions. This opened the possibility of changing the criteria for volume distribution, evolving from the re-censused surface to the paid surface and being closer to the crop area. The next steps will be the incorporation of demands by type of crop and, later, volumetric delivery and charges, to be defined with user participation\(^\text{86}\).

Problem 5 – Urban Environment and Industrial Waste:– the Case of the Pescara Canal

a) Definition of Problem:

31. Mendoza is recognized as one of the country’s most beautiful cities, and is characterized by groves of trees irrigated by crystalline waters that flow through “acequias”, small open canals that run along the sidewalks and walkways of its main streets and avenues. In the outskirts of the city, the greenness of the irrigated crops contrasts with the dominant pallor of the rest of the territory, underlining the outline of the Northern Oasis, constituted as a rich and exemplary outcome of a historical process of adjustment to the regional climate and intelligent use of available waters.

32. However, these same outlying regions beyond the urban center are currently showing the strong signs of an acknowledged process of economic changes, brought about by demands for greater productivity and competitiveness, improved levels of efficiency and added value to production. As in other regions, these demands affect the Province of Mendoza, as demonstrated, in the rural zones of the Northern and Southern Oases, by the mechanization of productive techniques, more intensive use of capital, and the concurrent change in the viable dimension of productive modules (land tenure concentration), as well as by the vertical linkage of traditional crops with the growing agroindustry. Thus, it may be stated that agricultural production ends up being subject to an industrial and urban command. Despite the need to recognize its negative unfoldment, this is an unrelenting process; to deal with it the Province of Mendoza, and its municipalities in particular, need to create the necessary alternatives and instruments.

\(^{85}\) Water Plan, Doc. cited.

\(^{86}\) Future water deliveries should be made according to two modalities: with regulation centralized by the Watershed Inspections; or decentralized to the users themselves, as in the case of the delivery of drinking water (Water Plan, Doc. cited, pg. 9-21).
33. The principal changes engendered under this process include the redistribution of activities and the population throughout the territory, with the movement of rural contingents, including small- and medium-scale farm owners, toward urban centers in search of jobs and income, especially in the services sector and, to a lesser degree, to factories which are also usually located in cities. This redistribution follows specific rhythms and may result in significant imbalances between the growth of marginal urban areas and social capacity (in general, under the exclusive responsibility of the public sector) in terms of suitable infrastructure for new uses, particularly with respect to sanitation equipment. The resulting situations are recurrent in most Latin American cities and may become particularly serious: high population density, difficult access and traffic, absence of basic sanitation infrastructure, increased flooding, direct contact with bodies of water used for the dumping of liquid and solid waste, as well as increasing unfoldment of social disadvantage and insecurity.

34. In fact, problems of this nature may already be identified in Mendoza, with greater intensity in the Northern Oasis, where the degradation of the Pescara Canal is a good example. The following situations overlap: improper disposal of solid waste (paper, cardboard, plastics, packaging, etc.); dumping in natura (crude effluents) of household waste; dumping of untreated industrial waste; as well as scattered occupation of its banks by low-income families, in groupings of substandard housing. According to interviews, there are over 130 slums in Greater Mendoza, 109 of them in the capital.

35. This water pollution is accompanied by the impermeabilization of urbanized lands, which increases the occurrence of urban “flash flooding,” although such flooding is localized and somewhat infrequent in Mendoza. In general, they are limited to summer, when melted snow and ice are added to torrential rains at mountain headwaters. This additional water invades rivers and urban streams, emptying into canals used for irrigation which are not appropriate for draining floodwaters, since they have narrow sections, i.e., they function as hydraulic controls. The result is the eventual accumulation of 0.50 m of water on urban lands, with damaging effects due to its speed, for which existing canals lack proper structure and design.

b) Resolution of the Problem (Challenges and Opportunities):

36. Engineering of Solutions and Corresponding Institutional Arrangements. Environmental quality recovery programs in cities – including those organized with the objective of removing pollution from reservoirs, lakes, rivers and streams draining from urban networks –, do not constitute a trivial pursuit, particularly when they involve substandard areas (slums and other irregular land occupations). The relative complexity of the institutional arrangements needed corresponds to the equally complex nature of problems to be faced, whose effective and sustainable resolution demands competent inter-sectoral linkages. To mitigate the inherent managerial and logistical difficulties, experiences from the implementation of interventions in this field seem to

87 In the case of Mendoza, the concentration tends to increase around the capital, where the highest rates of urban growth occur.

88 Floods not only affect the Pescara Canal but also the Cacique Quaymallén, one of Mendoza’s principal conductors (effective capacity: 45 m3/s). In secondary, unlined canals, the problem is worsened by bank erosion, siltation and reduction in drainage sections.
indicate the need for the following joint effort: integrated concept and implementation previously negotiated among the executors, with a clear division of responsibilities.

37. The problems found in the Pescara Canal fit into this general formulation. In it, the dumping of solid waste is noted, naturally stemming from insufficient waste collection services and improper final disposal of urban waste. Without specific revenues to enable its financial sustainability (even if partially), or incentives for procedures to selectively collect or use recyclable materials, Mendoza’s municipalities end up coexisting with over 1800 clandestine, open dumps, with only 22 sanitary landfills operating properly in the province. Consequently, a substantial part of the irrigation system’s budget is used to clean up canals. The structural solution has been the piping (canalization) of some sections by DGI, in general, when water crosses through lower-income zones, so to speak, “brushing the water under the carpet,” without a proper solution being given to this source of pollution (trash).

38. In this same regard, mentions are made of flood control being treated separately, as an exclusive municipal duty, isolated from the network of irrigation canals. In both cases – trash and drainage – it should be stressed that DGI’s quantitative leap toward a General Water Department will necessarily imply a cultural change, where ongoing linkage with other sectors and institutions, recognized as moderators in water resources management, is a fundamental working guideline. Thus, eventual definitions of the construction of accumulation reservoirs (in urban areas or upstream from them, in DGI’s own interest), as an alternative for avoiding critical flooding, should be made through the use of joint studies which consider both hydraulic suitability and intervening urban-related variables.

39. This intersectoral interaction becomes even more essential with the water supply and household waste collection and treatment sector, in a context where the quantitative shortage of water resources leads to the re-use of treated wastewater. In Mendoza, the provision of drinking water services is carried out mainly by Obras Sanitarias Mendoza (OSMA), privatized in 1998, which is responsible for serving 59% of the total population, with its operations concentrated in the capital and principal cities. In Luján and Maipú, another 9% of the province’s population are served by the municipalities, as well as another 11% by isolated systems in the province. Thus, with the exception of the capital, where the index reaches 99%, a significant balance of 21% of Mendoza’s population remains without connection for the grid of public water supply. In 1997, the production of drinking water reached 217.44 Hm3, of which 27% is extracted from underground sources, indicating an extremely high per capita volume of 614 l/inhab./day (including losses)89, a value well above international standards, replicating the same paradox noted in Catamarca and Tucumán: relative scarcity of water resources, but no effective management of urban demand has yet been achieved (see Box 2).

---

89 *Water Plan*, Doc. cited.
The price of a cubic meter of drinking water is a function of the quantity of bimonthly basic consumption according to the following scale:

<table>
<thead>
<tr>
<th>Bimonthly basic consumption</th>
<th>Category A Water ($/m^3)</th>
<th>Category A Water and sewer ($/m^3)</th>
<th>Category B Water ($/m^3)</th>
<th>Category B Water and sewer ($/m^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ from 0 to 1 C:B:B</td>
<td>0.21</td>
<td>0.42</td>
<td>0.42</td>
<td>0.84</td>
</tr>
<tr>
<td>+ from 1 to 2 C:B:B.</td>
<td>0.32</td>
<td>0.64</td>
<td>0.64</td>
<td>1.28</td>
</tr>
<tr>
<td>+ from 2 to 3 C:B:B.</td>
<td>0.47</td>
<td>0.94</td>
<td>0.94</td>
<td>1.88</td>
</tr>
<tr>
<td>+ from 3 to 4 C:B:B.</td>
<td>0.71</td>
<td>1.42</td>
<td>1.42</td>
<td>2.84</td>
</tr>
<tr>
<td>+ from 4 C:B:B.</td>
<td>1.07</td>
<td>2.14</td>
<td>2.14</td>
<td>4.28</td>
</tr>
</tbody>
</table>

Source: Preliminary Description of the Mendoza River Basin (DGI – 1998)

Obs: As one can see, the price per cubic meter of drinking water varies from a minimum of $0.21 and a maximum of $2.14. These values double for the case of water and sewer service.

40. Concerning the collection and treatment of household sewage, it is estimated that coverage reaches nearly 50% of the provincial population, again with emphasis on the capital, where 99.4% of inhabitants receive services. Of the waste generated, around 2.7 m3/s can potentially be reused (see Box 3).

**Box 3 – Reuse of Effluents**

There is a resource that should be available for some uses in the agricultural sector, i.e., referring to water treated in plants that purify liquid sewage, such as: a) **Campo Espejo**, where the average volume treated per year is 50.5 Hm3; and b) the Paramillos Plant, with a volume of 33.5 Hm3.

The quality of these effluents is variable according to the season of the year; moreover, to date only primary treatment was given to incoming liquids. Since 1997, in Campo Espejo and Paramillos all oxidation tanks that have been constructed for secondary treatment will be put into operation.

It is being proposed that these effluents be used in the so-called **A.C.R.E.** (Area de Cultivos Restringidos Especiales – Area of Restricted Special Crops), in order to ensure that the rest of the Oasis will not be contaminated. The “Campo Espejo” ACRE has 2000 has currently under cultivation, and may possibly be expanded to 4000 has. In Paramillos, the final use of these effluents has still not been determined.

Source: Preliminary Description of the Mendoza River Basin (DGI – 1998)

41. Despite high indices of coverage of water supply and household sewage collection services in the capital, information collected from interviews indicates the existence of problems in network operations, due to their age and insufficient maintenance during their useful life. Thus, losses in the water distribution system may be considerably higher than the 30% estimated in the Water Plan90, nor should one overlook the possibility that part of the wastewater is being sent to drainage

---

90 With regard losses of drinking water, a massive micro-metering program, conducted by OSMA, should allow the problem to be estimated more precisely, as well as establish better conditions for the management of urban demands.
collectors, reaching irrigation canals, including the Pescara. In this regard, in the more populated zones of Greater Mendoza, high nitrate levels have been detected, around 180 mg/l in the free aquifer, above the recommended 45 mg/l values.

42. Similarly, this involvement should likewise be strengthened in light of the industrial sector, mainly because the latter constitutes the main source of contamination in bodies of water that drain Mendoza’s urban and adjacent areas. It is estimated that over 1,200 industrial establishments may carry out potentially polluting activities in the province, with differing degrees of quantity and quality. The Northern Oasis is the most affected, with over 750 factories, over 90 of them dumping around 200 l/s directly into the Pescara Canal, and 62 are classified as priorities for purposes of effluent control, in which organic material with high levels of DBO predominate (wine residue, principally), as well as solids in suspension, caustic soda and occasionally heavy metals.

43. Industrial pollution problems, however, will not be resolved solely with the strengthening of public enforcement power as a basis. The so-called policies of command and control have limits to their efficiency and do not encourage new attitudes and behaviors on the part of economic agents. Monitoring and enforcement need to be complemented, along the line of DGI Resolution No. 298/99, through which the “Blue Seal” was created, as an acknowledgement and instrument of giving positive rewards for proper use of water resources (in diverting flows and dumping effluents), according to the standard of classifications of series ISO 9,000 (quality management) and ISO 14,000 (management of technologies and environmentally correct productive processes). In addition to instruments of this nature, the handling of industrial contamination will also surely require greater inclusion of this segment along with the institutional arrangements planned to be implemented, until it is granted representation in accordance with that of the Watershed Inspections, as an essential counterpart to increases in its financial participation, which should be required for pollution control efforts. The proposal of the Water Resources Pollution Prevention Program of the Province of Mendoza (see Box 4) may be a good initiative in this regard.

<table>
<thead>
<tr>
<th>8.12.2</th>
<th>Box 4 – WATER RESOURCES POLLUTION PREVENTION PROGRAM OF THE PROVINCE OF MENDOZA – 6 SUBPROGRAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Information to protect the province’s water quality.</td>
<td></td>
</tr>
<tr>
<td>2) Community education and training to protect the province’s water quality.</td>
<td></td>
</tr>
<tr>
<td>3) Updating of the legal and administrative regime for pollution control in the province’s watersheds.</td>
<td></td>
</tr>
<tr>
<td>4) Controlling of clandestine dumping of industrial effluents in public waters.</td>
<td></td>
</tr>
<tr>
<td>5) Controlling of the dumping of household and municipal effluents and waste in public waters.</td>
<td></td>
</tr>
</tbody>
</table>

---

91 Aimed at improving its enforcement efforts, DGI, through its Water Policing Bureau, established the Single Registration of Establishments (RUE), concentrating the registration of information on users and sources of pollution of the water resources under its jurisdiction. Among the registered industries (nearly 900), wine cellars and canneries predominate, and with 74 establishments linked to petroleum production.

92 Studies sponsored by the Institutional Environmental Development Program – PRODIA, propose the channeling of these effluents, isolating them laterally from the main bed of the Pescara, for purification at a primary plant and dilution into acceptable concentrates, through aggregate flows extracted from underground wells. Field interviews made it possible to identify that there is no consensus in light of the proposed alternative.
6) Coordination and promotion of industrial consortia for the creation of industrial sanitation infrastructure.

Source: Preliminary Description of the Mendoza River Basin (DGI – 1998)

44. Finally, with regard to the engineering of solutions and corresponding institutional arrangements, consideration should be given to occupations promoted by squatters (lower-income families) located along streams and canals, often involving risk or the impossibility of installing sanitation infrastructure. Interventions of this nature are highly sensitive in social terms and are logistically complex. They initially require political definitions on the selection (or composition) of alternatives between the permanent settlement, or resettlement, of marginal communities, simultaneously encompassing (i) physical variables; (ii) urban and environmental planning variables; (iii) social variables; and (iv) economic-financial variables. Annex III – Water Quality Problems in the Province of Córdoba (paras. 67 to 71) presents a generic approach to the above-mentioned variables.

45. Economic Approach. Payment for the availability of water resources has been made for a long time in the Province of Mendoza, attesting to its lengthy tradition in matters of water management. It is worth remembering that, in the Latin American context, there are few places that apply this instrument. Fundamentally, the charge made is characterized by the coverage of costs of extracting water and transporting it to users, through the construction, operation and maintenance of a complex network of canals. It is therefore a tariff for the rendering of services, defined in terms of irrigated surface. The long predominance of agricultural use implies that the payments of other sectors (public supply, for example) should also be calculated in equivalent crop areas. The formula below presents the factors considered in the basic tariff applied for rural use:

\[
T = S1 + S2 + D1 + T1 + I1 + F1 + O1 + O2
\]

where:
- \(T\) = Total tariff;
- \(S1\) = quota for financing of DGI’s Central Administration;
- \(S2\) = quota for financing of DGI’s regional Subdivision;
- \(D1\) = quota for operation and maintenance of storage and diversion dams in the corresponding region;
- \(T1\) = quota for canal maintenance and machinery maintenance expenses;
- \(I1\) = quota used by Watershed Inspections (Local Water Users’ Associations), for maintenance of derivations and local sections of irrigation canals;
- \(F1\) = quota of the Permanent Fund, established by Law Decree Nº 555/75, with a common value for the entire province;
- \(O1\) = apportionment of 80% of costs corresponding to small-scale works, financed in previous years by DGI; and
- \(O2\) = apportionment of 60% of costs of large-scale works, financed in previous fiscal years by the Provincial Government, with a 10-year payment period.
46. In addition to these items, expenses for the maintenance of the Users’ Associations, the Watershed Inspections, should also be computed; these were previously of an eminently local nature. There are a total of 750, now in the process of being unified and strengthened, totaling nearly 163 associations. With charges, the objective is to ensure the sustainability and financial independence of the system. Table 5, below, shows the typical account of a farmer, by year and irrigated hectare.

Table 5- Breakdown of a Typical Bill for an Agricultural User (per ha/year)

<table>
<thead>
<tr>
<th>DGI</th>
<th>Watershed Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>Association Quota</td>
</tr>
<tr>
<td>$12.00</td>
<td>$22.00</td>
</tr>
<tr>
<td>Dams</td>
<td>$ 2.69</td>
</tr>
<tr>
<td>Machinery</td>
<td>$ 3.55</td>
</tr>
<tr>
<td>Permanent Fund</td>
<td>$ 2.75</td>
</tr>
<tr>
<td>Minor Works</td>
<td>$ 2.10</td>
</tr>
<tr>
<td>Larger Works</td>
<td>$ 1.60</td>
</tr>
<tr>
<td><strong>Total DGI</strong></td>
<td><strong>Total Association</strong></td>
</tr>
<tr>
<td><strong>$24.69</strong></td>
<td><strong>$22.00</strong></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>TOTAL</strong></td>
</tr>
<tr>
<td><strong>$46.69</strong></td>
<td><strong>$46.69</strong></td>
</tr>
</tbody>
</table>

Source: *Preliminary Description of the Mendoza River Basin* – (DGI – 1998)

47. There are differences in unit values between surface and underground sources, with variations in average prices for agricultural use, in the first case, between US$0.005 and US$0.010, and between US$0.079 and US$0.017, for aquifer use. With regard to other user sectors, DGI applies equivalency coefficients, which may triple the unit prices as in the case of household supply, due to greater levels of assurance for flows reserved for it. Hydropower collects 2.5% of the tariff received. Note that the prices charged (by DGI and Watershed Inspections) represent 1.1% of the total cost of the Obras Sanitarias de Mendoza (OSMSA) and up to 2.6% of its water purification and public distribution expenses. For agriculture, in the case of fruits such as apples and pears (Matriz Canal zone), prices represent 1.3% of production costs, reaching 7.4% for grapes in the Galigniana zone. These are, therefore, significant percentages that reveal high elasticity in the commercialization of these crops, since the prices charged for water have not led to greater levels of efficiency in irrigation practices (today, between 20% and 40%). Box 5, below, presents the percentage distribution of DGI’s sources of collection, which, during fiscal 1997, exceeded 18.6 million pesos.

Box 5 – DGI’s Budget

The budget of the General Irrigation Department (DGI) for 1997 totals $18,619,468. This budget will be financed on an estimated basis with the contributions of those who use the water. For 1996, it followed the scheme shown below:

The Budget covers all of DGI’s activities, both at headquarters and at the level of Sub-delegations and infrastructure investments, but it does not include the budgets of the Watershed Inspections which have their own budget and total approximately $4,000,000.

Source: Preliminary Description of the Mendoza River Basin (DGI - 1998)

48. The agricultural sector is the major source of contributions to the system, in proportion to available water slated for irrigation (see table 3, pg. 5). The low percentage of participation by the household supply sector and in efforts to fight water pollution is noteworthy. In fact, one of the main challenges faced by DGI is to overcome the current tariff system for raw water delivery services, toward managed charges as an economical management instrument. The Water Plan presents numerous observations in this regard, particularly that the charge, insofar as possible, should translate the opportunity costs in water use, as a scarce natural resource. As an example of the comparison of this cost, the Water Plan records that the price of one hectare without counting irrigation, in the Department of Luján, is worth $3,000, increasing to $12,000 if it obtains a water use concession.

49. In order to foster this progress, the intended measures of volumetric charges to irrigators, as well as staggered tariffs to manage demands for urban supply, are a good start. One might add to these the escalation in the charge made by DGI for the use of raw water, for example, with a basic price for essential household consumption (around 200 to 250 l/inhab./day), added if demand for greater volume by OSMSA indicates waste, undesirable losses in supply (physical or commercial)
or luxury consumption. Specific studies could subsidize similar policies on growing prices, also applicable to irrigators and other users of water resources.

50. However, despite these measures, the fight against the growing pollution of rivers, streams, and canals should be of key importance in the coming years. It is a matter of preserving the quality of available waters, threatened by the direct dumping of effluents, as in the notable case of the Pescara Canal. Here again, the Water Plan shows awareness of the problem, standing up for payments for discharges that are “considerably higher than the updated cost of treatment and final disposal of wastewater.” It is worth noting that, until very recently, thanks to the overall relative shortage of water resources, the local culture tended to conceive of the dumping of effluents as the production of contaminated waters, insofar as industrial use, contrary to irrigation, is not entirely consumptive. Thus, disregarding its negative externalities, the devolution of effluents has been permitted with certain parsimony.

