

**JAPAN INTERNATIONAL
COOPERATION AGENCY**

**POTABLE WATER AND SEWERAGE SERVICE OF LIMA
THE GOVERNMENT OF THE REPUBLIC OF PERU**

**STUDY
ON
INTEGRATED WATER RESOURCES DEVELOPMENT
IN THE CAÑETE RIVER BASIN
IN
THE REPUBLIC OF PERU**

FINAL REPORT

VOLUME IV SUPPORTING REPORT

**M. SUPPLEMENTAL INVESTIGATION ON
WATER USE AND LOSS IN RÍMAC RIVER BASIN**

JANUARY 2002

**NIPPON KOEI CO., LTD.
PACIFIC CONSULTANTS INTERNATIONAL**

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**STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT
IN THE CAÑETE RIVER BASIN
IN THE REPUBLIC OF PERU**

LIST OF FINAL REPORT VOLUMES

Volume I : Executive Summary/ *Resumen Ejecutivo*

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A: Topographic Survey

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H: Facilities Plan

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J: Socio-Economy and Finance

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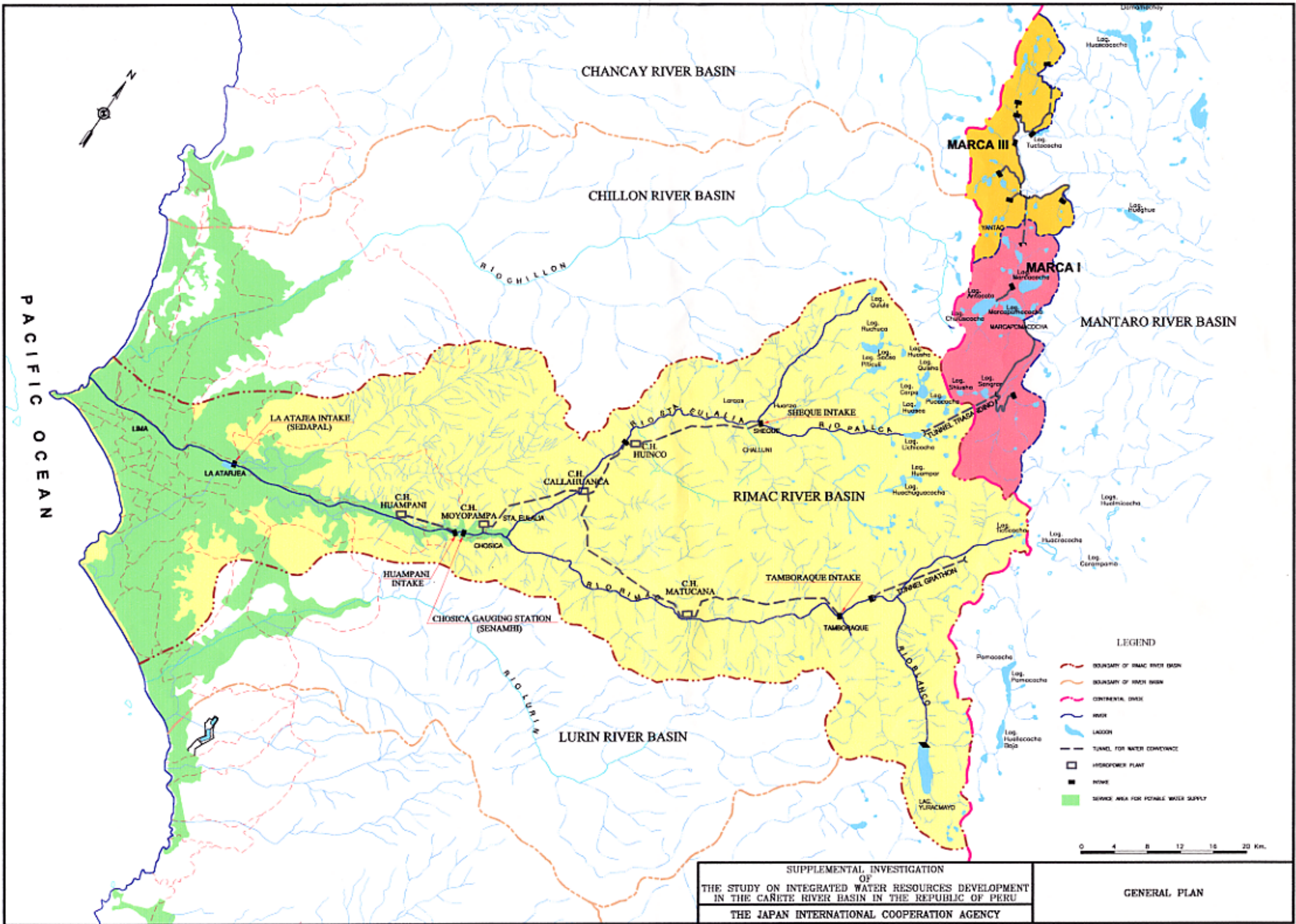
**M: Supplemental Investigation on Water Use and Loss
in Rímac River Basin**

