ASIAN DEVELOPMENT BANK **TAR: NEP 34571**

TECHNICAL ASSISTANCE
(Financed from the Japan Special Fund)

TO THE

KINGDOM OF NEPAL

FOR

OPTIMIZING WATER USE IN KATHMANDU VALLEY

August 2001

CURRENCY EQUIVALENTS
(as of 15 July 2001)

Currency Unit	–	Nepalese Rupee/s (NRe/NRs)
NRs1.00	=	$0.01335
$1.00	=	NRs74.89

(i) The Nepalese rupee is pegged to the Indian rupee (Re) at NRs1.60 to Re1.00. It is fully convertible on all current account transactions.
(ii) For the calculations in this report, an exchange rate of NRs72.00 was used. This was the rate prevailing at the time of fact-finding.

ABBREVIATIONS

CIDA	–	Canadian International Development Agency
JICA	–	Japan International Cooperation Agency
KVWA	–	Kathmandu Valley Water Authority
MLD	–	million liters per day
MPPW	–	Ministry of Physical Planning and Works
MWR	–	Ministry of Water Resources
MWSDB	–	Melamchi Water Supply Development Board
NWSC	–	Nepal Water Supply Corporation
WECS	–	Water and Energy Commission Secretariat

NOTE

In this report, "$" refers to US dollars.

I. INTRODUCTION

1. In response to a request from His Majesty's Government of Nepal, a Fact-Finding Mission (which coincided with the appraisal of the Melamchi Water Supply Project) visited Nepal from 17 September to 4 October 2000, to formulate an advisory technical assistance (TA) project for optimizing water use in Kathmandu Valley. Another Mission from 21 April to 4 May 2001 discussed with the Government the scope, costs and implementation arrangements for TA.[1] The TA framework is in Appendix 1.

II. BACKGROUND AND RATIONALE

2. The Kathmandu Valley has a drainage area of 620 square kilometers (km^2) and is home to about 1.4 million people. The population is growing at up to 7 percent per annum in some urban areas and 4 percent per annum throughout the valley. The existing water supply system operated by the Nepal Water Supply Corporation produces about 120 million liters per day (MLD) in the wet season and 80 MLD in the dry season from a combination of surface water and groundwater sources. However, unaccounted-for water is estimated at 40 percent of production. Most people receive piped water for about two hours every two days in the dry season and resort to tankered and other sources of water. Against this supply situation, the demand is around 150 MLD.

3. The Kathmandu Valley on average receives 1,400 millimeters of rainfall per year. Most of this rainfall flows out of the valley as surface runoff. Rainwater harvesting at the community and household level is not practiced and storage to supplement the public supply in the dry season is only available in-house. The main problem is that the valley receives most of its rainfall in July-September, thus requiring a large storage to ensure water for use over the rest of the year. The other problem is that the removal of vegetative cover in the past, and the nature of the soils and geology prevent most rainwater from seeping into underground aquifers to allow its use throughout the year. Water conservation is not practiced and within the valley, there are a number of competing water uses.

4. Water is used for agricultural, industrial, commercial, domestic, recreational, and environmental purposes. Factors affecting demand include town planning, land in agriculture, type of agriculture, population, tourist population, public awareness and education, tariffs, industrial development, alternative water sources, groundwater licensing, access to coverage with piped supply, and quality of water.

5. Water sources include rainwater, surface water, groundwater, and interbasin transfers from the Melamchi, Yangri and Larke Rivers in 2007, 2011, and 2018. Factors affecting supply include watershed cover, water rights, efficiency of irrigated or piped distribution, rainwater harvesting, artificial recharge of groundwater, unaccounted-for water, recycling of wastewater, and climate change by season.

6. In December 2000, the Asian Development Bank (ADB) approved a loan of $120 million toward a $464 million Melamchi Water Supply Project that will bring 170 MLD of water from the Melamchi Valley through a 26 km tunnel to the Kathmandu Valley. When the options for additional water supply to Kathmandu Valley were being studied in 1985-2000, a number of in-valley actions that could improve the situation were identified: further groundwater development, trading water rights, damming of some of the rivers to store wet season flows, harvesting rainwater, excavating shallow Sri Lankan-style tanks, recycling wastewater, and artificially recharging groundwater. These possibilities were examined in the context of least-cost alternatives, current and anticipated social and political realities, and the likely speed of reforms. When out-of-valley alternatives were also looked at, the Melamchi option involving phased transbasin supply from the Melamchi, Yangri, and Larke rivers was identified as the overall best option for a long-term supply to Kathmandu

[1] The TA first appeared in *ADB Business Opportunities* on 14 December 2000.