51. The most recent developments in the Bureau of Water Policy and in Resolution 778/96, instituted under the scope of DGI, constitute important changes in focus on this subject. The Resolution establishes the granting of a Dumping Permit, issued under determined conditions of concentration, flow and location, to agents registered in the RUE (Single Registry of Establishments)94. Registration in the RUE implies payment of a fixed rate of $150, added to an annual financial quota for water resource preservation, established according to the following formula95:

$$\text{Quota} = \frac{V.}{6.500 \times \text{P.C.}} + \left(\frac{V.}{V.T. \times \text{C.C.C.} \times \text{Cpo.R.}} \times (\text{C.E.} + A)\right)$$

where:

- **V.** = Total volume dumped annually by the establishment;
- **P.C.** (Pro-rating of Watershed) = Annual quota established in the budgets of DGI and the Watershed Inspections, with reimbursement of works, placed in each fiscal year;
- **V.T.** = Total volume of dumping to be controlled throughout the province;
- **C.C.C.** (Pollution Control Cost) = direct budget of DGI for pollution enforcement and control;
- **Cpo. R.** (Receiving Body) = Publicly-owned good that receives the dumped material, to which the following coefficients are applied, in terms of their later uses:
  - Drainage = 0.8
  - Dumping (sewage waste) = 1.0
  - Irrigation = 1.50
  - Recreation and fish hatcheries = 2.0
  - 8.12.2.1.1.1 Public Supply = 2.5

**C.E.** (Category of Establishment) = Coefficient for weighting of parameters on the dumping of loads, i.e.:

---

94 General Irrigation Department - *Resolution 778/96, Annex I*. This Annex sets rigid physical, chemical, biological and organic parameters, with maximums permitted and tolerated.

Dumping Permit within the maximum permitted = 1.0
Dumping Permit within the tolerated maximum = 1.25
Permit in accordance with agreement on management of dumping = 2.00
A (Seniority) = For those establishments with a management agreement, 1.0 is added to the value of C.E., for each year (or fraction thereof) needed to adjust them to the maximums permitted and tolerated, required so that definitive permits may be obtained.

52. With the effective application of charges for the dumping of effluents, as stated above, revenues and investments in the treatment of industrial discharges tend to grow. Besides proceeding to allocate monitoring costs, the formula presents interesting escalation factors, beginning with greater levies on pollution dumped into bodies of water slated for human consumption. Likewise, those establishments that delay investment of effluent pre-treatment are surtaxed, which delays their adherence to the rules established by Resolution 778/96.

53. In order to gauge the proper levels of pollution charges, in terms of making it an inducement factor, i.e., an effective economic management instrument, it would be desirable for DGI to carry out evaluations of the potential incidence of the charge (in both the intake and dumping of pollution loads) on (agro)industrial sector accounts, comparing their relative participation in production costs (and/or in billing), as in the indicators presented in the Water Plan for the different irrigated crops in the province.

54. What should be underlined at this time, is that Mendoza has a paradoxical situation, the opposite of that of other countries and regions (France and even neighboring Brazil, for example), in which the major sources of contribution to water resources management systems are the industrial and urban sectors: the former because it adds greater value to its production (and thus to its basic inputs, including water); the latter since it has a service that serves as a monopoly and can more easily transfer environmental costs to its users (charges for water use) which should be debited to it. Box 6 below shows the current profile of DGI’s applications (1996), with special emphasis on expenditures for the Central Administration and with sets of larger and smaller works.
8.12.2.1.1.2 Box 6 – Distribution of Revenue

DGI's expense budget is presented as overall values, with a breakdown for Central Administration and watersheds or irrigation zones, according to the following percentages:

![Bar chart showing fees collection by source]

Source: Preliminary Description of the Mendoza River Basin (DGI - 1998)

Comments and Final Observations

55. Without overlooking the irrigation systems currently managed by DGI, it should be noted that in Mendoza, industrial activities and urban pollution are having an increasing environmental impact, particularly on the soil and on water resources, with indirect repercussions on regional flora and fauna, as a consequence of deficient treatment of liquid and solid waste. It must be noted that industries are not producers of polluted waters but they utilize rivers, streams and canals as vehicles for diluting and getting rid of effluents. Likewise, water quality is negatively affected as a consequence of inappropriate disposal of solid waste.

56. This growing participation by urban and industrial sectors in issues pertaining to water management stems from changes occurring in the current stage of Mendoza’s regional development, understood as a sphere supervenient to that of water resources, which should be considered a relevant production input as well as an essential element for the maintenance of ecosystems.

57. In this general situation of economic changes, the main challenges facing DGI - and, in a broader way, the very management of water resources in Mendoza – are not limited to the mere
resolution of necessary physical interventions, but are especially related to new, more complex and sophisticated institutional and economic approaches, as are problems related to water quality and the environmental health of urban areas. This being said, first, the institutional system should reserve more space for polluters (industries, municipalities and concessionaires of sanitation services), granting them the status as well as the decision-making and fiscal responsibilities of water resources users, eventually permitting and encouraging them to form consortia and associations similar to those of the Watershed Inspections.

58. Second, with regard to other public authorities, also involved in this issue (particularly, entities associated with the Ministry of Environment), the keyword should be partnership. Much will be lost if the preferential attitude is one of dispute. Much more will be lost if bureaucratic restrictions are placed on autonomy and on monitoring and enforcement authority, which are currently important attributes of the DGI. The synergy of an institutional arrangement that promotes acknowledged attributes and proficiencies thus appears to be the best way. Naturally, cultural changes will be needed within DGI, in terms of greater impartiality and neutrality in its practices, with respect to different sectors of water resources users (without irrigation privileges), if the entity’s intention is to move toward the position of a General Water Department.

59. Finally, it is essential to make economic management instruments more sophisticated in order to overcome their condition as service tariffs, until these become true means of inducing proper user behavior, by promoting more appropriate means of utilizing the water resources available in Mendoza.
ANEXO F

WATER AND SANITATION SECTOR IN ARGENTINA

REVIEW AND STRATEGY

First Draft for Discussion

June 3, 1999

Finance, Private Sector and Infrastructure
Country Management Unit 7
Latin America and the Caribbean Regional Office
ARGENTINA
WATER AND SANITATION SECTOR
REVIEW AND STRATEGY

TABLE OF CONTENTS

I. PRESENTATION ................................................................................................................................. 7
II. EXECUTIVE SUMMARY .................................................................................................................. 7
III. WATER SCHEME AT NATIONAL LEVEL ...................................................................................... 7
  III.A NATIONAL CONSTITUTION ...................................................................................................... 7
        8.4.1 V.A Provincial Constitutions ............................................................................................ 10
        8.4.2 V.B Provincial Water Legislation .................................................................................... 11
  8.5 V.D. GROUNDWATER ................................................................................................................... 12
Decree 20/99: The UNDER-SECRETARIAT OF WATER RESOURCES no longer belongs to the Secretariat of
Natural Resources and Sustainable Development, and is transferred to the Secretariat of Public Works of the Ministry of
Infrastructure and Housing .................................................................................................................. 43

  5.1 Province of Mendoza ...................................................................................................................... vii
  5.2 Province of Santa Fé ....................................................................................................................... viii
  5.3 Province of Buenos Aires ............................................................................................................. xi

Objective and Content ....................................................................................................................... xi

Brief Geographic Overview of the Territory of Córdoba .................................................................. xi

  8.6 PROBLEM 1: SHORTAGE OF WATER RESOURCES IN THE NORTHWEST (SALINAS GRANDES) .................................................................................................................... XIII
  8.7 PROBLEM 2: SEASONAL NATURE OF WATER RESOURCES IN THE QUINTO RIVER BASIN .............................................................................................................................. XIII
  8.8 PROBLEM 3: FLOOD CONTROL AND SILT RUNOFF IN THE QUARTO RIVER BASIN .......................................................................................................................... XIII
        8.8.1 a) Definition of the Problem ................................................................................................ xiii
        8.8.2 b) Problem Solving (Challenges and Opportunities) .......................................................... xiv
  8.9 PROBLEM 4: TREATMENT OF INDUSTRIAL WASTE, POWER GENERATION AND PUBLIC SUPPLY FROM TERCEIRO RIVER .................................................................................................. XV
        8.9.1 a) Definition of Problem ..................................................................................................... xv
        8.9.2 b) Problem Solving (Challenges and Opportunities) .......................................................... xvi
  8.10 PROBLEM 5: CONSERVATION AND USE OF THE SEGUNDO RIVER AS A WATER SOURCE FOR GREATER CÓRDOBA ................................................................................................. XVII
  8.11 PROBLEM 6: (6.1) WATER POLLUTION IN SAN ROQUE LAKE (6.2) URBAN ENVIRONMENT OF THE CITY OF CÓRDOBA .................................................................................................. XVIII
        8.11.1 a) Primeiro River Basin ..................................................................................................... xviii
        8.11.2 b) Definition of Problems in San Roque Lake .................................................................... xix
        8.11.3 c) Definition of Problems in the Urban Environment of the City of Córdoba ................. xxi
        8.11.4 d) Solving Problems in San Roque Lake (Challenges and Opportunities) ................... xxiii
        8.11.5 e) Solving Problems in the Urban Environment of the City of Córdoba (Challenges and
                              Opportunities) ............................................................................................................. xxv
  8.12 COMMENTS AND FINAL OBSERVATIONS .................................................................................. XXVI

29. The Province of Catamarca has significant occurrences of salt marshes:- Antofala, la Mina, Hombre Muerto, situated to the northwest; the Laguna Verde salt marsh to the southwest; the Pipanaco in the center-south; and the Salinas Grandes, in the extreme southeast. Rivers flowing
into these areas filter and feed water tables, but there is little data on the effective availability of
water resources which are most often jeopardized by high levels of salinity ........................................... xxxv
30. Problems of economic depression stem from these adverse natural conditions, linking the
possibilities of regional development to the adjustment of activities in light of climate seasonality.
Despite other alternatives, the high costs of providing these areas with infrastructure to transfer
water constitute a limiting factor and indicate restricted options; their expansion will be quite
dependent on compensation mechanisms, made available either by the Central Government or the Province.

(2) Major concentration in Greater Mendoza, now surely in excess of one million inhabitants, including the Capital (121,620 inhab.), Godoy Cruz (179,588 inhab.), Guaymallén (221,904 inhab.), Las Heras (156,545 inhab.), Lavalle (26,967 inhab.), Luján (79,952 inhab.) and Maipú (125,331 inhab.), with an average growth rate of 22% in the 1980-91 period.

(3) Special mention of San Rafael (91,519 inhab.), situated in the basin of Diamante River, and General Alvear (26,609 inhab.), in the Atuel basin.

Problem 1 – Natural Quality of Available Waters

20. In general, surface waters in Mendoza are scarce but are classified as being of good quality. A review of the diagnostics of the principal river basins makes it possible to identify the occurrence of relatively significant variations of hydrochemical features, according to available flows, especially with regard to salinity. In most rivers, for samplings taken under medium flow conditions, compositions from calcium sulfate to calcium sodium sulfate predominate. These changes in characteristics, according to surface flows, have an effect on the chemical composition of underground aquifers and accentuate conditions of salinity, hardness and the presence of nitrates, sulfates and metals. However, these natural conditions are constantly monitored, with DGI maintaining an extensive network and an important series of samplings, some dating back over 80 years.

Problem 2 – Conveyance of Solids, Silting, and Reduction of Storage Capacity in Provincial Reservoirs

21. The above-mentioned relief features in Mendoza, with strong slopes at headwaters, together with the sources of the main river basins already identified (altitudes between 3,000 and 5,000 meters above sea level, or higher), due to steep slopes, favor the conveyance and later dumping of solid materials, particularly important in the Carrizal (Tunuyán River) and Agua del Toro (Diamante) reservoirs. In the former, the volume of sediments deposited is estimated at 46 Hm3, with an average of 2.3 Hm3 (or 0.6%) per year.

Problem 3 – Localized Water Pollution from Mining and Oil Drilling Activities

23. In the pre-Cordillera, in a region of headwaters, the Sierra Pintada uranium mining and processing complex is located (Department of San Rafael); this process requires the elimination of 1,000,000 m3 of so-called aguas de cantera (quarry water). The possible alternatives for recovering these effluents (containing radium, uranium and other heavy metals) may be: “the use of resins of anionic and cationic interchange and/or the accumulation over a determined period of time for the loss of radiation of previously treated water poured into waterproof pools”. Oil drilling, with greater concentration in the upper portion of the Malargüe basin, however, disseminated in various departments of the province, occasionally sends effluents to the water network, containing hydrocarbons and cleansing waters (highly saline), as well as potential contamination from the petroleum itself, spill drilling (formation) water, chemical products used in the refining process or by its by-products. In both cases (mining and oil drilling), the monitoring and enforcement efforts of the Water Policing Bureau, linked to DGI, through direct agreements, may achieve the improvement needed for the environmental performance of such undertakings.

Problem 4 – Contamination of Underground Springs and Improvement in the Efficiency of Irrigation Systems

25. Strong concerns about contamination problems in underground aquifers are contained in the Mendoza Water Plan as well as in diagnostics carried out for Mendoza’s principal river basins. Although the contamination of the first level of the water table is difficult to avoid, due to rapid percolation of excess irrigation, the capping by sealing and clogging of hundreds of inactive wells
and proper isolation of drillings in operation constitute urgent tasks insofar as they should halt the vertical filtration of salinized water to the second and third layers of the water table.

With regard to the efficiency of irrigation systems, this is one of the actions chosen by DGI’s Board. It was identified that inadequate agricultural practices, together with excess irrigation and deficiencies in the drainage system, are causing soil depletion and the consequent increase in the use of agrochemicals and fertilizers, with greater risks of contamination and swiftness in the processes of soil and aquifer salinization. Data contained in the Water Plan indicate that, with the irrigation methods practiced, efficiency levels in the province may vary from 20 to 40% (see Box 1). The principal causes identified by DGI for these low levels of efficiency include:

- Low percentage of canal lining;
- High filtration due to predominant light soils and clear waters, with low sediment content;
- Inadequate flexibility of distribution systems that deliver large allotments of water to the user for application in a short period of time;
- High costs of new irrigation technologies, with scarce financing for small- and medium-sized producers;
- Tariff and concession system based on surface served and not on the volume actually consumed (low incentives to save water);
- Poor/incomplete maintenance of the main irrigation and drainage networks; and
- Unawareness of a crop and irrigation plan by those in charge of water distribution.

This set of factors is particularly relevant for the segment of small- and medium-scale rural producers. Of the 360,000 irrigated ha in the province, it is estimated that only 14,000 ha correspond to modern, capital-intensive irrigation systems, although this participation has grown significantly in recent years (in 1997, there were only 4,470 ha). Table 4 illustrates this problem, presenting the typology of farm sizes in the Diamante River basin.

It may be noted that the large majority of rural producers (nearly 95%) hold properties of less than 20 ha. Moreover, the predominant crops in Mendoza (grapes, fruits, olives and vegetables) are suited to smaller-scale production (family farming, in many cases), hindering the financial viability of absorbing modern irrigation practices. There may potentially be a serious socioeconomic problem, in that the desired expansion of capital-intensive agricultural undertakings may be accompanied by increased migration from the countryside to the cities, especially around the capital, which would imply settlement in peri-urban areas by workers and/or former rural farmers, on lands with high agricultural potential and with good soil conditions and irrigation infrastructure; “these soils cannot be reproduced in other areas of the province, even if the necessary water resources were available to irrigate lands now used for rainfed farming”. However, this movement appears to be unrelenting, even though its consequences will amplify the so-called urban environmental problems, to be discussed later.
use rights, DGI obtained the sanction of Law No. 6.105/94, which allowed it to modify, cancel or
cancel or concessions now corresponding to urbanized areas. To facilitate the rearrangement of current water
current water, since some areas have different degrees of use or neglect, as in the notable case of
censused surface, may generate situations of inequity and inefficiency in the allocation of available
available
30. In fact, the simple delivery of water volumes according to standard demand curves by re-
delivery of water volumes according to standard demand curves by re-
user participation”. ............................................................................................................................ lxii


restricted demand, according to economic characteristics and availability of water in the zones, with


• comply with a “service concept” for operation and high standard maintenance; ............................. lxii


• raise their volumetric productivity;................................................................................................... lxii


• (c) economic and credit actions (financing of systems and management): ....................................... lxii


• (a) physical actions (systems engineering).......................................................................................... lxii


• (b) institutional actions (dissemination and training): ....................................................................... lxii


• “Implement a joint-use pilot project for pressurized irrigation and ferti-irrigation, which will
stem from the preparation of plans, works and studies on the regulation of rivers and aquifers; and


lxii

• Redesign the irrigation network with a view to increase efficiency through piped systems and
pressurization, promoting the purchase of machinery and equipment suitable for their efficient


lxii

• “Promote the use of new technologies through expositions, courses and pilot demonstration
projects; and ............................................................................................................................................. lxii


• Provide technical assistance, information and training to irrigators […].” ................................. lxii


• Increase the level of commitment of water user organizations..................................................... lxii


• “…facilitate access to credit, so that (irrigators) can modernize their irrigation techniques and
raise their volumetric productivity;……………………………………………………………………lxii


• Promote sustainable water fees (for irrigation, industrial, urban, public and other uses) that can
comply with a “service concept” for operation and high standard maintenance; ............................. lxii


• Obtain, in the short term, measuring in the entire system and volumetric delivery; and ...... lxii


• Progressively implement over the long term a system of distribution and charges for free or
restricted demand, according to economic characteristics and availability of water in the zones, with
user participation”. …………………………………………………………………………………………… lxii


lxii

30. In fact, the simple delivery of water volumes according to standard demand curves by rec-
censused surface, may generate situations of inequity and inefficiency in the allocation of available
water, since some areas have different degrees of use or neglect, as in the notable case of
concessions now corresponding to urbanized areas. To facilitate the rearrangement of current water
use rights, DGI obtained the sanction of Law No. 6.105/94, which allowed it to modify, cancel or
reassign concessions. This opened the possibility of changing the criteria for volume distribution, evolving from the re-censused surface to the paid surface and being closer to the crop area. The next steps will be the incorporation of demands by type of crop and, later, volumetric delivery and charges, to be defined with user participation.

Problem 5 – Urban Environment and Industrial Waste: the Case of the Pescara Canal

a) Definition of Problem:

31. Mendoza is recognized as one of the country’s most beautiful cities, and is characterized by groves of trees irrigated by crystalline waters that flow through “acequias”, small open canals that run along the sidewalks and walkways of its main streets and avenues. In the outskirts of the city, the greenness of the irrigated crops contrasts with the dominant pallor of the rest of the territory, underlining the outline of the Northern Oasis, constituted as a rich and exemplary outcome of a historical process of adjustment to the regional climate and intelligent use of available waters. ....

32. However, these same outlying regions beyond the urban center are currently showing the strong signs of an acknowledged process of economic changes, brought about by demands for greater productivity and competitiveness, improved levels of efficiency and added value to production. As in other regions, these demands affect the Province of Mendoza, as demonstrated, in the rural zones of the Northern and Southern Oases, by the mechanization of productive techniques, more intensive use of capital, and the concurrent change in the viable dimension of productive modules (land tenure concentration), as well as by the vertical linkage of traditional crops with the growing agroindustry. Thus, it may be stated that agricultural production ends up being subject to an industrial and urban command. Despite the need to recognize its negative unfoldment, this is an unrelenting process; to deal with it the Province of Mendoza, and its municipalities in particular, need to create the necessary alternatives and instruments.

33. The principal changes engendered under this process include the redistribution of activities and the population throughout the territory, with the movement of rural contingents, including small- and medium-scale farm owners, toward urban centers in search of jobs and income, especially in the services sector and, to a lesser degree, to factories which are also usually located in cities. This redistribution follows specific rhythms and may result in significant imbalances between the growth of marginal urban areas and social capacity (in general, under the exclusive responsibility of the public sector) in terms of suitable infrastructure for new uses, particularly with respect to sanitation equipment. The resulting situations are recurrent in most Latin American cities and may become particularly serious: high population density, difficult access and traffic, absence of basic sanitation infrastructure, increased flooding, direct contact with bodies of water used for the dumping of liquid and solid waste, as well as increasing unfoldment of social disadvantage and insecurity.

34. In fact, problems of this nature may already be identified in Mendoza, with greater intensity in the Northern Oasis, where the degradation of the Pescara Canal is a good example. The following situations overlap: improper disposal of solid waste (paper, cardboard, plastics, packaging, etc.); dumping in natura (crude effluents) of household waste; dumping of untreated industrial waste; as well as scattered occupation of its banks by low-income families, in groupings of substandard housing. According to interviews, there are over 130 slums in Greater Mendoza, 109 of them in the capital.