Volume V : Data Book

The cost estimate is based on the price level and exchange rate of September 2001.

The exchange rate is :

US\$1.00 = ¥120.0



PACIFIC OCEAN

CHANCAY RIVER BASIN

CHILLON RIVER BASIN

MANTARO RIVER BASIN

RIMAC RIVER BASIN

LURIN RIVER BASIN

MARCA III

MARCA I

LA ATARJEA INTAKE (SEDAPAL)

LA ATARJEA

C.H. HUAMPANI

C.H. MOYOPAMPA

C.H. CALLAHUANCA

CHOSICA GAUGING STATION (SENAMHI)

C.H. MATUCANA

TAMBORAQUE INTAKE

TAMBORAQUE

LA ATARJEA INTAKE (SEDAPAL)

SEBQUE INTAKE

TUNNEL TRASA BORO

TUNNEL GRATHON

LEGEND

- BOUNDARY OF RIMAC RIVER BASIN
- BOUNDARY OF RIVER BASIN
- CONTINENTAL DIVIDE
- RIVER
- LAGOON
- TUNNEL FOR WATER CONDUIT
- HYDROPOWER PLANT
- INTAKE
- SERVICE AREA FOR POTABLE WATER SUPPLY

0 4 8 12 16 20 Km.

SUPPLEMENTAL INVESTIGATION
OF
THE STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT
IN THE CAÑETE RIVER BASIN IN THE REPUBLIC OF PERU
THE JAPAN INTERNATIONAL COOPERATION AGENCY

GENERAL PLAN

SUMMARY AND RECOMMENDATIONS

Table S1 illustrates the summary of discussions made in the following Sections with regard to the issues about 'Potable water demand & supply and Water management'. The table compares the figures in the 1998-SEDAPAL M/P and the updated figures in this P/R (2) for the purpose to see eventually the priority of river basin, Mantaro or Cañete, for 'new water sources development' and 'water management'.

1. Potable Water Demand and Supply

(1) Demand Estimate (See details in Section 4.1, Figure 4.1.2)

Demand estimate made in 1998-SEDAPAL M/P was updated in April 2001 to an estimate made by BLASA (Consulting firm in Lima), which indicates;

- * Effect of demand reduction by means of metering/pipe rehabilitation will be realized at the maximum in 2005, from 32.1 m³/sec in 2000 to 26.4 m³/sec in 2005.
- * Estimate in 2030 is 40.2 m³/sec, almost the same as 40.7 m³/sec in 1998-M/P.
- * Actual water production in the year 2000 was 21.4 m³/sec to be compared to the demand estimate 32.1 m³/sec.

(2) River Runoff at Chosica and Water Loss (See details in Section 3.2, Figure 3.2.1 and Table 3.2.5)

Runoff at Chosica (gauging station of SENAMHI about 32 km upstream of the Atarjea SEDAPAL intake) has been gauged at 22.1 m³/sec in average and 14.7 m³/sec in 90% return period, in terms of monthly mean in 1973/1997.