35. This water pollution is accompanied by the impermeabilization of urbanized lands, which increases the occurrence of urban “flash flooding,” although such flooding is localized and somewhat infrequent in Mendoza. In general, they are limited to summer, when melted snow and ice are added to torrential rains at mountain headwaters. This additional water invades rivers and urban streams, emptying into canals used for irrigation which are not appropriate for draining floodwaters, since they have narrow sections, i.e., they function as hydraulic controls. The result is
the eventual accumulation of 0.50 m of water on urban lands, with damaging effects due to its speed, for which existing canals lack proper structure and design. .................................................. lxxiii
b) Resolution of the Problem (Challenges and Opportunities): .................................................. lxxiii

8.12.2 Box 4 – WATER RESOURCES POLLUTION PREVENTION PROGRAM OF THE PROVINCE OF MENDOZA – 6 SUBPROGRAMS ................................................................. lxxvi

where: ........................................................................................................................................ lxxvii
Quota = (V./6.500 x P.C.) + [(V./V.T. x C.C.C. x Cpo.R.) x (C.E. + A)] ........................................ lxxviii
where:

C.C.C. (Pollution Control Cost) = Direct Budget of DGI for Pollution Enforcement and Control..... lxxviii

53. In order to gauge the proper levels of pollution charges, in terms of making it an inducement factor, i.e., an effective economic management instrument, it would be desirable for DGI to carry out evaluations of the potential incidence of the charge (in both the intake and dumping of pollution loads) on (agro)industrial sector accounts, comparing their relative participation in production costs (and/or in billing), as in the indicators presented in the Water Plan for the different irrigated crops in the province. .................................................................................................................................... lxxxi

54. What should be underlined at this time, is that Mendoza has a paradoxical situation, the opposite of that of other countries and regions (France and even neighboring Brazil, for example), in which the major sources of contribution to water resources management systems are the industrial and urban sectors: the former because it adds greater value to its production (and thus to its basic inputs, including water); the latter since it has a service that serves as a monopoly and can more easily transfer environmental costs to its users (charges for water use) which should be debited to it. Box 6 below shows the current profile of DGI’s applications (1996), with special emphasis on expenditures for the Central Administration and with sets of larger and smaller works. .......... lxxxi

Comments and Final Observations .............................................................................................................. lxxxi

55. Without overlooking the irrigation systems currently managed by DGI, it should be noted that in Mendoza, industrial activities and urban pollution are having an increasing environmental impact, particularly on the soil and on water resources, with indirect repercussions on regional flora and fauna, as a consequence of deficient treatment of liquid and solid waste. It must be noted that industries are not producers of polluted waters but they utilize rivers, streams and canals as vehicles for diluting and getting rid of effluents. Likewise, water quality is negatively affected as a consequence of inappropriate disposal of solid waste. ................................................................. lxxi

56. This growing participation by urban and industrial sectors in issues pertaining to water management stems from changes occurring in the current stage of Mendoza’s regional development, understood as a sphere supervenient to that of water resources, which should be considered a relevant production input as well as an essential element for the maintenance of ecosystems. ........................................................................................................................................ lxxii

I. OBJECTIVE ............................................................................................................................................... 8
II. BACKGROUND ............................................................................................................................................ 8
III. STATUS OF THE WATER SUPPLY AND SANITATION SECTOR .......................................................... 10
IV. KEY ISSUES IN THE SECTOR .................................................................................................................. 18

(ii) Develop a clear strategy to address poverty issues and incorporate then in the PSP contract design or in the regulatory framework; .................................................. 21

V. MEDIUM-TERM VISION FOR THE SECTOR ............................................................................................... 22
VI. PROPOSED GOVERNMENT STRATEGY .................................................................................................... 23
VII. BANK ASSISTANCE STRATEGY ................................................................................................................ 25
8.13 ANNEX 1: KEY SECTOR INFORMATION .................................................................................................. 28
8.14 ANNEX 2: PROPOSED GUIDELINES FOR REGULATORY MODELS AND CONCESSION CONTRACTS .......... 32
8.15 ANNEX 3: POTENTIAL BENEFICIARIES OF THE ARGENTINA WATER SECTOR REFORM PROGRAM ....... 36
8.16 ANNEX 4: REFERENCES ............................................................................................................................ 1
I. OBJECTIVE

1. The water and sanitation sector in Argentina is going through a major and unprecedented process of reform. This reform, initiated in the early nineties, is expected to introduce long lasting changes in the public sector’s role in water and sanitation activities, by progressively shifting service provision responsibilities to the private sector. This note will be the basis to continue and deepen the sector policy dialog with the Government. It will also layout the critical issues, set a common agenda to address pending reform issues, and will provide a conceptual framework for the Bank assistance strategy and new sector projects and non-lending assistance..

II. BACKGROUND

Economic and Social Context

2. During the final years of the eighties Argentina faced the most severe crisis of the last few decades. In 1989 the Government of Argentina started a period of transformation at the economic, political, administrative and social levels that affected both public and private sectors. The growing fiscal deficit and the large inefficiencies of state utilities, affected its capacity to provide adequate and efficient public services. It was considered by both the population and the Government, that economic recovery would be linked to transformation of the structure of the public sector, reduction of public expenditure, liberalization of the economy, increased investment in the infrastructure sectors, and creating the conditions for developing the private sector. As a solution the Government of Argentina adopted the Convertibility Plan. The adopted measures positively transformed Argentina’s economic environment, from extreme hyperinflation to single digits in four years, and GDP growth average was increased to an impressive 7.7 percent for the 1991-94 period. The initial consumption-led boom matured into a healthy pattern of investment and export-led growth.

3. The regional financial crisis of 1995 caused a contraction of the economy of an estimated 4.6 percent of GDP. The recession translated into higher level of unemployment and affected the performance of the financial system and increased fiscal deficit. Total public debt rose by US$ 6.5 billion in 1995. In addition to federal deficit, provincial deficits rose to 1.1 percent of GDP (over US$ 11 billion). Provincial deficits were mainly financed by arrears to suppliers, provincial workers and pensioners.

4. The Federal Government strongly reacted by continuing its adjustment measures with labor, social security and fiscal reforms. At the provincial level the crisis aggravated its situation. Provinces faced serious fiscal deficits, in 1995 assisted by the Government and with World Bank financing, accelerated their adjustment processes. Provinces started privatizing provincial banks and the process of privatizing other public enterprises, many provinces transferred public pension funds to the reformed national system, and reduced redundant workers.

5. The economic crises affected disproportionately the poor. As a result of the severe crisis at the end of the past decade, those living in poverty doubled from 1980 to 1989, with raising unemployment levels and real wages eroded by hyperinflation. Poverty levels

declined in the early nineties as a consequence of macroeconomic stability and growth provided by the implementation of the Convertibility Plan, but were affected again by the 1995 regional crisis, when unemployment reached a high 18.4 percent.

**Recent Economic Performance**

6. During the period following the 1995 crisis, the Government again stabilized the economy. By 1997, average annual growth of GDP was 8.6 percent, average annual growth of GNP per capita increased from 3.7 in 1996 to 7.1 in 1997. However unemployment levels remained high at around 15 percent.

7. The effects of the Asian crisis increased risk associated with Argentina’s ability to access international financial markets to roll over its debt and finance the fiscal deficit. However, the Argentine economy continued to show resilience during the past year. In the first semester of 1998, growth averaged about 7 percent and unemployment had continued to decline slowly, reaching 13.2 percent in mid 1998, down from a high 18.4 percent in 1995. Nevertheless, economic activity was affected. Industrial output growth is near zero, export activity decreased as a consequence of weak international demand, and employment creation ceased. The financial system however, remained stable, despite difficulties to access international markets that affected most developing countries, including Argentina, despite its record of macroeconomic stability and deep structural reforms.

**Water and Sanitation Sector**

8. During 1980 Argentina started a process of restructuring of the water and sanitation sector, with the decentralization of the services provided by National Sanitary Works (Obras Sanitarias de la Nación, OSN) to the provinces. OSN remained as the service provider for Buenos Aires. Before the decentralization process began the quality of the service provided by OSN was deteriorating rapidly, due to lack of maintenance. Network coverage was reduced due to lack of investments in service expansion.

9. As reported by the Ministry of Economy and Public Works (1997), during the period between 1980 and 1990, the level of investment in the sector for the whole nation was reduced considerably, it dropped from approximately $ 400 million dollars in 1980 to US$ 100 million dollars in 1990. This reduction was a consequence of the fiscal deficits in the provinces that did not allow them to invest at the same levels as the national government was investing during the seventies. The growing fiscal deficit combined with the large inefficiencies of state utilities, affected its capacity to provide adequate and efficient public services.

---

10. In 1989, when Argentina was facing a severe economic crisis, the Government adopted the Convertibility Plan and started a period of transformation at the economic, political, administrative and social levels that affected both public and private sectors. Economic recovery was linked to the transformation of the structure of the public sector, reduction of public expenditure, increased investment in the infrastructure sectors, and creating the conditions for developing the private sector, which had strong repercussions on the water and sanitation sector, mostly under public operation.

11. With the laws of State Reform and Economic Emergency the structural change of the government was initiated, and the basis for private sector participation (PSP) in the provision of public services were created. Under the new model, efficiency and effectiveness were associated to PSP. National Sanitary Works, (OSN) the national agency responsible for the provision of water and sanitation services in Buenos Aires, and other provincial and municipal public utilities fall in to the category of agencies to be open to private operation.

12. During the early nineties the process of private sector participation in the water and sanitation sector began with a concession in the province of Corrientes in 1991. This thirty year concession included water and sanitation services in the provincial capital, Corrientes, and other nine major localities of the province. The Corrientes concession was followed by the concession of the services of OSN in Greater Buenos Aires Metropolitan Region to Aguas Argentinas in 1993, which had a catalytic effect in introducing the private sector in other provinces of the country, such as Tucumán and Santa Fé in 1995.

13. Currently, there are private operators in the Buenos Aires province, in the Federal Capital, in Corrientes, Formosa, Santa Fé, and Tucumán. Service provision in Córdoba, (provincial capital) was recently awarded for a concession, too. Additionally, there are ten contracts, for private participation in the sector, under preparation for different localities in the provinces of Buenos Aires, Catamarca, Entre Ríos, La Rioja, Mendoza, Misiones, and San Luis (Table 1, Annex 1). In terms of population, more than 60 percent of urban population, approximately 16 million, are currently served or in the process of been served by private providers, when these new private sector participation arrangements are finalized (Table 2, Annex 1 and Annex 3).

III. STATUS OF THE WATER SUPPLY AND SANITATION SECTOR

A. Water Supply

14. According to the World Bank, 1999100 the percentage of population with access to water in Argentina in 1995 was 64 percent, the lowest within a group of countries of equivalent income per capita—upper middle-income category—, the average for which was 79 percent, and was also below the Latin American coverage average of 73 percent.

According to information from the Permanent System of Information on Sanitation (SPIDES) developed by the National Agency of Water and Sanitation Works (ENOHSA),

---

Argentina has only marginally improved access to piped water and sanitation services in the period between 1991 and 1996. In 1996, 81 percent of urban population was connected to a water network, showing some marginal improvement with respect to census information from 1991 when water coverage in urban areas was only 77 percent.

16. ENOHSA estimates that 8.5 million people of total population of approximately 36 million, still do not have access to water services by a network connection. The estimated water coverage rate is 79.6 percent of total population in 1996. The following table shows recent evolution of access to piped water and sewerage services in urban and rural areas.

Table 1. Piped water and sanitation services - coverage levels

<table>
<thead>
<tr>
<th>Sector</th>
<th>1980</th>
<th>1991</th>
<th>1996(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>67 %</td>
<td>77 %</td>
<td>81 %</td>
</tr>
<tr>
<td>Sewerage</td>
<td>35 %</td>
<td>40 %</td>
<td>51 %</td>
</tr>
<tr>
<td>Rural Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>27 %</td>
<td></td>
<td>17 % (b)</td>
</tr>
<tr>
<td>Sewerage</td>
<td></td>
<td>2.6 %</td>
<td></td>
</tr>
</tbody>
</table>

(a) Estimated by SPIDES.

17. A closer look at the coverage levels, however, reveals large disparities. There is a large gap of coverage levels between urban and rural areas and between regions within the country. ENOHSA estimates that one third of the population in extreme poverty lives in rural areas (localities of 0 to 2,000 inhabitants), and is the population group with greatest vulnerability to sanitary risk. According to data from the 1991 census, total rural population was four million, rural coverage of piped water networks reached only 27 percent of the population. An additional 30 percent of rural population had access to water from wells; 1.8 million people in rural areas did not have access to safe water (Table 3, Annex 1).

18. There are large regional differences in the provision of piped water. In the north provinces, of Jujuy and la Rioja and in Chubut, about 95 percent of the urban population have access to piped water supply, while coverage rate is much lower in Misiones 68 percent, and below 50 percent in the province of Buenos Aires (Table 4, Annex 1). During the period between 1990 and 1992 the northwestern provinces in the limit with Bolivia received a strong investment in water services as a consequence of the cholera epidemic. Rural water supply coverage shows wide disparities between provinces, with coverage rates ranging from 92 percent in Buenos Aires to 13 percent in Formosa (Table 5, Annex 1).

19. Access to network services also varies considerably depending on the size of the city (Table 6, Annex 1). Coverage of the piped water system is greatest (90%) in cities of 100,000 to

---

1,000,000 inhabitants, and is lowest in cities with more than 1,000,000. Access to sewerage is also greatest in localities of 50,000 to 100,000 inhabitants and is lowest in small localities and rural areas.

20. The quality of water supply services varies across the country. In the central region, in the provinces of Santa Fé, La Pampa, South of Córdoba and North of Buenos Aires, there are problems related to the quantity and quality of the resource. Water availability is limited and there are problems with water quality due to high levels of arsenic and fluor in the aquifers. In Buenos Aires Metropolitan Area, where more than 60 percent of households in the outer ring use ground water for human consumption, aquifer contamination is increasingly a major problem, caused mainly by drain of septic tanks to the aquifers.102

<table>
<thead>
<tr>
<th>Box 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental Impacts of Inadequate Water Supply and Sewerage</strong></td>
</tr>
<tr>
<td><strong>The Case of Greater Buenos Aires Metropolitan Region</strong></td>
</tr>
</tbody>
</table>

Although Argentina has the highest GNP per capita in Latin America, coverage levels of water and sewerage are among the lowest. The urban population not connected to urban sewerage systems has increased by more than one million in the last decade. The lack of adequate sewage collection, treatment and disposal facilities has created a highly vulnerable environmental situation, particularly at the fringes of large urban areas, as it is contaminating ground water sources. Ground water contamination should be regarded as the most important pollution problem in Argentina mainly due to the health-risk exposure for the large share of households that depend on groundwater for its daily needs (28 percent in the country, but 65% in the outer ring of Greater Buenos Aires Metropolitan Region ), and the irreversibility of the contamination.

A 1988 study found excessive levels of nitrate contamination in about half of the ground water samples in Grand Buenos Aires (GBA), and evidence of bacterial contamination in about a third of samples. Similar groundwater nitrate contamination, as well as salinization, are reported in other cities of the Province of Buenos Aires and in other provinces. Mercury and chromium pollution, most likely from solid waste dumps, have also been documented in groundwater sources in the GBA area.

The main source of contamination is believed to be septic tanks used by households not connected to sewerage network (approximately 71 percent in GBA and 62 percent in the whole country). A second major source is industrial effluent, which is also frequently disposed of in leaching pits and septic tanks. In Buenos Aires, both residential and industrial septic tanks are designed to drain into the freatic Epipuelche aquifer (10-30m deep), which is the only one that can be reached through hand-pumps. Some contamination of the deeper Puelche aquifer (25-60m deep) occurs through inadequately insulated water wells.

As the main sources of contamination are septic tanks and, to a much lesser extent, industrial effluents, the most effective solution is to promote the extension of water and sanitation services to low-income neighborhoods and peripheral urban areas that are now unserved.

Source:

---

Further to low coverage levels and poor water quality, many public utilities in the sector face efficiency problems. Production levels are high, with a national average of 488 lpcd, and metering levels are low, with an average of 26 percent. In 10 provinces micro-metering levels are below 20 percent. The provinces of Chubut, Salta, Santa Cruz, Santiago del Estero and Catamarca have metering levels below 5 percent. Only La Pampa and Corrientes have metering levels of about 80 percent. In towns of over 10,000 inhabitants the relationship between water production per capita and micro-metering levels show that in provinces with high metering levels production per capita is lower, like in the case of La Pampa, with 81 percent of metering—the highest metering level in Argentina—and per capita production of 168 lpcd—the lowest production level in the country. High levels of water production, not only create efficiency problems from the water provision point of view, but also creates serious problems in terms of wastewater collection and treatment.

22. Given the existing low metering levels, most provincial and municipal tariff systems are not based on consumption levels but in property values and on social or economic distribution by zones with implicit cross-subsidization. When tariff systems are not based on volumetric consumption, the tariff does not provide clear signals to the consumers on the real value of water, creating inefficiencies in the allocation of the resources. There are perverse incentives to waste, which are reflected in the high levels of production per capita in most provinces of Argentina.

23. Historically, water utilities in Argentina have been run with high levels of subsidy from the federal and provincial governments, which has removed the need for enforcing collection from users, and has created a no payment culture. In general collection levels are low, averages in most provinces range from 60 to 80 percent, with the worst cases in La Rioja (31%) and Santiago del Estero (44%), currently under provincial or municipal service provision. The highest of levels of collection are found in provinces under private sector operation like Corrientes (89%) and Formosa (91%), or where service is provided by cooperatives associated with the provision of another service like electricity, as in the case of the southern provinces of Chubut (91%) and Santa Cruz (96%).

24. Efficiency problems are also a result of high costs, related to poor investment selection in the past, where public sector has financed over-dimensioned systems, and to high operation costs mainly caused by high labor costs. On average labor costs represent 50 percent of operation costs.\textsuperscript{103} The average number of staff is high at 5 staff/1,000 water connections. The lowest averages are found in the Federal Capital and the province of Buenos Aires, Córdoba and La Pampa with less than 4 staff/1,000 water connections. The provinces of Catamarca, Formosa and Corrientes, in the other hand, present the highest levels of staffing with provincial averages of 12.5, 11 and 10.3 staff/1,000 water connections, respectively.

B. Sanitation

25. Access to sewerage networks in urban areas increased from 40 percent in 1991 to 51 percent in 1996, according to ENOHSA and it is estimated that an additional 18 percent have individual solutions such as septic tanks, for a total urban access to sanitation services of 69 percent, whereas in rural areas access to sewerage network is negligible, total coverage is less than two percent. These figures indicate some progress in urban coverage, but they also reflect large disparities between urban and rural areas and between provinces.

26. Sewerage coverage in urban areas is much higher in the North provinces in the limits with Bolivia, Jujuy (85%) and Salta (73%), where high levels of investment by federal and provincial governments were a priority as a consequence of the cholera epidemic in early nineties percent (Table 2, Annex 1). Urban sewerage coverage at 51 percent is among the worse in Latin America, much lower than in countries with a lower income level such as Bolivia (63%), Colombia (72%), and Peru (80%). Coverage level is below 30 percent mainly in the northeast region, in the provinces of Chaco, San Juan, Formosa, Santiago del Estero and Misiones.

27. Ground water contamination was identified by the World Bank (1995), as the most important pollution problem in Argentina, the report also identified the Buenos Aires Metropolitan Region as the most critical area. As the main sources of ground water contamination were septic tanks and to a much lower extend industrial effluents, the most effective solution would be to promote access to the networks of water and sewerage to peri-urban and lower-income areas currently not served in the larger urban centers (see Box 1, above).

28. Waste Water Treatment. According to information from the previous World Bank strategy note and Environmental pollution report only a small part of the wastewater that gets collected is treated before final disposal, below 5 percent, and hence sewage is often discharged into the natural drainage system without any control. Federal regulations concerning water pollution apply only to Buenos Aires Metropolitan Region, with enforcement responsibilities under the Secretariat of natural Resources and Sustainable Development. The provinces of Buenos Aires, Mendoza, San Juan and Tucumán have issued effluent standards applicable to domestic and industrial sewage, but enforcement of such regulations at provincial level is still weak. Because sanitation coverage lags behind that of water supply, particularly in urban areas which are densely populated, this has resulted in a deterioration of environmental conditions but could also have a negative impact to public health. Mendoza, Tucumán and Neuquén provincial capitals have wastewater treatment plants: Mendoza one primary and one secondary treatment plants, Tucumán a primary treatment plant and Neuquén two secondary treatment facilities.

29. The main reason for low coverage and poor quality of the water and sanitation services is due to the historically low levels of investment and poor operation and maintenance. The backlog of investment needs is large, particularly for those related to collection and safe disposal of sewage and delayed preventive maintenance of water supply facilities. Current annual investments (1995 and 1996) of about US$300 million (including US$200 million in Buenos Aires) are still low. Per-capita investments in Buenos Aires and Corrientes of about US$22/year are below the targets set in the concession contracts in Argentina. Investment requirements to reach 90 percent coverage of piped-water supply and 70 percent of collection—not including any eventual treatment of sewerage—in urban centers has been conservatively estimated at US$5.3 billion. To achieve this target in 8-10 years, more than US$500 million a year of investments in constant terms would be required.

30. In the past, sector investments have been heavily subsidized, as the revenue generated by utilities has been insufficient to meet highly inefficient sector operations. Moreover, sector investments under public utilities are subject to strong political pressures which generally lead to inefficient—and frequently oversized—investment decisions. These problems of capital investments are compounded by the costs which are to be borne by the individual client associated with changing services provided through individual shallow wells and septic tanks to services provided through network facilities. These costs are typically out of reach of the poor consumers, and are resisted by more wealthy individuals who do not see the rationale for switching to the network. As Argentina progresses and eventually has to face the problem of sewerage treatment, this gap between investment needs and capital availability and willingness to pay will only increase.

C. Sector Organization

31. The legacy of the inefficient OSN (National Sanitation Agency) system, dismantled in the early eighties, left the sector in disarray. Ten years later, in the early nineties, the dismal quality of water and sanitation services in most of the country and the major overhaul of the public sector provided conditions to initiate the reform of the water utility sector. To that end, the concession of water and sanitation services in Buenos Aires had a catalytic effect and provided the overall direction to the reform of the sector. In parallel, the public sector assumed a new and challenging—but largely unknown—role as a regulator of public utilities. Under the new sector arrangement, the capacity of the federal and provincial governments to formulate sector policy is still embryonic. There is no institutional capacity in the government and professional organizations to provide the normative framework required by water and sanitation activities. Sector apex institutions are subject to frequent changes of direction, and the institutional priority assigned to water and sanitation is low, when compared with other utility sectors.

111 World Bank, 1999(a).
32. Since 1980 when National Sanitary Works Agency (OSN) was decentralized, sector policies and regulation have been usually dictated by the ministry of public works of each province and service provision became responsibility of either the province or the municipality. Historically, the water and sanitation sector in Argentina has been characterized by its weak management and lack of leadership, this condition has been reflected in its fragmented nature, the highly autonomous nature of the operating entities, and the poor institutional incentives for collective action across jurisdictions. The organization of the sector at the Federal level has suffered several changes in the past few years, two since June 1997.

Federal Government

33. Secretariat of Natural Resources and Sustainable Development. During the latest reorganization of the sector in January 1998, the Secretariat of Natural Resources and Sustainable Development received the clear mandate to consolidate all functions of the Federal Government related to the formulation of water sector policy, including public sector financing of water-related infrastructure. This consolidation included the functions of the Federal Government related to the water and sanitation sector, formerly under the Secretariat of Natural Resources and Sustainable Development and Services of the Ministry of Economy. This latest change has provided much needed clarity to the functioning of the Federal Government in the sector, since it eliminates ambiguity and overlap that existed in the previous institutional arrangement.

34. National Agency of Water and Sanitation Works, ENOHSA. ENOHSA is a decentralized entity reporting to the Secretary of Natural Resources and Sustainable Development. It is responsible for the administration of funds to promote sector reform at the provincial and municipal levels, within the national policy framework for the sector. It manages investment programs amounting to US$40 million per year with an operating cost of US$4 million, and with 70 staff (including 20 consultants and 50 civil servants affiliated to the union of water and sanitation workers).

35. Federal Council for Sanitation, COFESA. COFESA’s members are high level representatives of the provincial governments, providing the opportunity to the provinces to participate in the formulation of sector policies at the national level. Its functions include the coordination and development of programs to be executed by ENOHSA.

36. Ministry of Health and Social Action. Formulates water quality norms under the National Food Code. As with other norms formulated at the national level, these will only be applicable in the provinces that incorporate them into provincial legislation.


38. Provincial Governments. After the decentralization of the sector in 1980, the provincial governments are responsible for the provision of water and sanitation services, regulation and sector policy formulation for their own province. Policies are usually formulated by the Ministry of Public Works of each province. Many provinces have delegated the provision of services to the municipal governments. Overall, regulatory capacity in the provinces is very weak. Regulatory bodies are usually staffed by previous OSN employees, which usually are highly
bureaucratic and not always have the required qualifications to adequately perform their new role.

39. **Municipal Governments.** Are responsible for the provision and regulation of services in certain municipalities, when the provincial government has delegated to them these functions.

40. **Service Providers.** Argentina has both public and private service providers, at the municipal and provincial levels. Of the approximately 240 providers most of them (44%) are municipal providers, 21 percent provincial providers and 20 percent cooperatives, only 6 percent are private or under preparation to be open to the private sector (Table 1, Annex 1). However, the percentage of urban population served or in the process of been served by private providers is currently more than 60 percent and it is expected to increase considerably with the support from the Argentina Water Sector Reform Project, and when 10 localities finalize their private sector participation arrangements, currently under preparation (see Table 2, Annex 1 and Annex 3).

41. **Cooperatives** are private associations based on the principles of no discrimination in which each member represents one vote in the shareholders meeting. They are governed by Law 20,337 of 1973, which allows for new members to sign on with only 5 percent of the value of a share, and 5 years to pay for the rest. In general, cooperatives provide a better service than provincial and municipal utilities. Their technical staff tend to be well-trained and stable, but management is frequently changed following annual shareholders meetings, frequently controlled by local politics. Cooperatives have a long and important tradition in the provision of public services in Argentina (power, water and sanitation, telecom, banking, funerary services, etc.). In some provinces, cooperatives started to provide public services more than one hundred years ago, even before local and provincial governments existed (Chubut). Cooperatives are particularly strong in the provinces of Córdoba, Chubut, Misiones, Buenos Aires, La Pampa, and Santa Fé. Cooperatives provide water and sanitation services in 570 localities of which 330 are medium to small cities.

42. Overall utility performance has been commercially and operationally poor. The main reasons relates to the culture of no payment inherited since the OSN centralized period. Low collections rates, low metering levels, high unaccounted for water levels and overstaffing in most utilities provide an inadequate environment for cash flow generation, which finally translates into low levels of investment and services of low quality. Average revenue per connection in Buenos Aires is about US$150/year, for both water and sanitation services. It compares unfavorably with other utilities of the region (Sao Paulo, Rio, Lima), about US$300/year. Public utilities are plagued with aging and unmotivated personnel with a labor productivity index of 150

---

112 47% of Argentina’s total urban population is located in the province of Buenos Aires and the Federal Capital, most under private operation.

113 Distribution of cooperatives providing water and sanitation services, according to city size, is the following: one greater than 100,000 (Comodoro Rivadavia, Chubut); one between 50,000 and 100,000 (Trelew, Chubut); 10 between 20,000 and 50,000; 24 between 10,000 and 20,000; 61 between 5,000 and 10,000; and 232 between 2,000 and 5,000. For a total population service by cooperatives of about 2.5 million. Sistema SPIDES, Subsecretaría de Recursos Hídricos, Mayo, 1997.
connections per employee, or lower\textsuperscript{114}. Unaccounted for water is unknown since the majority of connections are not metered, but presumably is higher than 40 percent, given the fact that per-capita water production and treatment capacity in most cities exceeds 400 liters per person/day. Because of all of these factors, water utilities in Argentina are not able to generate the cash needed to support a substantive investment program, nor are they able to attract reasonable levels of equity and/or debt financing that match their investment needs.

IV. Key Issues in the Sector\textsuperscript{115}

43. \textit{Low coverage and poor quality of water and sanitation services}. Argentina has the lowest share of population with access to safe water and sewage collection, within its income category, and its coverage level is below the average level of Latin American countries. According to the 1991 census, about 72 percent of the urban population was connected to a water network, and only 38 percent was connected to a sewerage network. By 1996, coverage indicators in urban centers improved to 81 percent for water and 51 percent for sewage collection. The World Bank estimates that only 17 percent of the five million rural inhabitants have access to safe water.\textsuperscript{116} Water rationing in summer months is a frequent occurrence in practically all major cities. Quality of drinking water is sub-standard for most systems supported by shallow aquifers. Existing sewage collection systems are insufficient to handle increasing flows as more households move from on-site disposal to conventional network system. This situation is being exacerbated by irrational consumption patterns and wastage of the vast majority of water supply systems in Argentina compounded by the lack of adequate tariffs based on metered consumption. The Buenos Aires concessionaire is facing major overflow problems in one of the four main sewage interceptors of the city because of these reasons. Moreover, sewerage collection, let alone any degree of treatment even in major urban centers, is at unacceptably low levels for a country of Argentina’s income level.

44. \textit{Low investments}. Current annual investments (1995 and 1996) of about US$300 million (including US$200 million in Buenos Aires) are still low. Per-capita investments in Buenos Aires and Corrientes of about US$22/year are below the targets set in the concession contracts in Argentina. Investment requirements to reach 90 percent coverage of piped-water supply and 70 percent of collection—not including any eventual treatment of sewerage—in urban centers has been conservatively estimated at US$5.3 billion.\textsuperscript{117} To achieve this target in 8-10 years, more than US$500 million a year of investments in constant terms would be required. As Argentina progresses and eventually has to face the problem of sewerage treatment, this gap between investment needs and capital availability and willingness to pay will only increase.

45. \textit{Inadequate revenues, internal cash generation, and efficiency}. Average revenue per connection in Buenos Aires is low at about US$150/year, for both water and sanitation services. As discussed above, the problem is exacerbated by the prevailing culture of no-payment for water and sanitation services: even if tariff levels in aggregate are adequate (albeit not efficient

\textsuperscript{114} In the largest utilities of Colombia and Perú, the labor productivity index oscillates between 400-500 per employee. In Brazil, for the contrary this index ranges 100-200, at best.

\textsuperscript{115} World Bank, 1999 (a).

\textsuperscript{116} World Bank, 1999 (a)

nor progressive), low collection rates and high water losses mitigate against achieving a reasonable level of cash flow. Sector operations are also highly inefficient. Public utilities are plagued with aging and unmotivated personnel with a labor productivity index of 150 connections per employee, or lower.\textsuperscript{118} Unaccounted for water is unknown since the majority of connections are not metered, but presumably is higher than 40 percent, given the fact that per-capita water production and treatment capacity in most cities exceeds 400 liters per person/day.

46. **Weak institutional framework.** Since the early nineties, when the process of private sector participation began in the provision of services, the public sector assumed a new and challenging—but largely unknown—role as a regulator of public utilities. Under the new sector arrangement, the capacity of the federal and provincial governments to formulate sector policy is still embryonic. There is no institutional capacity in the government and professional organizations to provide the normative framework required by water and sanitation activities. Sector apex institutions, are subject to frequent changes of direction, and the institutional priority assigned to water and sanitation is low, when compared with other utility sectors.

**Reform Issues**

47. The following issues represent the main topics of the pending agenda for sector reform. Most of them are post-privatization issues that are being addressed by the new Water Sector Reform Project.

48. **Lack of transparency in privatization processes.** Some of the earlier privatization attempts in the sector faced difficulties because of the lack of transparency in the privatization processes. Complex and subjective bid award criteria, changes in selection criteria midway through the bidding process, and ill-defined award criteria contributed to long delays in PSP processes in the provinces of Córdoba and Mendoza, and it is one of the defining factors in the failed concession in Tucumán.

49. **Weak and expensive regulatory institutions.** The existing regulatory agencies are, in general, weak, overstaffed with former public utility employees, and without clear regulatory processes for dispute resolution. In many cases, like in the province of Tucumán, the regulatory body is not independent and is captured by the government. They charge regulatory fees ranging from 1 percent to 7 percent of tariff revenue, compared with 0.14 percent for the UK’s OFWAT. In addition, in most provinces there is the tendency to replicate the federal model by creating costly single-sector regulatory institutions.\textsuperscript{119}

50. **Inefficient tariff regimes.** The prevailing tariff regimes are rigid, do not encourage efficiency, nor address equity issues effectively. The tariff regime for the Buenos Aires Concession is undergoing a major review to correct this issue. **We will expand in the case of Buenos Aires.**

\textsuperscript{118} In the largest utilities of Colombia and Perú, the labor productivity index oscillates between 400-500 per employee. In Brazil, for the contrary this index ranges 100-200, at best.

51. **Lack of dispute resolution mechanisms.** We will expand in the case of Tucumán.

52. **Poor choice of Award Criteria.** When the privatization of the metropolitan water service of Buenos Aries took place in 1993, it was done on the basis of the greatest reduction being proposed to the government in average water tariffs, in lieu of any payment or cannon to the government for the concession rights. At the time, this was heralded as an extremely innovative and highly progressive way to award a concession, putting the interests of the consumer ahead of the fiscal goals of the government. However, in actual practice, this method was shown a major flaw in that it has not been able to be sustained over time. Because the company’s cash generation capacity did not turn out to be as expected, the concessionaire was forced to seek tariff increases—albeit remaining below the original, pre-privatization level—to finance the investment program. This has severely eroded the public support and confidence for water privatizations as the promised benefits have not be realized. More recent water concessions and those being promoted under the proposed program revert to a more traditional approach, awarding the concessions on that basis of the highest cannon, while respecting the required operational and investment targets.

53. **Lack of clear strategy and feasible models to expand services to the urban poor in the context of PSP.** Most existing private water concession contracts establish service coverage increase as contractual targets. However, few of them explicitly require service extension to the poor areas. As a result, private concessionaires tended to leave out the poor areas. Furthermore, those private concessionaires which attempted to extend services to the poor urban areas have faced difficulties because of (i) the high personal costs which were to be borne by the new consumers for the connections and internal house remodeling needed; and (ii) the lack of any sort of financial support for these new connections. Nor was there any effort by the concessionaires to reach out to the communities to understand what they could afford to pay, test out new alternatives which might lower the costs, or seek joint agreements on how the communities, who had not paid in the past, could pay, or use and maintain the systems in the future. Past experience in Argentina shows that—depending on the design of the concession contract—the poor not necessarily have to benefit from PSP (See Box 1 below).

### Box 2

**Private Sector Participation in the Water Utility Sector: Winners and Losers**

Introducing competition in the water and sanitation sector through PSP is expected to increase efficiency, and thereby adding to the utilities’ financial resources to invest in poor neighborhoods. The general perception is that the poor are the main beneficiaries of PSP. Yet, a distributive analysis on some proposed concession contracts in Argentina found that in fact the poor can become the main losers from PSP depending on how these contracts are structured.

These studies revealed that (i) initial tariff reductions tend to benefit the rich customers; (ii) concession contracts awarded on the bases of license fees (or cannon payments) can make the government the largest winner at the expense of the customers, notably the poor; and (iii) any benefits to the poor because of environmental benefits and access to improved services can be offset by the large costs of secondary network and connection costs to be borne by the poor.

These findings highlight the following policy lessons in designing PSP contracts. In preparing PSP contracts, the government should:
(i) Identify the poor and the subsidy level required to service the poor as part of the preparatory activities for PSP;

(ii) **Develop a clear strategy to address poverty issues and incorporate them in the PSP contract design or in the regulatory framework**;

(iii) Pay special attention to the capital cost subsidy, if new customers are expected to pay for secondary and network expansion costs as the majority of the new customers will be poor;

(iv) Set explicit targets for service expansion to the poor (if not, the poor will be the last to be served);

(v) Include transparent mechanisms to provide subsidies to the poor.

Source:

54. **Limited participation of risk capital by private investors in water and sanitation utilities.** Since the award of the first water and sanitation concession in 1991, the private sector has shown limited interest in mobilizing financial resources to the sector. Investments in water and sanitation projects are frequently lumpy with long amortization periods, when compared to investments in telecommunications, gas and power. Even the best case for water privatization—the metropolitan area of Buenos Aires, with some 7 million consumers—has not been able to attract sufficiently long term financing from private sources and is depending on financing from IFC and the IDB. Smaller concessions, with a much lower revenue base, are clearly going to be less attractive to private sources. Thus, concessionaires largely rely on their internal cash generation, which is weak, to finance investments resulting in unacceptably long periods before targets for services levels are to be reached.

55. **Lack of well-defined contracts and regulatory frameworks for existing cooperatives.** More than 300 water systems are managed by cooperatives. These cooperatives are private concessions awarded by the municipalities, but often do not operate under a well-defined contract or a regulatory framework, and are often subject to political interference.

56. **Lack of a comprehensive framework for sector development.** A comprehensive framework for water and sanitation sector development should be developed. We will expand on this topic.

Cross-sector issues

57. **Fragmented water resources management system.** Urban water and sanitation services form part of a large, complex system of water resource management in Argentina, as elsewhere. In the case of Argentina, river basin management across political boundaries is constrained by the current legal framework since water resources belong to the provinces in their respective jurisdictions. Inter-provincial conflicts related to the use of shared resources are increasingly frequent, particularly in the provinces of Mendoza, La Pampa, Chaco and Santa Fé.

58. **Complex framework of environmental institutions and regulations affecting the sector.** Environmental management in Argentina is to a large extent a provincial responsibility. However, under certain circumstances, the national government can assume authority for specific environmental issues. Normally, the Federal Government enacts laws, and invites provinces to adhere. The province is free to adopt the law in total or in part, and determines how
the law is going to be enforced. The complexity of the system makes policy formulation and enforcement of environmental regulations practically impossible to coordinate.

59. **Lack of a policy framework to address poverty issues.** Argentina does not have an integrated and coherent strategy to provide basic urban services to the poor. Each sector is dealt with separately, with notable advances in the area of education to upgrade public facilities for poor neighborhoods. However, investment in municipal level infrastructure—roads, sidewalks, street lighting, garbage pick-up and disposal—are left in the hands of local municipalities most of which do not have the financial or institutional capacity to handle the upgrading needed in these services. Water and sanitation is in the hands of provincial utilities without any explicit poverty goals and housing is largely financed through federal transfers to provinces for essentially lower-middle income groups (who have formal employment). On the other hand, there are numerous programs funded by different development financing agencies (UNICEF, etc.) which extend water and sanitation services to the poor, but no formal coordination mechanisms exist. Many of these programs take a paternalistic approach, where water (often low quality) is provided for free to the poor. There is no common policy framework for cost recovery, and, as noted earlier, the issue of poverty is frequently neglected in PSP arrangements.

V. **Medium-Term Vision for the Sector**

60. In the medium-term, a majority of water utilities—serving seventy percent of the country’s population—have been opened to for-the-market competition and subject to comparative regulation through concessions, leases and management contracts. In relation to cooperatives, the government would promote adjustments to their corporate structure and regulatory arrangements to introduce competitive pressures on the utility. A few relatively well-run publicly managed utilities will remain subject to the same regulatory arrangements as those for privately managed utilities. The medium-term vision for sector organization can be summarized as follows:

- Long-term concessions in cities greater than 50,000, about 46 urban centers with a total population of about 22 million (including 9.1 million in Buenos Aires).
- Management or lease arrangements for cities between 10,000 and 50,000, about 100 small cities and towns with a total population of about 3.5 million.
- Cooperatives in cities with long tradition of such organizations in charge of public utility services to about 2.5 million.
- Public sector managed utilities in a few relatively well-run provinces and municipalities with a population of about 1.5 million.
- Operational contracts with the private sector for small and medium-size towns with a population between 2,000 and 10,000, about 350 towns, with a total population of 2 million.
- Rural population, dispersed and concentrated (about 4.5 million) will rely on cooperatives and users’ associations (neighborhood groups) with a back-stop technical assistance provided by private firms financed by local and provincial governments.
61. Water agencies are efficient, financially self-sufficient, and politically autonomous. The agencies operate under regulatory frameworks which promote efficiency, ensure quality of service and protect consumers. Tariffs, based on consumption levels, cover costs, promote efficiency and address the social equity issues, water pollution control and other externalities. Regulations are enforced by politically and financially independent regulatory agencies, staffed with competent regulators, capable of making decisions on sound economic and technical criteria in a timely basis. The SPIDES or other credible sector information system has been developed to allow yardstick comparisons for regulatory decision making, and to effectively inform consumers. Consumers will participate in the regulatory exercise through a transparent consultation process. With stable regulatory framework and efficient management, water companies are able to obtain financing from domestic and international capital markets. The governments’ budget transfers to the sector are limited to select poverty and environmental investments (sewage treatment in particular).

62. As water companies improve their financial performance and a clear subsidy and tariff policy are implemented, basic sanitation services are extended also to the urban poor. Water companies use a combination of appropriate low-cost technologies and community participation to ensure the provision of sustainable services. In general, operation and maintenance costs are fully recovered through tariffs from low income customers. Where investment subsidies are needed, a clear and transparent subsidy policy is implemented.