Historical monthly mean runoff record and daily mean runoff measurements made in this study period indicate that:

- * River water loss between Chosica and Atarjea is gauged between 3.5 m³/sec and 9.1 m³/sec, say 6 m³/sec in average.
- * The loss may be attributed chiefly to 'Infiltration' by 2 m³/sec in the maximum and 'Irrigation/Industry water take' by 4 m³/sec.

(3) Groundwater Take (See details in Section 2.5 and 4.3)

Over-pumping of the groundwater in the coastal area of the Rímac river basin in the Lima city area has contributed drawdown of groundwater table, by inviting an increase of non-operable wells as well as an increase of salinity of the pumped up water. Groundwater take has therefore been reduced from 11.3 m³/sec in 1998 as reported in the 1998-M/P to 6.0 m³/sec in 2000 as in the revised M/P, and planned to be further reduced to 5.0 m³/sec to attain a balanced-stable take.

(4) Supply Schedule (See details in Section 4.3, Figure 4.3.4)

To meet with the updated estimate of water demand upto the year 2030, development of water source will be required, including the committed implementation (Marca II by 6.5 m³/sec and Huascacocha by 2.5 m³/sec) followed by new supply:

- * In case without counting the river water loss (6 m³/sec), in the year 2021 by 5 m³/sec (probably the Mantaro-Carispacha scheme planned in the 1998-M/P).
- * In case with counting the river water loss, in other words in case without any provision to squeeze the water loss, in the year 2011 by 5 m³/sec (probably the same Mantaro-Carispacha) to meet with the demand upto the year 2019, followed by 5.4 m³/sec new source (probably other source in the Mantaro basin) for 2030 demand.

(5) Economic Priority of New Supply (See details in Sections 5.2 and 4.4)

The Cañete river water is being deployed by Cementos Lima (Private firm in Lima) as 'EL PLATANAL Integrated Project' for the development of total 270 MW power production and total 27,000 ha irrigation, with construction of a storage named Moro de Arica dam in the upstream stretch of the Cañete river.

It is therefore necessary to implement some additional facility to yield new water for the purpose to transfer the Cañete river water to Lima:

- * Option for the additional facility to yield new 5 m³/sec water is deemed to be a construction of storage named San Jerónimo in the midstream or a construction of both Paunacocha dam at a upstream glacial lake, and 3 m³/sec groundwater wells in the downstream coastal area.
- * Economic comparison of the alternatives for yielding 5 m³/sec water between the above Cañete basin facility and the Mantaro basin facility (Mantaro-Carispacha scheme) shows that the latter is preferred.
- * Further, it would be the case that the transfer of Cañete river water to other basin, namely to Lima, invites serious objection by the people in the Cañete basin.

With the assumption of no provision for squeezing the current water loss in the Rímac river, new implementation of water source, following to the committed Marca II and Huascacocha schemes, will be required in the year 2012, for which development in the Mantaro basin would be preferred option.

2. Water Management

(1) Water Quality (See details in Section 3.3)

Water quality in the Rímac river is currently an acute issue in pollution with heavy metal from mining, sewerage water from residence, and drainage water from agricultural lands and industries. Raw water quality (before treatment) sometimes exceeds the tolerable value in Peruvian water law, e.g. maximum 240,000 PMN/100 ml of Coliform for 4,000 in tolerance, maximum 7.31 mg/l of BOD for tolerance 5 and maximum 5.45 mg/l of Pb for tolerance 0.05.

(2) Institutional Arrangement (See details in Section 2.3)

Water in the Rímac river is in multiple use for potable water production, hydropower production and irrigation/industrial uses. Runoff regulation is agreed between SEDAPAL for potable water and EDEGEL for hydropower with a coordination by COES, however agreement with the agricultural/industrial users is not formalized. Rule of water allocation, especially in drought period, has yet to be established.