Box 3

<table>
<thead>
<tr>
<th>Water Utility Sector Benchmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Efficiency</strong></td>
</tr>
<tr>
<td>Staff/1,000 connections</td>
</tr>
<tr>
<td>Labor/operating costs (%)</td>
</tr>
<tr>
<td>Unaccounted-for-water (%)</td>
</tr>
<tr>
<td>Metering (%)</td>
</tr>
</tbody>
</table>

| Coverage                      | **Base-line** | **2010** |
| Water distribution (%)        | 81 $^2$       | >90 |
| Sewage collection (%)         | 57 $^2$       | >80 |
| Sewerage treatment (%)        | nil           | >50 |

$^1$ Base-line was taken from best-practice provincial indicators, as reported by ENOHSA, in SPIDES Report, 1998.

$^2$ National average estimated by ENOHSA.

VI. Proposed Government Strategy$^{120}$

63. The government’s strategy recognizes that it has an extremely long road ahead of it to be able to provide the level and quality of water and sanitation services, especially for the poor, that

the country needs. This strategy balances the goals of universal service, with due regard to equity, affordability, and fiscal responsibility. This calls for putting in place the right incentives for conservation, caring for the environment, and attracting private risk capital.

64. The first part of the strategy is to promote private operation and management as the key step to bring efficiency to the sector. The proposed program, along with what has been done to date, are clear reflections of that strategy. To achieve efficiency and investment goals in the sector the governments would intend to maximize competitive forces. In the medium-term, it is expected that a majority of water utilities—serving seventy percent of the country’s population—had been opened to for-the-market competition and subject to comparative regulation through concessions, leases and management contracts. Long-term concessions would be in place in cities greater than 50,000, about 46 urban centers with a total population of about 22 million (including 9.1 million in Buenos Aires) and management or lease arrangements for cities between 10,000 and 50,000, about 100 small cities and towns with a total population of about 3.5 million. Operational contracts with the private sector would be in place for small and medium-size towns with a population between 2,000 and 10,000, about 350 towns, with a total population of 2 million. In relation to cooperatives, the government would promote adjustments to their corporate structure and regulatory arrangements to introduce competitive pressures on the utility. Cooperatives would be providing services to about 2.5 million, in cities with long tradition of being served by cooperatives. A few relatively well-run publicly managed utilities will remain subject to the same regulatory arrangements as those for privately managed utilities, serving a population of about 1.5 million. Rural population, about 4.5 million, dispersed and concentrated, will rely on cooperatives and users’ associations with a back-stop technical assistance provided by private firms financed by local and provincial governments.

65. The second part of the strategy is oriented to modify the existing and highly inefficient pricing system for water and sanitation services in order to get the signals right, especially to attract future private risk capital. The Government would be guided by the following principles: universal metering, two-part tariff with adequate consideration to the allocation of capacity costs and demand differentiation, automatic adjustments to account for inflation, and periodic multiyear reviews to address revenue-adequacy requirements to meet expansion costs and changes in environmental regulation. The Government would also aim at: (i) developing a transparent cross-subsidy system—with minimum price distortions—to target clearly defined poverty and environmental objectives; and (ii) promoting provincial regulatory entities—preferably multi-sector—following consistent principles dictated by a federal law.

66. At the same time, the government would intend to incorporate explicitly the needs of the poor in the new concessions and tariff regimes. This will be done, on the short run, by adopting a social tariff, which caps water and sewerage tariffs for the poor at 5 percent of estimated family income. For typical poor families in Argentina, with monthly incomes of about $ 120-150, this means water and sanitation bills of about $ 7.50 per month. It will also ensure that there are means (mainly through surcharges) to cover the costs of connections and possibly to offset the costs of internal house renovations. On the longer term, the government hopes to evolve a more coherent approach to basic urban services for the poor. The part of this strategy is being addressed as part of a poverty assessment presently being conducted by the Bank.

67. The government would also develop a strategy to deal with the need of improvement and expansion of wastewater collection and treatment. Given the negative impact that low levels of
wastewater collection and treatment is having in regions that depend in groundwater sources for human consumption, like in Greater Buenos Aires Metropolitan Region, and in other major industrial centers, these should be considered as high priorities in the sanitation sector.

68. The final part of the government’s strategy would be to work gradually on the issues of water resource management, starting with analytical work supported by the Bank. These issues should be integrated progressively into the agenda for water shed management, irrigation and environmental developments in the sector.

VII. Bank Assistance Strategy

69. The Bank assistance strategy for Argentina supports the proposed strategy of the government, and would focus specially in the areas of regulation, utility reform, provision of services to the poor, wastewater collection and treatment and provision water and sanitation services in rural areas.

70. **Regulation and institutional reform** The objectives for the Bank are to provide assistance for the development of comprehensive regulatory frameworks for the sector that promote efficiency, ensure high quality of services and protect the consumers; and to establish financially and politically independent, and economically sound regulatory agencies. The Bank will promote provincial level multiple-sector agencies to ensure efficiency and economies of scale, where possible; or regulation by contract if the first option is not feasible.

71. The SPIDES information system, managed by ENOHSA, at the federal level, should be strengthened to serve as a credible information system that would permit the introduction of yardstick comparisons for regulatory decision making, to promote transparency and to effectively inform consumers.

72. The government would continue to promote private operation and management as the key step in restoring efficiency in the sector. To achieve efficiency and investment goals in the sector federal and provincial governments would intend to maximize competitive forces. In the medium-term, it is expected that a majority of water utilities had been opened to for-the-market competition, and subject to comparative regulation, through concessions, leases and management contracts. To promote efficiency, even cooperatives and other remaining well-run public utilities will also be subject to the regulation and yardstick comparisons.

73. **Urban areas.** At the utility level the Bank would promote aggressive actions towards demand management: Production levels at a national average of 488 l/h/d are too high, campaigns to reduce consumption, should be combined with and motivated by the adoption of: universal metering, increased tariff levels and adoption of a new price structure based on two-part tariff with adequate consideration to the allocation of capacity costs and demand differentiation, automatic adjustments to account for inflation, in the case of an inflationary process strikes the economy, and periodic multiyear reviews to address revenue-adequacy requirements to meet expansion costs and changes in environmental regulation. To ensure adequate service to the poor the Government would develop a transparent cross-subsidy system—with minimum price distortions—to target clearly defined poverty and environmental objectives. To ensure financial sustainability of utilities increased billing and collection rates would also be a priority.
74. Any physical investments for urban areas should be target specifically to: (i) the improvement and expansion of wastewater collection and treatment, given the negative impact that low levels of wastewater collection and treatment is having in regions that depend in groundwater sources for human consumption, these should be considered as high priorities in the sanitation sector; and (ii) to the improvement of water and sanitation services to the poor.

75. Service to the poor and rural areas. Given the low water and wastewater service coverage levels in rural areas throughout the country, regions with higher share of unserved rural population should be prioritized, and service strategy for rural areas should be based on the same principles as service provision to the poor, through community participation, use of appropriate technology (often low-cost) and transparent subsidies mechanisms. Service to rural areas will rely on cooperatives and users’ associations with a back-stop technical assistance provided by private firms financed by local and provincial governments.

---

**Box 4**

**Argentina Water Sector Reform Project**

**Policy Objectives and Recommendations for Serving the Urban Poor**

The Water Sector Reform Project intends to address social and poverty issues through the following strategies. First, by improving the capacity of the Federal Government to formulate sector policy, including the detailed design of a subsidy system to improve/expand water and sanitation to the poor; and by keeping a backstopping capacity to assist provinces and municipalities to resolve conflicts emerging from the reform process. Second, by training regulators and policy makers to address issues related to universal service and subsidy policy. Third, by formulating specific targets in existing PSP arrangements to extend services to the poor within affordable levels. Fourth, by supporting development of credible models to service poor neighborhoods within private concessions. The fourth strategy is supported through the poverty pilot program to be implemented together with private concessionaires. The pilot will develop a model where private concessionaires can extend water and sanitation services to the poor in a more effective and sustainable way, with strong community participation and using low-cost appropriate technologies.

The preparation of the project has been quite instrumental in assisting the Government to clarify the issues related to the expansion of water and sanitation services in poor areas within private concessions. As a consequence, specific policy prescriptions have been adopted and reflected in the standard concession documents. They include: (i) replacement of the infrastructure charge with a fixed fee charged to all existing customers; (ii) establishment of a social tariff for water and sanitation services which should not exceed five percent of the monthly family income for NBI dwellers; and (iii) adoption of the license fee criteria (canon) to award concessions and make provisions to use the proceeds of the canon to directly subsidize the poor. In addition, as part of the preparation of new water concessions, specific targets for service expansion in poor areas have been established.

**Service to the poor: guidelines for new concessions**

- Identify the number of poor families (monthly family income below two minimum salaries or an equivalent NBI indicator).

- These families should be charged a fixed tariff of no more than three percent of monthly income for water and five percent for water and sewerage combined. This fixed tariff allows for approximately 10/15 M3 of water per month, controlled by a volumetric device when economically viable to the operator.
• Connection fees should be about US$100 (about US$50 for each service) which is financed by the utility in one year at no interest.

Source:

Portfolio management

76. The Bank portfolio in the water and sanitation sector now consists of one loan totaling US$64 million, closing December 1999. One new adaptable lending program for a total of US$70 Million in two tranches over the next four years is expected to be approved by the Board in June 1999. This new Water Sector Reform Project would provide support to the sector strategy proposed in this document by financing investment subprojects and technical assistance designed to support the ongoing reform of the water utility sector in Argentina.

77. The ongoing project is performing satisfactorily, and has provided support to sector reform. In fact, its overall project objectives are to: (a) promote greater sector efficiency and financial viability; (b) expand service coverage; (c) improve the quality of the water supply and sewerage services while protecting the environment; and (d) encourage private sector participation in the water and sanitation sector. This project, which was approved in December 1990, is expected to be closed by December 31, 1999.

78. Other Bank financed related projects are the Flood Protection Project, and the El Niño Project. And sector work. (We will expand on sector work).

Coordination with IDB and IFC

79. IDB program for Argentina can be grouped into two categories: Investment projects and Technical cooperation grants. Under the investment projects category there are three projects: The first one is a rural water supply and sanitation project, Rural Water and Sanitation 6th Phase, which is expected to be satisfactorily closed during 1999. The second is the Matanza – Riachuelo project, effective since 1997, for flood and pollution control in the Basins of the rivers Matanza and Riachuelo, in the Greater Buenos Aires Metropolitan Region. The third is the Support to the Reform of the Water and Sanitation Sector Program, which was recently approved by the IDB Board and the loan will be signed by mid 1999. This IDB loan will be for a total of US$250 M but the total amount of the program is US$570 M, which includes counterpart funds and private sector financial resources. The Program will provide resources through three windows: (a) a private bank that will operate as a trustee and would lend resources to large and mid-size financially sustainable utilities, this window will be open for qualifying private concessions, cooperatives and public credit worthy utilities nation wide; (b) the second window through the public Banco de la Nación, would lend to small and mid-size utilities financially sustainable for investments and reform of up to US$7.5 M; and (c) a third window through ENOHSA, for utility modernization and reform.

80. The second group, Technical Cooperation grants, financed by the Multilateral Investment Fund of the IDB (FOMIN) includes: Strengthening to Provincial Regulatory Entities and Support to the Process of Private Participation in the Water and Sanitation Sector, for a total of US$13 M— a grant for US$9 M and counterpart funds for US$4 M. Its objectives are to: provide resources for the creation, strengthening and or training for provincial regulatory agencies for
economic regulation, community participation and consumer relations, and mechanisms for conflict resolution; and to facilitate private sector participation in the sector,—e.g. by providing funds for the preparation of bidding documents—for any other provinces that would like to apply, except for Mendoza, Santa Fé and the province of Buenos Aires. There are three additional specific Technical Cooperations for Regulation, for those three provinces, the one for Mendoza will be finalized during 1999, and the ones for Santa Fé and Buenos Aires should become effective soon. Additionally, the Private Sector window of the IDB, made a loan to the concessionaire of Santa Fé, Aguas de Santa Fé and is preparing a loan to the concessionaire of Buenos Aires, Aguas Argentinas.

81. The IFC has made two investments in Aguas Argentinas (approved in 1994 and 1995). Investment for IFC’s own account includes equity of US$7 million and loans of US$ 78 million; a further US$ 307.5 million has been provided in the from of a B loan syndicated with commercial banks. IFC is currently discussing possible investment in 3 other Argentine provinces but have not yet entered into mandates.

ANNEX 1: KEY SECTOR INFORMATION

TABLE 1. NUMBER OF OPERATORS BY TYPE AND PROVINCE

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Capital</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Buenos Aires</td>
<td>1</td>
<td>6</td>
<td>33</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catamarca</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Córdoba (a)</td>
<td>9</td>
<td>20</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrientes</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaco</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chubut</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entre Ríos</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formosa</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jujuy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>La Pampa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>La Ríoja</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Mendoza</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misiones</td>
<td>8</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Neuquén</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Río Negro</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salta</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Juan</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Luis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santa Cruz</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santa Fé</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sgo. del Estero</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Tucumán</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong> (%)</td>
<td>8</td>
<td>4</td>
<td>105</td>
<td>51</td>
<td>7</td>
<td>1</td>
<td>10</td>
<td></td>
<td></td>
<td>241</td>
</tr>
</tbody>
</table>

(a) Does not include recent concession of Córdoba (provincial capital).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuyo</td>
<td>35</td>
<td>392</td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td>1,524</td>
<td>2,031</td>
<td></td>
<td>2,031</td>
<td>8</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>9,428</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9,428</td>
<td>39</td>
</tr>
<tr>
<td>Northeast</td>
<td>20</td>
<td>766</td>
<td>254</td>
<td>17</td>
<td>552</td>
<td></td>
<td></td>
<td>226</td>
<td></td>
<td>1,834</td>
<td>8</td>
</tr>
<tr>
<td>Northwest</td>
<td>9</td>
<td>680</td>
<td>24</td>
<td>69</td>
<td>1,035</td>
<td>406</td>
<td></td>
<td>297</td>
<td></td>
<td>2,520</td>
<td>10</td>
</tr>
<tr>
<td>Pampa</td>
<td>1,764</td>
<td>490</td>
<td>3,707</td>
<td>418</td>
<td>554</td>
<td>302</td>
<td></td>
<td>7,234</td>
<td></td>
<td>7,234</td>
<td>30</td>
</tr>
<tr>
<td>Patagonia</td>
<td>132</td>
<td>220</td>
<td>170</td>
<td>573</td>
<td>140</td>
<td>1,235</td>
<td></td>
<td>1,235</td>
<td></td>
<td>1,235</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>167</td>
<td>421</td>
<td>12,638</td>
<td>987</td>
<td>4,043</td>
<td>2,577</td>
<td>406</td>
<td>554</td>
<td></td>
<td>2,489</td>
<td>24</td>
</tr>
<tr>
<td>(%)</td>
<td>1</td>
<td>2</td>
<td>52</td>
<td>4</td>
<td>17</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td></td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>


Table 3: Rural Population Without Access to Safe Water and Sanitation by Population Range

<table>
<thead>
<tr>
<th>Population Range</th>
<th>Disperse</th>
<th>&lt;500 inhabitants</th>
<th>500 – 2,000 inhabitants</th>
<th>Total Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural population without access to Safe Water</td>
<td>53.6 %</td>
<td>23.6 %</td>
<td>11.6 %</td>
<td>43.0 %</td>
</tr>
<tr>
<td>Rural population without access to Sewerage</td>
<td>99.5 %</td>
<td>98.1 %</td>
<td>94.5 %</td>
<td>98.4 %</td>
</tr>
</tbody>
</table>


Table 4. Water and Sewerage Coverage by Province

<table>
<thead>
<tr>
<th>Province</th>
<th>Less than 30%</th>
<th>30-40%</th>
<th>40-50%</th>
<th>50-60%</th>
<th>60-70%</th>
<th>70-80%</th>
<th>80-90%</th>
<th>More than 90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chubut</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Jujuy</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>La Rioja</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Santa Cruz</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>San Luis</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Río Negro</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Salta</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Mendoza</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Corrientes</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>San Juan</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Neuquén</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Entre Ríos</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Tucumán</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Sgo. Del Estero</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Córdoba</td>
<td>Sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td>Province</td>
<td>Without access to safe water (%)</td>
<td>Without access to sewerage (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------</td>
<td>--------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buenos Aires</td>
<td>8.3</td>
<td>99.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catamarca</td>
<td>34.1</td>
<td>97.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaco</td>
<td>81.8</td>
<td>99.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chubut</td>
<td>38.9</td>
<td>94.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Córdoba</td>
<td>38.8</td>
<td>99.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrientes</td>
<td>63.5</td>
<td>99.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entre Ríos</td>
<td>22.1</td>
<td>90.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formosa</td>
<td>86.9</td>
<td>99.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jujuy</td>
<td>54.0</td>
<td>94.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>La Pampa</td>
<td>16.8</td>
<td>99.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>La Rioja</td>
<td>37.6</td>
<td>99.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mendoza</td>
<td>44.9</td>
<td>98.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misiones</td>
<td>86.1</td>
<td>99.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuquén</td>
<td>49.0</td>
<td>90.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Río Negro</td>
<td>26.0</td>
<td>98.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salta</td>
<td>55.8</td>
<td>97.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Juan</td>
<td>52.6</td>
<td>97.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Luis</td>
<td>45.9</td>
<td>98.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santa Cruz</td>
<td>27.4</td>
<td>72.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santa Fé</td>
<td>13.3</td>
<td>99.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santiago del Estero</td>
<td>74.0</td>
<td>99.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tierra del Fuego</td>
<td>43.7</td>
<td>76.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tucumán</td>
<td>30.2</td>
<td>99.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43.0</strong></td>
<td><strong>98.4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) Buenos Aires is served by Aguas Argentinas (49%), Administration of Sanitary Works of Buenos Aires, AGOSBA (24%), cooperatives and municipalities (16%) and others (11%). However AGOSBA’s data was not available and is not included.

Table 6: Service Coverage by Locality Size

<table>
<thead>
<tr>
<th>Population in 1995</th>
<th>0 to 10.000</th>
<th>10.000 to 50.000</th>
<th>50.000 to 100.000</th>
<th>100.000 to 1.000.000</th>
<th>More than 1.000.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water coverage</td>
<td>89.3 %</td>
<td>85.1 %</td>
<td>85.3 %</td>
<td>90.2 %</td>
<td>79.5 %</td>
</tr>
<tr>
<td>Sewerage Coverage</td>
<td>15.0 %</td>
<td>47.3 %</td>
<td>62.2 %</td>
<td>50.1 %</td>
<td>57.0 %</td>
</tr>
</tbody>
</table>


The net benefit from private sector participation (PSP) in Argentina’s water and sanitation sector has been generally positive with notable increase in quality of service and investment levels. Nonetheless, numerous lessons were learned from the past PSP experiences in the sector. The sustainability of these concessions is under significant stress, unless actions are taken to correct the problems. A major re-negotiation of contract was needed for the Buenos Aires concession, and the concession contract in the province of Tucumán was finally rescinded after several efforts to renegotiate the contract had failed. Other concessions are also facing varying degrees of problems. Through an ongoing loan and as a part of the preparation of the new Project, the Bank has been supporting the Government’s effort to bring these troubled concessions back on track.

For the new group of PSP contracts to be supported by the Water Sector Reform Project, the lessons learned from the past PSP experiences in the water and sanitation sector will be fully taken into account. The main problems can be grouped into several issues:

(i) lack of transparency in PSP/competition process;
(ii) lack of clarity in regulatory framework and PSP contracts;
(iii) weak and expensive regulatory institutions;
(iv) inefficient tariff regime;
(v) lack of clear strategy and feasible models to expand services to urban poor within the context of PSP; and
(vi) unclear environmental responsibilities.

For each one of these issues, a set of guidelines and a corresponding checklist were prepared during project preparation. Furthermore, a set of standard documents (of regulatory framework, tariff regime, bidding document, draft concession contract, etc.) was also prepared to simplify the process. These guidelines, checklists, and standard documents were made available to participating local governments, and to consultants hired by them. Box 1 below describes how the guidelines and the checklists are used vis-à-vis project processing and PSP process.

Summary of Guidelines

(i) **PSP/competition Process**

- Two stage bidding process is preferable. Pre-qualification, then technical and financial envelopes presented at the same time.
- Pre-qualification criteria (technical and financial) should be clear and objective.
- Technical evaluation criteria should be “pass or fail”.
- Bids should be awarded based on economic criteria (canon or tariff discount).
- Potential bidders should be given opportunities to comment on the bid document.
- Secondary network and connection cost (infrastructure charge) should be recovered from a fee charged to all customers, instead a one time charge to the new and mainly poor customers.
(ii) **Regulatory Framework and PSP Contract**

- Decision-making authorities must be clear – what decisions are taken by executive branch? By legislature?
- Service targets must be based on output, not input (e.g., quality of wastewater after treatment, instead of technical specifications of a wastewater treatment plant).
- Conflict resolution mechanisms and contract termination procedures must be clearly defined.
- Penalty mechanism must be clearly specified (when, how to calculate, etc.).
- Treatment of existing utility employees (how many transferred, how compensated) must be clearly defined.
- Information requirements (e.g. reports submitted to the regulatory by the concessionaire) must be clearly defined.
- Concessionaire must conduct periodic client survey to measure the service quality improvements.

(iii) **Regulatory Agency**

- Qualified directors should be appointed for a term that does not coincide with local government’s mandate to ensure political independence.
- Overstaffing should be avoided by limiting the size and income.
- Qualified staff should be hired and properly trained.
- Financial independence should be maintained through collection of regulatory fees from utilities, but without overcharging the utilities.
- Multi-sector regulatory agencies are preferable in a small province to have economy of scale.

(iv) **Tariff Regime**

- Two-part tariff is desirable. If two-part tariff, what is covered by fixed part, and what is covered by variable part must be clearly specified.
- Tariff structures should promote metering and efficient use of water.
- Who and how structures, levels, adjustments of tariffs are approved must be clearly specified.
- Reasons for extraordinary reviews must be clearly defined.
- Objective and frequency of regular reviews must be clearly defined.
- Tariff adjustment formula should be simple and objective.

(v) **Poverty**

- The poor families within PSP area must be identified (including their income level and estimated willingness to pay) by the Government as a part of preparatory activities of PSP process.
- These families should be charged a fixed tariff of no more than three percent of monthly income for water and five percent for water and sewerage combined. This fixed tariff allows for approximately 10/15 M3 of water per month, controlled by a volumetric device when economically viable to the operator.
As a part of the concession process, the government in charge of the process must launch a public campaign, including for the poor residents, to raise awareness about the purpose and expected impact of privatization.

- Service targets and service extension plans for the poor must be clearly defined.
- Subsidy and social tariff mechanism should be designed, when deemed necessary.
- Targeting mechanisms (how to identify the poor) for the subsidy and social tariff must be made clear.
- Secondary network and connection cost (infrastructure charges) should be recovered from a fee charge to all customers, instead a one time charge to the new and mainly poor customers.
- Connection fees should be about US$100 (about US$50 for each service) which is financed by the utility in one year at no interest.

(vi) **Environment**

- Environmental regulation regarding domestic and industrial wastewater must be clearly identified.
- Penalty mechanism should be clearly specified.
- Right and cost of bulk water, if any, should be specified.
- Shared water sources must be identified to avoid future problems.
- Responsibility to protect water sources must be specified, if any.
<table>
<thead>
<tr>
<th>Project Process</th>
<th>PSP Process</th>
<th>Use of Guidelines/Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipality/province requests TA support for PSP in water and sanitation sector</td>
<td>Elaboration of technical studies.</td>
<td>PMU provides guidelines and standard documents to municipalities/provinces and consultants.</td>
</tr>
<tr>
<td>Municipality/province signs TA agreement with the National Government</td>
<td>Elaboration of regulatory framework, tariff regime, bidding document, and draft concession/PSP contract.</td>
<td></td>
</tr>
<tr>
<td>Municipality/ province receives grants to hire consultants to conduct technical studies, elaborate a regulatory framework, prepare PSP bidding documents and draft contracts. Standard terms of reference are used to hire the consultants.</td>
<td>PMU review the PSP documents against the checklist, conduct technical, economic and financial evaluation, and recommends changes as necessary.</td>
<td></td>
</tr>
<tr>
<td>Municipalities/provinces present regulatory model, bidding document, and draft concession contract to PMU.</td>
<td>Regulatory framework finalized and submitted for local government approval.</td>
<td></td>
</tr>
<tr>
<td>The Bank allocates funds to those bids awarded according to the Bank guidelines.</td>
<td>PSP bid is announced.</td>
<td></td>
</tr>
<tr>
<td>Private concessionaire requests financing by the project.</td>
<td>PSP bid is awarded.</td>
<td></td>
</tr>
<tr>
<td>The project finances eligible subprojects/utilities.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 8.13 ANNEX 3: POTENTIAL BENEFICIARIES OF THE ARGENTINA WATER SECTOR REFORM PROGRAM

<table>
<thead>
<tr>
<th>Utility</th>
<th>Province</th>
<th>Modality</th>
<th>Population (000)</th>
<th>Coverage (%)</th>
<th>Framework</th>
<th>Reform</th>
<th>Government</th>
<th>Strategy</th>
<th>Bank has supported</th>
<th>Bank will support</th>
<th>IDB Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utilities with PSP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aguas Argentinas S.A.</td>
<td>Buenos Aires</td>
<td>concession</td>
<td>9091</td>
<td>85</td>
<td>53</td>
<td>Yes</td>
<td>A</td>
<td>3.4.5.9</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Aguas de Santiago S.A.</td>
<td>Sgo. Del Estero</td>
<td>concession</td>
<td>325</td>
<td>94</td>
<td>29</td>
<td>Yes</td>
<td>3.5</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sociedad Prestadora Aguas de Salta S.A.</td>
<td>Salta</td>
<td>concession</td>
<td>688</td>
<td>84</td>
<td>55</td>
<td>Yes</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agualar S.A.</td>
<td>La Rioja</td>
<td>concession</td>
<td>139</td>
<td>94</td>
<td>36</td>
<td>Yes</td>
<td>B</td>
<td>2.4.8</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Aguas de Campana S.A.</td>
<td>Buenos Aires</td>
<td>concession</td>
<td>68</td>
<td>86</td>
<td>53</td>
<td>Yes</td>
<td>3</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aguas Provinciales de Santa Fe S.A.</td>
<td>Santa Fe</td>
<td>concession</td>
<td>1795</td>
<td>84</td>
<td>41</td>
<td>Yes</td>
<td>A</td>
<td>4.5</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Aguas Cordobesas S.A.</td>
<td>Córdoba</td>
<td>concession</td>
<td>1158</td>
<td>97</td>
<td>22</td>
<td>Yes</td>
<td>3.5</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Obras Sanitarias de Mendoza S.A.</td>
<td>Mendoza</td>
<td>concession</td>
<td>927</td>
<td>92</td>
<td>49</td>
<td>Yes</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aguas de Corrientes S. A.</td>
<td>Corrientes</td>
<td>concession</td>
<td>484</td>
<td>94</td>
<td>44</td>
<td>Yes</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sudamericana de Aguas - Pilar</td>
<td>Buenos Aires</td>
<td>concession</td>
<td>121</td>
<td>14</td>
<td>8</td>
<td>Yes</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aguas de Formosa S.A.</td>
<td>Formosa</td>
<td>concession</td>
<td>185</td>
<td>77</td>
<td>41</td>
<td>Yes</td>
<td>5.9</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Obras Sanitarias Tucumán</td>
<td>Tucumán</td>
<td>Enobsa</td>
<td>832</td>
<td>91</td>
<td>45</td>
<td>Yes</td>
<td>C</td>
<td>1.2.3.9</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Agua de los Andes S.A.</td>
<td>Jujuy</td>
<td>concession</td>
<td>399</td>
<td>83</td>
<td>42</td>
<td>Yes</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Private</strong></td>
<td></td>
<td></td>
<td>16212</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td><strong>Provincial Utilities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFSE</td>
<td>Santa Cruz</td>
<td>Provincial Co.</td>
<td>148</td>
<td>96</td>
<td>50</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obras Sanitarias de CATAMARCA</td>
<td>Catamarca</td>
<td>Provincial</td>
<td>176</td>
<td>92</td>
<td>32</td>
<td>Yes</td>
<td>B</td>
<td>2.8.9</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>EPAS</td>
<td>Neuquén</td>
<td>Provincial</td>
<td>192</td>
<td>95</td>
<td>31</td>
<td>Yes</td>
<td>C</td>
<td>1.2.9</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>A R S E E</td>
<td>Rio Negro</td>
<td>Provincial Co.</td>
<td>354</td>
<td>92</td>
<td>44</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APOS</td>
<td>Misiones</td>
<td>Provincial</td>
<td>282</td>
<td>49</td>
<td>18</td>
<td>Yes</td>
<td>B</td>
<td>2.8.9</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Obras Sanitarias Sociedad Del Estado</td>
<td>San Juan</td>
<td>Provincial</td>
<td>415</td>
<td>96</td>
<td>15</td>
<td>No</td>
<td>C</td>
<td>1.2</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SAMEEP</td>
<td>Chaco</td>
<td>Provincial</td>
<td>494</td>
<td>86</td>
<td>22</td>
<td>No</td>
<td>1.2</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGOSBA</td>
<td>Buenos Aires</td>
<td>Provincial</td>
<td>3286</td>
<td>45</td>
<td>29</td>
<td>Yes</td>
<td>B</td>
<td>2.8</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Provincial</strong></td>
<td></td>
<td></td>
<td>5347</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Utility</th>
<th>Province</th>
<th>Modality</th>
<th>Population (000)</th>
<th>Coverage (%)</th>
<th>Framework</th>
<th>Status</th>
<th>Government</th>
<th>Strategy</th>
<th>Bank has supported</th>
<th>Bank will support</th>
<th>IDB Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Pergamino</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>79</td>
<td>66</td>
<td>57</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSSE</td>
<td>Buenos Aires</td>
<td>S.E.- Municipal</td>
<td>513</td>
<td>67</td>
<td>65</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Morón</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>644</td>
<td>27</td>
<td>52</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Berazategui</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>244</td>
<td>88</td>
<td>52</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirección Municipal de Agua Potable Paraná</td>
<td>Entre Ríos</td>
<td>Municipal</td>
<td>212</td>
<td>94</td>
<td>57</td>
<td>No</td>
<td>C</td>
<td>1.2</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>EMOS</td>
<td>Córdoba</td>
<td>Municipal</td>
<td>139</td>
<td>92</td>
<td>50</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de San Nicolás de los Arroyos</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>119</td>
<td>85</td>
<td>55</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de San Luis</td>
<td>San Luis</td>
<td>Municipal</td>
<td>110</td>
<td>99</td>
<td>60</td>
<td>Yes</td>
<td>C</td>
<td>1.2</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Muni. de Tandil</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>91</td>
<td>85</td>
<td>70</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Zárate (Dirección de Obras Sanitarias)</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>87</td>
<td>88</td>
<td>58</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Obras Sanitarias Mercedes</td>
<td>San Luis</td>
<td>Municipal</td>
<td>77</td>
<td>96</td>
<td>65</td>
<td>No</td>
<td>C</td>
<td>1.2</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Muni. de SANTA ROSA</td>
<td>La Pampa</td>
<td>Municipal</td>
<td>75</td>
<td>79</td>
<td>69</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirección de obras Sanitarias Municipales -Junín</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>75</td>
<td>97</td>
<td>70</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Necochea</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>73</td>
<td>90</td>
<td>70</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Maipú</td>
<td>Mendoza</td>
<td>Municipal</td>
<td>72</td>
<td>96</td>
<td>60</td>
<td>Yes</td>
<td>1.2</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Luján</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>70</td>
<td>31</td>
<td>27</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Gualeguaychú</td>
<td>Entre Ríos</td>
<td>Municipal</td>
<td>65</td>
<td>80</td>
<td>58</td>
<td>No</td>
<td>3.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Río Gallegos</td>
<td>Santa Cruz</td>
<td>Municipal</td>
<td>65</td>
<td>96</td>
<td>71</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de VENADO TUERTO</td>
<td>Santa Fe</td>
<td>Municipal</td>
<td>59</td>
<td>0</td>
<td>44</td>
<td>Yes</td>
<td>A</td>
<td>6</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de CONCEPCION DEL URUGUAY</td>
<td>Entre Ríos</td>
<td>Municipal</td>
<td>56</td>
<td>84</td>
<td>65</td>
<td>No</td>
<td>1.2</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admin. Municipal de Obras Sanitarias (AMOS -San Francisco)</td>
<td>Córdoba</td>
<td>Municipal</td>
<td>56</td>
<td>95</td>
<td>55</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Luján de Cuyo</td>
<td>Mendoza</td>
<td>Municipal</td>
<td>54</td>
<td>94</td>
<td>70</td>
<td>Yes</td>
<td>1.2</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Mercedes</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>48</td>
<td>95</td>
<td>82</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Tres Arroyos</td>
<td>Buenos Aires</td>
<td>Municipal</td>
<td>45</td>
<td>95</td>
<td>60</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Cutral CO-PLAZA HUINCU</td>
<td>Neuquén</td>
<td>Municipal</td>
<td>45</td>
<td>98</td>
<td>43</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muni. de Villa Carlos Paz</td>
<td>Córdoba</td>
<td>Municipal</td>
<td>42</td>
<td>96</td>
<td>1</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Muni. de VILLA CONSTITUCION</td>
<td>Santa Fé</td>
<td>Municipal</td>
<td>41</td>
<td>95</td>
<td>90</td>
<td>Yes</td>
<td>C</td>
<td>1.2</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Total Municipal</td>
<td></td>
<td></td>
<td>3255</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility</td>
<td>Province</td>
<td>Modality</td>
<td>Population (000)</td>
<td>Coverage (%)</td>
<td>Framework</td>
<td>Reform</td>
<td>Status</td>
<td>Strategy</td>
<td>Bank has supported</td>
<td>Bank will support</td>
<td>IDB Support</td>
</tr>
<tr>
<td>---------</td>
<td>------------------</td>
<td>---------------</td>
<td>------------------</td>
<td>--------------</td>
<td>-----------</td>
<td>--------</td>
<td>--------</td>
<td>----------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water</td>
<td>Sewage</td>
<td>Regulatory</td>
<td>Reform</td>
<td>Government</td>
<td>TA to Reform</td>
<td>Conflict Resolution</td>
</tr>
<tr>
<td>Cooperatives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sociedad Cooperativa Popular Ltda Comodoro Rivadavia</td>
<td>Chubut</td>
<td>Cooperatives</td>
<td>124</td>
<td>96</td>
<td>70</td>
<td>Yes</td>
<td>6</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop Ltda. de consumo de electricidad de Olavarría</td>
<td>Buenos Aires</td>
<td>Cooperatives</td>
<td>81</td>
<td>66</td>
<td>45</td>
<td>Yes</td>
<td>3.8</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop de Agua Potable, Otr Serv Públy Vvda de Va Nueva Lda</td>
<td>Córdoba</td>
<td>Cooperatives</td>
<td>79</td>
<td>69</td>
<td>42</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop. Eléctrica de Azul Limitada</td>
<td>Buenos Aires</td>
<td>Cooperatives</td>
<td>49</td>
<td>90</td>
<td>50</td>
<td>Yes</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Coop. eléctrica de consumo y vivienda limitada de Trelew</td>
<td>Chubut</td>
<td>Cooperatives</td>
<td>78</td>
<td>98</td>
<td>71</td>
<td>Yes</td>
<td>A</td>
<td>6</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop. de electricidad de San Carlos de Bariloche Limitada</td>
<td>Río Negro</td>
<td>Cooperatives</td>
<td>78</td>
<td>85</td>
<td>33</td>
<td>No</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop. ltd. de provisión de servicios públicos de Pto. Madryn</td>
<td>Chubut</td>
<td>Cooperatives</td>
<td>45</td>
<td>98</td>
<td>52</td>
<td>Yes</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Coop. de obras y servicios públicos limitada de río Tercero</td>
<td>Córdoba</td>
<td>Cooperatives</td>
<td>43</td>
<td>98</td>
<td>59</td>
<td>Yes</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop. regional de electricidad de General Pico limitada</td>
<td>La Pampa</td>
<td>Cooperatives</td>
<td>42</td>
<td>84</td>
<td>75</td>
<td>No</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop. Electrica Limitada de OBERA</td>
<td>Misiones</td>
<td>Cooperatives</td>
<td>40</td>
<td>60</td>
<td>40</td>
<td>Yes</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cooperatives</td>
<td></td>
<td></td>
<td>658</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td></td>
<td>25472</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References

a/ Coverage figures have inconsistencies as private wells and septic tanks are reported differently by operators
b/ Supported by two previous operations: 2641AR and 3281AR
c/ To be supported by the Water Sector Reform APL Program

Federal Government Strategy

1/ Support establishment of regulatory framework
2/ Provide TA to reform utility and establish regulatory framework
3/ Support strengthening of regulatory framework
4/ Provide assistance in conflict resolution
5/ Assistance in expanding services to the poor
6/ Improve governance of cooperatives
7/ Finance Emergency/Rehabilitation Investments
8/ Support reform strategy of provincial/municipal government
9/ Support improvement of environmental regulations
10/ Assistance to redraft tariff systems

Status of Reform

A/ PSP contract in re-negotiation
B/ PSP contract bidding in progress
C/ Regulatory Framework in preparation
D/ Regulatory framework legislature approval in progress
E/ Post-privatization issues being addressed
ANNEX 4: REFERENCES


ANNEX H

CONFIDENTIAL

ARGENTINA

Water Resources Management in Argentina

Issues and Policy Notes

Concept Paper

April 30, 1999
ARGENTINA

TABLE OF CONTENTS

ARGENTINA ................................................................................................................................. 2
EXECUTIVE SUMMARY .................................................................................................................. 1
  I. Introduction .................................................................................................................................. 1
  II. Water Resources Management Issues ...................................................................................... 1
  III. Objective ................................................................................................................................... 5
  IV. Relation to CAS ........................................................................................................................... 5
  V. Scope of Work .............................................................................................................................. 6
  VI. Methodology ............................................................................................................................. 7
  VII. Targeted Audience and Dissemination ..................................................................................... 11
  VIII. Implementation ....................................................................................................................... 12
  IX. Staffing and Budget .................................................................................................................... 12
  X. Peer Reviewers .......................................................................................................................... 14

ANNEX A ........................................................................................................................................... 14
ANNEX B ........................................................................................................................................... 17
ANNEX C ........................................................................................................................................... 19
ANNEX D ........................................................................................................................................... 21
ANNEX E ........................................................................................................................................... 24
ANNEX F ........................................................................................................................................... 27
ARGENTINA

8.14 EXECUTIVE SUMMARY

8.14.1 I. Introduction

1. Water Resources in Argentina is a priority area where both dimensions of scarcity and quality are present. Proposed investments to address these issues are high and frequently poorly analyzed and selected. Argentina’s water sector is at a critical point facing several policy constraints that jeopardize water availability, its proper management, and sustainable use. Moreover, this is exacerbated by the inefficient use of the resource, and the associated weakness of the institutional structure and fragmented management found at the Provincial level. This concept paper outlines these main objectives through the assessment of significant water problems and policy gaps in Argentina. In Section II, the main water issues are described, covering both technical aspects, as well as the economic and institutional dimension. The main objectives of this study are then outlined in section III and its relation to the CAS is discussed in section IV. Section V describes the scope of work while section VI illustrates the methodology to be followed. The targeted audience is presented in section VII, and after illustrating the agenda of implementation (section VIII), the staffing and budget as well as the selected peers reviewers are listed. This economic sector work (ESW), designed as “Policy Notes”, is an attempt to highlight the main issues, identify policy gaps, and propose options for the water sector in Argentina.

8.14.2 II Water Resources Management Issues

2. Surface Water. Argentina is well endowed with both surface and groundwater water resources (684 km$^3$/year)$^{122}$ However, these resources are unevenly distributed, with about 84 percent (580 km$^3$/year) located in the lower Paraná basin, which represents only 10 percent of its territory. The rest of the country is either arid, with average rainfall of less than 400 mm/year (mid-west and the Patagonia), or semi-arid with a rainfall between 400 and 800 mm/year (mid-west and northwest). In the arid zone total runoff is equal to 74 km$^3$/year (Atlantic basin) and only 5.7 km$^3$/year in a large endorreic basin (without outlet to the sea) covering several provinces of the country. The driest regions are the Northwest and Cuyo with only 7.3 km$^3$/year and an availability index of about 1,800 m$^3$/inhab/year, comparable with the regions of the Middle East, coastal Peru, the Sonora Desert in Mexico and Australia. The poorest province is La Rioja which has a water availability of 500 m$^3$/inhab/year, an average similar to those of Jordan and Israel.

3. Groundwater Groundwater in the Paraná Basin is divided into two major superimposed aquifer formations: the more superficial Pampeano, fed by the Paraná system and increasingly polluted; and the deeper fossil originated Puelche. The Pampeano is frequently of low quality due to toxic contents of arsenic, fluor and nitrates, which limits its use for human and animal consumption. Hydro-geological information is limited when

---

$^{122}$ The per-capita water availability in Argentina is equal to 18,000 m$^3$/year/inhabitant, compared to 34,000 m$^3$/year/inhabitant in Brazil, 32,800 in Chile, and 9,500 in the USA.
compared to Mexico, Brazil and Chile since the main information available in Argentina is exploratory maps on the scale of 1:2,500,000.