(3) Cañete River Development (See details in Section 5.2)

As explained in the foregoing paragraph 1 (5), Cañete river development is being proceeded to allocate the water to an irrigation scheme, resulting in most probably that new water supply to Lima upto the year 2030 would be preferred on the Mantaro basin development. If this is the case that Cañete basin water transfer is not immediate issue, SEDAPAL would then have less linkage to the management of the Cañete river basin.

Water management in the Rímac river basin is deemed more important than the management in the Cañete river basin.

It is conclusively recommended that the priority of river basin is placed on the Mantaro river basin for ‘new water sources development’ and on the Rímac river basin for ‘water management’.

**STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT IN
THE CAÑETE RIVER BASIN IN THE REPUBLIC OF PERU
SUPPORTING REPORT**

**M: SUPPLEMENTAL INVESTIGATION ON WATER USE
AND LOSS IN RÍMAC RIVER BASIN**

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ANNEX

Annex I	Meteorology - Hydrology
Annex II	SEDAPAL Demand - Supply Balance
Annex III	Moritz's Formula
Annex IV	Water Balance

LIST OF ACRONYMS

AACH	:	Autoridad Autónoma de la Cuenca Hidrográfica (Autonomous Hydrographic Basin Authority)
ATDR	:	Administración Técnica de Distrito de Riego(Technical Administration for Irrigation District)
COES	:	Comité de Operación Económica del Sistema Interconectado Nacional (Committee for Economic Operation of the National Interconnected System)
CONAM	:	Consejo Nacional del Ambiente (National Environment Council)
DGAA	:	Dirección General Asuntos Ambientales (Directorate General for Environmental Affairs)
DGAS	:	Dirección General de Aguas y Suelos (General Board of Water and Soil)
DGE	:	Dirección General de Electricidad (Directorate General for Electricity)
DGM	:	Dirección General de Minas (Directorate General for Mining)
DIGESA	:	Dirección General de Salud Ambiental (Directorate General for Environmental Health)
EDEGEL	:	Empresa de Generación Eléctrica de Lima S.A. (Electric Generation Company of Lima)
ELECTROPERU	:	Empresa de Electricidad del Perú (Peru Electricity Enterprise)
FONCODES	:	Fondo Nacional de Compensación y Desarrollo (National Fund for Compensation and Social Development)
IDB	:	Inter-American Development Bank
INADE	:	Instituto Nacional de Desarrollo(National Institute of Development)
INDECI	:	Instituto Nacional de Defensa Civil (National Institute of Civil Defense)

INRENA	:	Instituto Nacional de Recursos Naturales (National Institute of Natural Resources)
JBIC	:	Japan Bank for International Cooperation
JICA	:	Japan International Cooperation Agency
MAG	:	Ministerio de Agricultura (Ministry of Agriculture)
MD	:	Ministerio de Defensa (Ministry of Defence)
MEF	:	Ministerio de Economía y Finanzas (Ministry of Economy and Finance)
MEM	:	Ministerio de Energía y Minas (Ministry of Energy and Mining)
MIPRE	:	Ministerio de la Presidencia (Ministry of Presidency)
MITINCI	:	Ministerio de Industria, Turismo, Integración y Negociaciones Comerciales Internacionales (Ministry of Industry, Tourism, Integration and International Trade)
MS	:	Ministerio de Salud (Ministry of Health)
OECE	:	The Overseas Economic Cooperation Fund, Japan
OUA	:	Organizaciones de Usuarios de Aguas (Water Users' Association)
PRONAMACHS	:	Proyecto Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos (National Program for River Basin Management and Soil Conservation)
SEDAPAL	:	Servicio de Agua Potable y Alcantarillado de Lima (Potable Water and Sewage Service of Lima)
SENAMHI	:	Servicio Nacional de Meteorología e Hidrología (National Service for Meteorology and Hydrology)
SUNASS	:	Superintendencia Nacional de Servicios de Saneamiento (National Superintendence of Sanitary Service)