4. **Provincial Role in Water Resources.** Provinces have full jurisdiction over water management, except for navigation and international water issues. As a consequence water management is not made on River Basin criteria but on administrative boundaries. Conflicts arising from competing uses of water are increasing among irrigation, urban water supply, and industrial users and also among provinces sharing the same river basin like La Pampa with Mendoza, and Santa Fe with Chaco, among others. To address these issues, legislation and regulatory updating is required at both provincial and federal levels.

5. **Irrigation.** Irrigation in Argentina represents about 73 percent of “off-stream” and consumptive use with an estimated withdrawal from rivers and aquifers of 24 km$^3$/year. The irrigation potential in Argentina is high and is estimated on about six million hectares (20 percent of arable land). Currently, a total of 1.5 million hectares has irrigation infrastructure and is in operation. Another 0.5 million hectares can be irrigated through minor investments. From the current 1.5 million hectares under irrigation, 1.2 million are under large public systems and about 0.3 million are private developments. Irrigation is particularly important for high value agriculture production of fruits, certified seeds, potatoes, vegetables, olives, and vineyards in the provinces of Mendoza, San Juan, Rio Negro, Chubut, Catamarca, La Rioja, Tucumán, Salta and Jujuy. Most public irrigation systems began to be developed late in the 19th century as part of a geopolitical strategy to occupy a vast and mostly empty territory and promote regional development. Unfortunately, even today the most important public irrigation systems of Mendoza, San Juan and Rio Negro are still highly inefficient and require policies to create incentives to improve the use of scarce water resources as well as investment plans to modernize ancient and often dilapidated infrastructure of conveyance and distribution channels.

6. The Government estimates that over 75 percent of public irrigation systems are plagued by poor operation and maintenance policies and practices leading to sub-standard levels of efficiency in the use of water resources and related infrastructure. Soil salinity is becoming a major operational issue since 65 percent of irrigated area is affected by poor drainage and water logging. As demonstrated in Mexico, such problems can be reversed through marginal investments with sound cost recovery policies and strong participation of beneficiaries. More recently, the aggressive introduction of a complementary irrigation culture by private corporations has introduced a much needed dynamism in the irrigation sector. However, there are growing concerns due to evidence of a rapid depletion of the water table in some areas, a factor which could lead to unsustainable development of irrigation in the medium to long-term.

7. Most of Argentine’s Irrigation Districts (ID) which have been under the responsibility of the Federal Government were or will be transferred, according to a defined schedule, to water user organizations which are supervised by the provinces (WUOs are locally known as “asociaciones de inspecciones de cauces”). The transfer of this irrigation infrastructure represents a major policy decision to improve efficiency of the sector by transferring decisions to the lowest and most appropriate levels of
management. However, the transfer process in Argentina is incomplete and still requires some governmental support to be effective, as shown by the Bank experience in Turkey and Mexico where similar policy decisions were made. This is particularly relevant in the: (i) rehabilitation and modernization of main infrastructure of regulation, control and water transport; (ii) establishment of adequate structures and levels of water tariffs; (iii) introduction of efficient technology; and (iv) assistance in financing improvements of irrigated land.

8. **Hydropower, Navigation and Flood Management.** While most of the hydropower infrastructure has been transferred to the private sector, it is still unclear, under the current regulations, who is responsible for the protection of watershed resources upstream to the generating infrastructure facilities. There are also potential conflicts between power generators and farmers related to the control of river flows, as is also the case in Chile. There is a sizable potential for hydropower generation which could not be developed without a clearer social and environmental framework. Major efforts have been undertaken to improve navigation within the Paraná-La Plata river system which requires careful consideration of potential environmental hazards and international negotiation with neighboring countries. Periodic floods, mainly in the Paraná flood plain, also warrant substantial funds and technical assistance.

9. **Water and Sanitation.** According to the Secretary of Natural Resources and Sustainable Development collection system of water data (SPIDES), Argentina has the lowest population with access to safe water and sewage collection, within its income category. By 1996, the coverage indicators in urban centers were: 81 percent for potable water and 51 percent for sewage collection. Coverage indicators for the five million rural population were much lower; with 17 percent having access to safe water. Water rationing in summer months is a frequent occurrence in all major cities. Quality of drinking water is sub-standard for most systems supported by shallow aquifers. Existing sewage collection systems can not handle the increasing flows as more households move from on-site disposal to conventional network system. For example, the Buenos Aires concessionaire Aguas Argentinas (AA) is facing major overflow problems at one of the four main sewage interceptors of the city.

10. Since only 51 percent of the urban population is connected to a sewerage network, the remainder dispose sewage into septic tanks, which are not controlled by health authorities. This situation adversely affects the quality of aquifers and is causing increased pollution of shallow—generally unprotected—wells used for human consumption, mostly in poor areas. Water pollution continues to grow in the most environmentally sensitive areas of the country, for example the Matanzas and Riachuelo rivers in Buenos Aires, the San Roque and Nahuel Huapi lakes in Cordoba and Rio Negro, the Salidulce River in Tucumán, and in irrigation channels in Mendoza. Industrial discharges account for a substantial contribution to pollution loads and represent the main source of water pollution in many cases, such as in Buenos Aires and Tucumán. Wastewater treatment capacity is still below 5 percent of collected sewage flows. Federal regulations concerning water pollution only apply to Buenos Aires with enforcement responsibilities under the Secretariat of Natural Resources and Sustainable Development. The provinces of Tucumán, Mendoza, San Juan, and Buenos Aires have issued effluent
standards applicable to domestic and industrial sewage, but enforcement of such regulations by provincial institutions is still weak.

11. **Pollution.** Water resources management issues affecting the provision of water and sanitation services are suffering the consequences of several legal, regulatory, and institutional gaps. There are gaps such as: (i) deficiencies of the current water extraction system for rivers and aquifers, (ii) complex framework of environmental institutions and regulations affecting the sector, and (iii) absence of a policy framework to address increasing water quality issues of the urban poor. Up to now, none of the provinces have adopted environmental quality objectives for surface waters. Economic instruments to abate industrial pollution, such as the pollution discharge fee stipulated by Decree 2125/80, were never implemented. This Decree introduced incremental fees linked to industrial pollution loads to achieve a tolerated limit in 10 years with 2 years grace period. After numerous transitional waivers, this Decree was modified in 1989 thereby substantially reducing the discharge fee and introducing “temporary tolerable limits” which also had very limited enforceability.

12. Many water supply systems in the Province of Cordoba have water quality problems particularly in the eastern part of the province due to high concentrations of arsenic and salts and uncontrolled growth of anaerobic algae in the San Roque Lake as a result of point and non-point discharge of pollutants. According to the Federal Constitution, the Province has the right to regulate and administer all water resources that occur within its political jurisdiction. There is also a provincial environmental policy that aims at the preservation, improvement and recovery of the environment, and includes quality suitable for life and socio-economic development, which includes environmental impact guidelines, to ensure a healthy living arrangement and social-economic development. Environmental protection and enforcement, however, is a responsibility at the local level, but only the municipality of Cordoba has a well structured organization which has created a pollution control system, and executes a number of decentralized environmental programs.

13. **Water Management Information.** Coordination and management of quantitative and qualitative water resources data is weak. This is a consequence of “Agua y Energia” system that was privatized and used to manage this public good part of the water sector as well. The gathering, collecting, processing, filing, and dissemination of meteorological, hydrometric, hydrological, hydro-geological and water quality data is extremely important for water resources management. It deserves and requires actions to have minimum international standards, as have been implemented in Brazil, Mexico, and Chile.

14. **Rural Drainage and Floods.** Excluding the Paraná basin, agricultural areas of the Pampa Region have an additional flood management issue. It is linked to the effects of local flash-floods and consequent inundation and water logging of agricultural areas under production. In this region there is an impressive land use change from natural pastures into intensive agriculture of staple grains taking place. Adequate management policies for improvement of land management together with agricultural storm drainage and sustainable maintenance of drains and outlets is required.
15. **Competitive Use Conflicts.** Conflicts of competitive uses are now growing. A clear case is the one among the mining sector and traditional users (urban and irrigation) in the arid zones of Cuyo Region like the provinces of Catamarca and Mendoza. A lack of clear water rights and river basin management makes the issue potentially more hazardous.

### 8.14.3 III. Objectives

16. The general objective of the proposed “notes” is to facilitate the policy dialogue for improvement of Water Resources Management in Argentina at both Federal and provincial levels.

   The specific objectives are to:
   (i) identify key sector issues and related policy gaps
   (ii) analyze and propose policy options as compared with international best practices; and
   (iii) suggest policy instruments for actions

The rationale behind the selection of this objective was discussed in a workshop with the Federal Government and selected Provinces held in Buenos Aires last February. During the workshop a long set of issues constraining efficiency in use of Water Resources was identified (see para 20). In order to keep the study focused, from this long list of issues, five main ones were selected:

(i) legal and regulatory
(ii) Economic and financial
(iii) Groundwater
(iv) Water Quality and Pollution; and
(v) Irrigation

While the two first issues (Legal/Regulatory and Economic and Financial) are cross cutting for all subsectors, the latter three ones are subsector specific that deserve immediate attention. These five issues have also been selected taking into consideration the comparative advantage of the Bank in terms of its regional and world wide experience in them as well as the benefit to guide a proactive future dialogue bringing international best practices into implementable actions.

Additionally, the Policy Notes could provide good and opportune water sector inputs to the forthcoming preparation of next CAS.

### 8.14.4 IV. Relation to CAS

17. The Country Assistance Strategy stated that while Argentina does not suffer from the acute environmental problems many other developing countries face, it has only just begun to establish the environmental standards and regulations befitting a country at its income level and major cities are plagued by localized pollution. It also highlighted the contamination of water resources by industrial and hazardous waste and the inadequacy
of water supply and treatment systems are serious problems in the Buenos Aires Metropolitan Area, and other provincial cities, and specific industrial locations. Moreover, water and wind erosion have led to soil loss and declining fertility, thereby threatening the sustainability of Argentina’s significant (in GDP terms) agricultural economy, and irrigated areas suffer from drainage and salinity problems.

V. Scope of Work

18. The Provinces selected for the study are: Mendoza, as the most advanced province in water resources management with a well established tradition in irrigation and water law, will provide most of the data and facts to prepare an aggregated economic analysis in terms of cost recovery issues in the water sector and to review technology and efficiency issues of the irrigation sub-sector; Chaco, a much less developed province with a strong technical team in charge of the administration of water, has been selected to complement the economic analysis of irrigated agriculture, especially cotton and rice. Additionally the Provinces of Catamarca, Tucumán and Rio Negro will be reviewed. The Province of Cordoba has water/environmental regulations and presents a good case to analyze water quality management and pollution control issues and to formulate policy options. Finally, the Provinces of Santa Fe, Buenos Aires and Mendoza, with increasing aquifer mining issues, provides a good example to review issues related to groundwater management.

19. The sector work will be developed under a participatory approach of the stakeholders at the federal and provincial levels. While the global issues on legal/regulatory and economic/financial aspects will be discussed under country wide perspective, some provinces are particularly relevant and have been chosen for a closer analysis on the three other issues: (i) Groundwater Management Issues and Policy Implications, the case of Santa Fe, Mendoza, and Buenos Aires; (ii) Water Quality Management and Pollution Control, the case of Cordoba; and (iii) Irrigation Management technology and efficiency; the cases of Mendoza, Catamarca, Rio Negro and Tucumán. The first workshop was a key element in developing the terms of reference of the study and henceforth of the report. The main report is expected to be structured in four chapters and three technical mini-cases, as follow:

Chapter 1: Background—Water Resource Management Review
Chapter 2: Legal Issues and Policy Options
Chapter 3: Economic and Financial Issues and Policy Options
Chapter 4: Water Resource Management Strategy

Technical Papers:

- Groundwater Management Issues and Policy Options in Santa Fe; Buenos Aires; and Mendoza
- Water quality management and Pollution control in Cordoba
- Irrigation management and technology in Argentina with focus on Mendoza, Rio Negro, Santa Fe, and Catamarca.
8.14.5 VI. Methodology

20. The proposed methodology of this sector study (see attached flow chart and table I) is to identify the key policy gaps as compared to international best practices, and suggest policy instruments to improve water resources management in Argentina. Prior to the preparation of this Concept Paper several steps have been taken:

- A first draft report was prepared in 1997 with the assistance of FAO. This report initiated the analysis of water quality issues in Cordoba.
- To gain support for the study two short missions were launched late in 1998. The missions concluded with the organization of a workshop to identify water resources management issues.
- To take into account the regional experience in water resources management, one team member interviewed Dr. Miguel Solanes from CEPAL.
- The provinces of Mendoza and Chaco were visited to establish professional contacts and incorporate the experience of these two provinces in managing their water resources.
- A workshop was organized by the Secretariat of Natural Resources and Sustainable Development with participation of government officials from several provinces and representatives of users associations of Mendoza.

**FLOW CHART**
The workshop allowed the identification of main issues and concerns in the water sector, as well as key stakeholders for the study. The discussions during the workshop focused on the following topics:

- Legal aspects of the federal and provincial regulation for water resources management
- Institutional set-up and the relationship among Federal, Provincial, Basin Committee, private operators and users
- National strategy for water resources management: scenarios, participation, federal consistency and stability
- Information availability issues
- Water pricing, pollution fees and other issues that deal with the economic and financial aspects of water, as well as the details of operational studies
- Technology improvement: salinity and drainage management, pollution, groundwater management and availability
- Methodologies for planning and formulation of investments—evaluation of projects (prioritization)
- Conflict resolution: inter-provincial and intra-provincial

21. The government has shown interest in modernizing water resources management legislation and in introducing policies to promote efficiency, which include: (i) defining and securing water rights; (ii) creating conditions for sustainable use and management of surface and groundwater; (iii) improving water fees collection (bulk and service) in all sub-sectors; (iv) creating a provincial registry of water rights and uses; (v) licensing, charging and penalizing misuse of groundwater and disposal of effluents; (vi) facilitating water transfer transactions; (vii) splitting water rights from land rights; (viii) setting conditions among neighboring provinces to set/operate water resources through River Basin Committees or Aquifer Committees; and (ix) setting standards for quality control and pollution monitoring.

22. Following the workshop, TORs were formulated for each section of the ESW (see annexes A to E). Both local and international consultants have been identified (see paras. 27 and 29). An analytical framework to facilitate and review policy issues was prepared (see Table I). This will therefore provide the set of mechanisms to be used to fulfill the policy changes and the strategic options to be targeted by this ESW. The integrated report will provide a tool for discussion and debate, in the Bank, as well as with Federal and Provincial Audiences. There will be both an English (50 copies) and
Table I. Methodological Matrix for Analysis of Gaps (example only)

<table>
<thead>
<tr>
<th>Possible Policy Gaps</th>
<th>POLICY ISSUES</th>
<th>POLICY INSTRUMENTS</th>
<th>APPROPRIATE TECHNOLOGY</th>
<th>SUSTAINABLE FEES FOR O&amp;M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Water Resource Areas</td>
<td><strong>WATER AS AN ECONOMIC GOOD</strong></td>
<td><strong>WATER PRICING</strong></td>
<td><strong>EFFICIENT USE OF RESOURCES</strong></td>
<td><strong>REGULATE TRANSFER &amp; TRADING OF WATER RIGHTS</strong></td>
</tr>
<tr>
<td>Legal &amp; Institutional Framework</td>
<td>Non-existent or poor water rights register water rights linked to land rights</td>
<td>Structure of fees does not reflect scarcity</td>
<td>Legislation that promotes incentives for water savings and efficient use</td>
<td>Poor law enforcement Low stakeholders participation</td>
</tr>
<tr>
<td>Economic/Finance</td>
<td>Water fees are generally low O&amp;M below standards</td>
<td>Weak formulation and analysis of water projects</td>
<td>Bias to manage supply rather than the demand</td>
<td>Determine the cost and price of water for trade</td>
</tr>
<tr>
<td>Groundwater Management</td>
<td>Lack of view of GW as the most dependable source in arid zones</td>
<td>Misuse of GW</td>
<td>Abstraction fees are insignificant</td>
<td>Licensing control</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------</td>
<td>------------</td>
<td>---------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Irrigation Technology Efficiency</td>
<td>Irrigation fees are among the lowest in the Americas Fees not linked to scarcity or productivity value water markets not regulated</td>
<td>Salinity and poor drainage plague irrigated areas Technology is out dated</td>
<td>O&amp;M below standards Few incentives to save water</td>
<td>Lack of integrated view among irrigation and other users Lack of coordination Lack of stakeholders-participation.</td>
</tr>
<tr>
<td>Water Quality and Pollution</td>
<td>No discharge fees</td>
<td>No effluents monitoring Lack of standards</td>
<td>Non-existent mechanism to manage the demand</td>
<td>Relationship between water rights and the level of water quality</td>
</tr>
</tbody>
</table>
Spanish version (250 copies) of the report, as well as Power Point presentations (in both English and Spanish)

23. To conduct the study the following next steps are proposed:
   • Preparation and discussion of the Concept Paper
   • Select top local consultants and international experts. Best practices at both the national and the international level will be highlighted, and a policy analysis as well as the integration of all the findings will be undertaken by the Bank team.
   • Desk review by local consultants
   • Inputs/analysis by international experts
   • Analysis, integration, drafting report by Bank team
   • First draft to CMU/Government
   • Final review/Dissemination

VII. Counterparts, Targeted Audience and Dissemination

24. Government counterparts are at Federal and Provincial levels. The main counterpart at Federal level is Secretaria de Recursos Hidricos in the Ministry of Environment, additionally, for irrigation issues, the relevant counterpart will be the Secretariat of Agriculture. At Provincial level the counterparts will be the relevant Provincial Ministries. The attached chart shows the targeted audience into two categories: internal, as referring to the Bank and external, meaning the government—both Federal and Provincial level, as well as the civil society and the Stakeholders. The primary audience are decision-makers and legislators both at Federal and Provincial levels. The secondary audience comprises Bank staff and management involved in operation and policies in the water sector in Argentina.

Audience Expected to be Targeted

<table>
<thead>
<tr>
<th>INTERNAL (World Bank)</th>
<th>CMU</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sector Leaders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CSU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management/Lead Specialists</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Task teams</td>
</tr>
<tr>
<td>EXTERNAL (Argentina)</td>
<td>Federal Level</td>
<td>Executive</td>
</tr>
<tr>
<td>Government</td>
<td></td>
<td>Legislators</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senate House of Representatives</td>
</tr>
<tr>
<td></td>
<td>Provinicial Level</td>
<td>Executive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Governors, Ministers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water Agencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mayor</td>
</tr>
<tr>
<td></td>
<td>Provinicial Legislator</td>
<td>Commissions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deputies Senators</td>
</tr>
<tr>
<td>Civil Society and Stakeholders</td>
<td>River Basin Committees</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Utilities/Organizations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Sector NGOs/Others</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Related Business</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Universities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Associations</td>
<td></td>
</tr>
</tbody>
</table>
25. Dissemination should also consider the upcoming elections in late-1999, and the opportunity that new Federal and provincial governments will take office soon after the completion of the ESW. The next CAS preparation could also benefit from the ESW findings/proposals to address the identified water sector issues and gaps.

VIII. Implementation

26. The implementation schedule of this study targets the completion of a Draft Report by late-July 1999 to be discussed with the government the following month. The implementation has been planned from February to September 1999 according to the following timetable:

1. Workshop in Argentina: Mid-February
2. Draft CD and consultants ToRs: March-April
3. Select/contract local consultants: April
4. Field work with local consultants: May
5. Interaction with international consultants: May-June
6. Draft report integration: July-August
7. Discussion with government: August
8. Final report for dissemination: September

IX. Staffing and Budget

27. The team leader is Jose Simas (Senior Water Resources Engineer, LCSES) assisted by Abel Mejia (Principal Water Resources Engineer, LCSFP). The team also comprises Musa Asad (Financial Analysis, LCSES), Hynd Bouhia (Water and Environmental Economist, LCSFP), Adrian Campbell (Civil Engineer, LCSFP) and Larry Simpson (Senior Water Resources Management Engineer, LCSES). The country manager of Argentina is Myrna Alexander (Director, LCC7). Asif Faiz (Sector Leader, LCC7) and Graciela Lituma (Sr. Operations Officer, LCSES) are expected to participate in discussions and make specific contributions to the study. To prepare the study several consultants have been already identified: Dr. Cesar Magnani, a top adviser of the Federal Congress and several Provinces in water legislation; Dr. Regina Martinez with extensive experience in water resources legislation in the region; Ing. Juan Carlos Jimenez to prepare the background information for the economic and financial analysis; Mr. H. Plusquelec, Juan Carlos Miller and Juan Morelli to review technology and economic efficiency issues of irrigation; Mr. F. Lobato to complete the assessment of water quality issues in Cordoba; and Dr. N. Trac and M. Auge to review groundwater issues and prepare a first policy analysis.
28. **Team Allocation and Budget.** The total cost estimate is about $175,000. About $100,000 is expected to be expended during FY 1999 while $75,000 is foreseen for FY 2,000.

**Bank participating staff**

<table>
<thead>
<tr>
<th>Staff</th>
<th>Accountable for:</th>
<th>HQ SW</th>
<th>Field SW</th>
<th>Budget in ‘000 US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musa Asad</td>
<td>Legal and financial analysis Strategy</td>
<td>2</td>
<td>1</td>
<td>3.6</td>
</tr>
<tr>
<td>Hynd Bouhia</td>
<td>Economic analysis Strategy</td>
<td>4</td>
<td>1</td>
<td>5.5</td>
</tr>
<tr>
<td>Adrian Campbell</td>
<td>Water quality management</td>
<td>1</td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Asif Faiz</td>
<td>Sector/Portfolio overview</td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>Garcia Lituma</td>
<td>Agriculture interface</td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>Abel Mejia</td>
<td>Sector Leadership Strategy</td>
<td>1</td>
<td></td>
<td>3.0</td>
</tr>
<tr>
<td>Jose Simas</td>
<td>Overall coordination, Team Leader</td>
<td>6</td>
<td>2</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>Irrigation, efficiency &amp; technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Groundwater management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strategy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larry Simpson</td>
<td>Legal aspects Strategy</td>
<td>1</td>
<td>1</td>
<td>5.6</td>
</tr>
<tr>
<td>Travel Budget</td>
<td></td>
<td></td>
<td></td>
<td>18.0</td>
</tr>
<tr>
<td>Bank Sub-total</td>
<td></td>
<td></td>
<td></td>
<td>54.5</td>
</tr>
<tr>
<td>Consultants</td>
<td></td>
<td></td>
<td></td>
<td>102.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>175.0</td>
</tr>
</tbody>
</table>

**Consultants, external peers, travel costs, and dissemination estimates**

29. The participating team of consultants, both local and international consultants, and external peers, have been identified (see next table). These expenditures include consultant fees, travel and subsistance, and editing and dissemination costs. The editing and dissemination costs include preparation of English and Spanish versions of the final report together with Power-Point presentations. The budget for consultants includes both fees and travel expenditures.
<table>
<thead>
<tr>
<th>Name</th>
<th>Accountable for:</th>
<th>Time</th>
<th>Budget ‘000 US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesar Magnani</td>
<td>Legal aspects Review</td>
<td>4 weeks</td>
<td>5</td>
</tr>
<tr>
<td>Regina Martinez</td>
<td>International experience</td>
<td>4 weeks</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Water law. Propose options and recommendation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juan-Jose Jimenez</td>
<td>Economic and financial aspects</td>
<td>5 weeks</td>
<td>5</td>
</tr>
<tr>
<td>Plusquelec/other</td>
<td>Irrigation Technology</td>
<td>1 week</td>
<td>2.5</td>
</tr>
<tr>
<td>Guillermo Wood</td>
<td>Irrigation economic efficiency</td>
<td>3 weeks</td>
<td>5</td>
</tr>
<tr>
<td>J.C. Miller</td>
<td>Argent. Irrigation Sector</td>
<td>4 weeks</td>
<td>5</td>
</tr>
<tr>
<td>F. Lobato</td>
<td>Water Quality</td>
<td>2 weeks</td>
<td>5</td>
</tr>
<tr>
<td>N. Quang Trac</td>
<td>Groundwater and WR Management Options Final Report Integration</td>
<td>3 weeks</td>
<td>15</td>
</tr>
<tr>
<td>Miguel Auge</td>
<td>Groundwater issues</td>
<td>4 weeks</td>
<td>5</td>
</tr>
<tr>
<td>Miguel Solanes</td>
<td>External Peer Reviewer</td>
<td>1 week</td>
<td>2.5</td>
</tr>
<tr>
<td>Hector Garduno</td>
<td>External Peer Reviewer Final Report Integration</td>
<td>3 week</td>
<td>10</td>
</tr>
<tr>
<td>Jerson Kelmann</td>
<td>External Peer Reviewer</td>
<td>1 week</td>
<td>2.5</td>
</tr>
<tr>
<td>Translation/Edit.</td>
<td>Spanish &amp; English</td>
<td>N A</td>
<td>10</td>
</tr>
<tr>
<td>Dissemination</td>
<td>Three Seminars</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Unforeseen</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>102.5</strong></td>
</tr>
</tbody>
</table>

X. Peer Reviewers

In order to assure a good level of comments and quality, two teams of top notch peer reviewers were selected, one inside the Bank and the other comprised by external peers. The internal group was selected from the Center, Asia, and LAC Regions: John Briscoe, Keith Oblitas, and Gabriel Azevedo.

The external group will be integrated by three peers from other LAC countries. The external peers will be: Miguel Solanes (Water law expert from CEPAL, Chile), Hector Garduno (Water Resource Institutions expert from Mexico), and Jerson Kelmann (Water Resources Management expert from Brazil).

ANNEX A

Argentina -- Concept Paper

Outline for Legal Framework Review
1 Resumen Ejecutivo

2 Objetivo del Estudio

3 Fundamento histórico de la Legislación de aguas en Argentina

4 Marco Constitucional y Legal a nivel Federal

4.1 Régimen Jurídico de las Aguas superficiales y subterráneas
4.2 Distribución de competencias entre Federación y provincias
4.3 Régimen para el manejo de aguas internacionales e inter-provinciales
4.4 Programa Nacional de Conservación de la tierra y el agua.

4.5 Personas de Derecho Público en el área de las cuencas inter-provinciales.

5 Revisión Constitucional, legal, reglamentaria y administrativa a nivel provincial

5.1 Marco constitucional y legal a nivel provincial
5.2 Políticas sub-sectoriales, estrategias y legislación.
5.3 Estructuras organizacionales para la gestión del recurso hídrico
5.4 Performance del sector hídrico en la solución de conflictos
5.5 Organismos de Regulación y Control.
5.6 Fiscalidad de las Aguas (Canon de regulación y/o tarifas por utilización)
5.7 Legislación para inversiones, financiamiento y recuperación de costos.
5.8 Régimen jurídico para concesiones y/o privatizaciones
5.9 Organizaciones de Usuarios, su participación en la gestión del recurso hídrico.
5.10 Comités de Cuencas.
5.11 Inspección de cauces

---

123 Este es un programa liderado por la Secretaría de Agricultura y Pesca, en el cual han participado todas las provincias; su objetivo por lo menos hasta finales de 1.995 era generar una ley federal para el efecto.

124 Este programa es liderado a nivel federal por la Comisión de Saneamiento y Recursos hídricos e inundaciones, para 1.995 se había avanzado bastante, existían a nivel de cada una de las provincias comisiones especiales que deliberaban a nivel nacional, para ese entonces había una fuerte discusión desde el punto de vista jurídico pues algunas provincias, entre ellas Salta, consideraban que el mismo era contrario a la distribución constitucional de competencias entre nación y provincias.

125 Las provincias a raíz de la privatización de algunos servicios, energía, gas, estaban creando Superintendencias de Servicios Públicos y Otras Concesiones, bajo cuya vigilancia y control se incorpora no solo agua potable sino también los distritos de riego.
5.12 Régimen jurídico de preferencias y prioridades en los usos y asignación de derechos de aguas (superficiales y subterráneas)
5.13 Registro y Catastro de derechos de agua
5.14 Legislación para transferencia de derechos de agua
5.15 Régimen de vertidos vinculados a masas de agua superficial y/o subterránea.
5.16 Acondicionamientos medioambientales de los derechos de agua.

6 Principales características Constitucionales y de legislación provincial en materia del recurso hídrico 126

6.1 Generalidades
6.2 Grupos regionalizados de provincias
6.3 Principales problemas por regiones
6.4 Mejores ejemplos internacionales
6.5 Matriz comparativa

7 Recomendaciones Regionales

7.1 Constitucionales y legales
7.2 Reglamentarias
7.3 Administrativas

8 Conclusiones

---

126 Resaltar la parte constitucional de las provincias es bien importante pues por lo menos en Jujuy a raíz del régimen de privatización impuesto por Cavalo se apresuraron a modificar la constitución para prohibir la participación del sector privado, no se si este ejemplo se repita.
ANNEX B

Argentina
Strategies for Water Resources Management Study

Outline for Economic and Financial Review

1 Background (coordinate with legal aspects review)
   a) Legal, Regulatory, and Policy Framework for pricing water, financing water investments, and cost recovery.
   b) Institutional Framework for setting prices, investment planning and decision-making, and collecting tariffs.
   c) Historical/Cultural Perspective regarding water pricing and cost recovery.

2 Costs of Water Supply and Use
   a) Past and planned (5-10 yr. depending on available data) investment and A,O&M costs (public and private) for uses referenced above.
   b) Basic unit cost structure for all uses (should include all related activities along the water supply chain, including generation/storage, treatment, distribution, pumping, human and industrial consumption, irrigation, etc.)
   c) Unidentified costs such as environmental costs, opportunity costs, etc. (may only be able to make qualitative statements with some very rough estimates to get a sense of orders of magnitude).

3 Value/Benefits (actual and potential) of Water Supply and Use
   a) Relative value of water for uses referenced above (rough estimates could be obtained by comparing relative GDP contributions for each sub-sector and respective water demands/uses; average/typical economic and financial returns for different uses could also be compared).
   b) Valuation of potential economic and financial gains from improving water use efficiency due to better use of technology (i.e. in irrigation – coordinate with irrigation aspects review), better O&M practices, improving water quality (coordinate with Cordoba review), accessing new water sources (i.e., groundwater), and better management practices (including appropriate pricing).

4 Tariff Design and Implementation
   a) Objectives (i.e., cost recovery, economic efficiency, conservation, social, etc.)
   b) Basic Designs for each use (i.e., uniform charges, fixed and volumetric charges, block charges, abstraction fees, investment and O&M charges, etc.)
   c) Subsidy policies, implementation and practice (describe any existing explicit policies or provide rough estimates of subsidies implicit in current tariff designs).
   d) Actual cost recovery results for each use.

5 Financing Considerations
   a) Projected investment needs for each use (rough estimates)
b) Public financing capacity (rough estimates of projected budgets and borrowings)

c) Private financing capacity (rough inventory of creditworthy entities)

d) Current financial policies and impacts/constraints for the sector (i.e., exchange and interest rates/policies, rough inventory of available public and private financing programs and description of progress/constraints, etc.).

e) Financing gaps (rough estimates based on analysis of 5.a-d).

6 Conclusions and Recommendations

a) Key strategies for each sub-sector to address economic and financial problems identified in the above analysis.

b) Investment needs and estimated costs associated with each strategy in 6.a.

c) Prioritization of strategies and related investments.

d) Constraints and Risks associated with 6.c.
Outline for Groundwater Management Review

The objectives of the proposed desk study are:

- to gather the essential information concerning groundwater resources (quantity and quality) in the three provinces;
- to prepare a synthetic report which will clearly identify the physical, technological, social, economic, legal and institutional key issues of policy options for managing the aquifers in a sustainable way.

The report should provide the essential basic information that would be needed for the identification and preparation of an eventual project of groundwater resources management in the three provinces.

The report should have about 30 to 40 pages (in any case, less than 50 pages). All useful supporting information should be put in annexes along with cartographic documents. The necessary material (slides, graphs, maps…) for a short presentation, of about 45 min duration, of the principal results and conclusions of the study should be also prepared.

Following is the suggested outline of the study report.

Executive Summary

1 Objective and Scope of the Study
2 Basic features of groundwater resources of Argentina
   Groundwater withdrawal, use and efficiency in the agricultural, domestic and municipal, and industrial sectors
   Principal problems and technical, socio-economic, legal and institutional key issues for efficient groundwater resources management
3 Groundwater resources in the province of Buenos Aires
   3.1 Basic features of the main aquifer systems
   Physical setting of the groundwater systems
   Climate and precipitation
   System inputs (Infiltration, input from surface water systems, return flow from irrigation)
   System outputs (Withdrawal and net extraction for different uses – domestic and municipal water supply, industry, irrigation -)
   Water balance (rough estimation or mathematical modeling)
   Groundwater quality (natural characteristics, point source and non point source pollution)
   3.2 Economics of groundwater exploitation in the various sectors
3.3 Main problems and key issues of groundwater resources management in the province (data and information gap, technological gap, socio-economic, legal and institutional aspects)

3.4 Main uses, permits, register/cadaster, relevant laws, and regulations.

3.5 Institutional set-up at Provincial level

3.6 Recommendations: contributions to policy options formulation for the province groundwater resources management

4 Groundwater resources in the province of Mendoza

(see topics of the Buenos Aires province)

5 Groundwater resources in the province of Santa Fe

(see topics of the Buenos Aires province)

6 General conclusion on the policy options for the three provinces in groundwater resources management and preliminary strategy formulation

7 Key references, mapping and bibliography
The main focus of the desk study is the economic and technological efficiency of Argentina irrigation subsector. The objectives of this desk study are: (i) to organize essential irrigation subsector information from the main representative Provinces; and (ii) prepare a synthetic report that clearly identify the physical, technological, economic, legal and institutional key issues related to the sustainable management of the Irrigation subsector in Argentina. These Key Issues will be analyzed together with other subsectors issues in order to organize policy notes and options for Water Resources Management in Argentina.

The report should have about 30 to 40 pages (in any case no more than 50 pages). All useful supporting information should be organized in annexes (major tables, graphs, maps).

The following is the suggested outline for the report.

1 Executive Summary and Objectives

2 The Irrigation Sub-sector in Argentina
   2.1 Regional context, climate and irrigation
   2.2 Main irrigation developments, valleys and Provinces
   2.3 Historic background Economic size of irrigation in agriculture
   2.4 Potential for the future
   2.5 Institutional set up
   2.6 Insertion in the water sector
   2.7 Main sources of water, quantity and quality
   2.8 Environmental issues, drainage and salinity
   2.9 Bank assistance to the irrigation sub-sector
   2.10 Main issues to address

3 Irrigation Development Models
   3.1 Institutional, legal and regulatory issues
   3.2 Provincial developments (case of Mendoza)
   3.3 Federal developments (cases of A&EE Provinces)
   3.4 Private Sector developments (cases of Cordoba and Santa Fe)
   3.5 Trends and challenges towards the future
4 Economic Efficiency Overview

4.1 Regional view of irrigation in Argentina (describe and make matrix table)
4.2 Main crops and related industry by region (describe and make matrix table - d.m.m.t)
4.3 Typical costs for on-farm and off-farm (d.m.m.t)
4.4 Typical farm models by region (d.m.m.t)
4.5 Yields and productivity (d.m.m.t)
4.6 Typical water productivity by region and cropping patterns (current situation and potential)
4.7 Water pricing, tariff design and cost recovery (by main Provinces)
4.8 Operation and Maintenance issues, costs and technology
4.9 Energy costs
4.10 Competitiveness (subsidies, import/export taxes, exchange controls and technology)
4.11 Main issues to address

5 Quick Comparative View of the Irrigation Sector with Other LAC Economies

5.1 Rationale for the exercise
5.2 Mexico
5.3 Chile
5.4 Brazil

6 Current National Sector Policies and Strategy

6.1 Overview of government Policies and Strategy
6.2 Research
6.3 Technology
6.4 Regulatory and water rights
6.5 Marketing
6.6 Financing
6.7 Key issues to address

7 Review of Key Representative Areas

Focus would be on: experience/lessons learned, economic and technological gains, technological improvements required/underway, water efficiency, water management and transfer of O&M functions.

7.1 Mendoza and San Juan
7.2 Rio Negro and Chubut
7.3 Santa Fe and Córdoba
7.4 Catamarca and Tucumán

8 Technological Issues

8.1 Research and Development
8.2 Education and Training
8.3 Operation and Maintenance Technology
8.4 Soil, Drainage, and Salinity Management
8.5 Private Irrigation and Drainage Industries and Business
8.6 Key issues to address

9 Institutional Issues
9.1 The role of Water Users Organization
9.2 Sustainable Water fees
9.3 Register of Water Rights and Uses
9.4 Transfer of Water Rights
9.5 The role of River Basin/Aquifer Users Committees
9.6 Issues and challenges

10 Key references, Bibliography, and Maps
ANNEX E

Argentina
Concept Paper

Outline for Water Quality Management

Objective

The consultant should carry out an assessment of impacts related to water quality management and control practices in the Province of Cordoba. The study would consist of: (i) a diagnosis of water quality issues; (ii) identification of policy gaps; and (iii) recommendations for short-term and long-term course of actions. The results of the study should provide guidance in prescribing policies, procedures and critical investments to be followed within the Province related to improving water quality control management activities, including the eventual establishment of water control plans, regulations, and enforcement.

Background

The Province of Cordoba suffers from various water quality problems. Examples of activities which create impact concerns for water quality include: (i) industrial plants withdrawing of surface water and discharging contaminated water (point source pollution); (ii) pollution of receiving waters from diffuse sources as a result of urban-area, industrial area, or rural runoff (pesticides, sediment, etc.); and (iii) natural occurring contamination of surface waters from groundwater sources, most commonly Arsenic.

Scope

Readings

The consultant is to read the given reports and conduct additional research as required, using the bibliographies of the given reports as a source for additional information.

Water Quality Issues

The consultant should evaluate water quality impacts based on land use determinants and land use patterns. From this evaluation the consultant should then identify and characterize six main water pollution areas within the Province, both qualitatively and quantitatively (at least in terms of magnitude). These six locations should be prioritized based on the use of common water quality degradation indicators, such as biodegradable organic, pathogens, nutrients, priority pollutants, heavy metals, refractory organic, etc. This should also include a summary of pollution sources and water uses.

The consultant shall also identify key issues related to information monitoring and management, such as gaps pertaining to water quality data collection, water quality data application, reporting, etc.
It is recommend that the consultant enter into contact with the consultant N. Quang Trac, whom is carrying out a similar study for the World Bank related to groundwater issues in the Provinces of Buenos Aires, Santa Fe and Mendoza.

Regulatory and Institutional Analysis

A review of water-quality and land use legislation should be conducted, with the primary objective of understanding the framework of the regulations in Cordoba. Such analysis would include: (i) sectorial policies and strategies; (ii) regulators; (iii) legislation on investments, financing and cost recovery; (iv) water quality standards; (v) user organizations and their participation in water resource management; (vi) water rights; and (vii) among others.

It is recommend that the consultant enter into contact with the consultant Cesar Magnani, whom is carrying out a similar study for the World Bank related to legal and institutional aspects of water resource management in Argentina.

Identification of Policy Gaps

From the above analysis, the consultant shall identify and report the existing gaps that need to be bridged in order to develop a sound water quality management program at the provincial level, while still respecting federal regulations, inter-provincial mandates, and other constraints.

Options and Recommendations

The consultant’s options and recommendations should be for: (i) short-term physical actions required to improve water quality based on the prioritized locations; and (ii) filling in the existing gaps in water quality standards, planning, and enforcement, based on tools used in other countries, such as Brazil and Mexico. Recommendations should be prioritized in order of importance.

Time Schedule

Completion of the assignment is expected to take two weeks, beginning on or about May 4, 1999. During the first week the consultant should read given materials and research as required and carry out a field visit to the Province of Cordoba and meet with the responsible authorities. During the second week, the consultant shall prepare his report.

Product

A report summarizing the consultant’s analysis, conclusion, and recommendations, including and executive summary and bibliography.
Reporting

The report should be submitted by the close of business on May 14, 1999, both in hard copy version and on a diskette using Microsoft Word 97 (or a compatible software tool), addressed to:

Mr. Abel Mejia
Room I5-193
1818 H Street, NW
Washington, DC 20433
USA

Furthermore, the consultant should be available to provide complementary comments and answer any questions that may arise from the review of the submitted report.
**ANNEX F**

**Argentina -- Concept Paper**

**PROCESSING OF ESW**

===========================================================================================================

**Step 1** Workshop

**Step 2** Identification of Key Issues and Preselection of Consultants

**Step 3** Formulation of Methodology, ToRs, Assignment of Consultant

**Step 4** Completion of Local Consultants work and Analytical exercise

**Step 5** Integration of Final Report

**Step 6** Presentation and Discussion with Federal and Provincial Level

**Step 7** Dissemination