Valley. The decision to implement the Melamchi option allows more time to fully study the various in-valley options, as the need for optimizing water use is still great. Implementing that option can provide some relief to the people of Kathmandu Valley in the pre-Melamchi period, will delay the time for investments in the Yangri and Larke river basins, and will minimize the water to be transferred each dry season from the three river basins. Optimizing water use in Kathmandu Valley is not an alternative to the Melamchi, Yangri, and Larke developments; it is an action that will complement these developments and will satisfy the people from those three river basins that the people of Kathmandu Valley are doing the best they can with water use. It is also necessary to ensure that conjunctive use of groundwater (in-valley) with surface water (transbasin) is both technically appropriate and economically cost-effective.

7. Other aid agency activities to improve the water situation in Kathmandu Valley include the proposed 15 MLD-25 MLD Manohara well field development, for which funding assistance is expected from the Japan International Cooperation Agency (JICA), and a small-scale groundwater development for a community of about 5,000 people that is being supported by Canadian International Development Agency (CIDA) Inc. The latter project was initially seen as an adjunct of the Optimizing Water Use TA, but due to timing, administrative, and scope considerations, the link was cut. Some initial activities in computer modeling in that project will be helpful to this TA and liaison will still be maintained.

8. There is a need to identify stakeholders – managers, users, and social auditors[2] of water – in Kathmandu Valley, to learn about earlier studies, to facilitate their interactions on ways and means of improving the water supply and demand balance, and to obtain agreement among them on the basic assumptions on which the proposed improvements are based. There is a need to research available literature and reports for relevant data and to update that data in the field, as well as obtain data in new areas. Finally, there is a need for a computer model to encapsulate the stakeholder recommendations and the data and then simulate various development and management scenarios as bases for better planning and policy decisions.

9. Policy decisions will include relocating industries outside the valley, requiring all new buildings to have rainwater collection and storage facilities, limiting the boundaries of urban development, trading of water rights, rehabilitating watersheds, demand management by pricing, etc. The Government has affirmed its intention to act on the findings of the model and to continually update the model with the latest information. This exercise will give political leadership the much-needed impetus to regulate growth in Kathmandu Valley.

III. THE TECHNICAL ASSISTANCE

A. Objective

10. The TA will (i) create a tool for optimal use of water within Kathmandu Valley based on an accurate knowledge of all sources and all demands, and (ii) identify immediate improvements to the water supply situation in Kathmandu Valley. The objectives are consistent with both ADB's and the Government's water sector strategies. The TA is a high Government priority, as it is needed to complement the major developments in the Melamchi Water Supply Project.

B. Scope

11. The TA will have eight principal tasks: (i) understanding the existing situation of water resources and use in Kathmandu Valley by examining all available studies and literature; (ii) identifying and quantifying the main factors affecting supply and demand of water; (iii) collecting data and surveys to establish a database on supply and demand; (iv) evaluating supply and demand, including ranges of values and a most likely value of volume and cost for given points in time; (v) inputting factors into the computer model and simulation trials; (vi) demonstrating and

[2] Academics, nongovernment organizations, journalists, lawyers.

explaining the computer model to key stakeholders; (vii) training stakeholders in the use and maintenance of the computer model; and (viii) preparing an action plan for water resource management based on the initial findings.

12. An understanding of the existing situation will necessitate preparing an annotated bibliography dealing with water resources and their use in Kathmandu Valley. The focus will be on studies and findings of the feasibility study[3] of water demand and water sources and subsequent studies or reviews that have modified those findings. Urban development strategies and plans for Kathmandu Valley, and ways and means of regulating growth will be also reviewed.

13. The main factors affecting water supply and demand will be identified. Appendix 2 provides indicative water supply and demand scenarios. Other sources and demands may exist and other factors affecting supply and demand may be identified. All those will be agreed upon in a stakeholder workshop. Activities to enhance each factor will also be agreed upon with the stakeholders.

14. The data collection and surveys for the TA will concentrate on establishing reliable and timely sources of data and mechanisms for its collection. In the past, much data was collected under project conditions, whereas the data required for the computer model must be generated through sustainable financial and human resources. Many agencies may have data, but it is important that it be collated into one database accessible to all. Gaps and weaknesses in the database and collection will be identified. Surveys will involve farmers, and domestic and industrial consumers of water.

15. The computer model will only be as good as the nature and quality of the data fed into it. Most of the data will initially come from existing reports prepared for the Melamchi Water Supply Project (1988-2000), the advisory TA Urban Water Supply Reforms in Kathmandu Valley (1999-2000), the ongoing Groundwater/Surface Water Monitoring being undertaken by the Melamchi Water Supply Development Board (MWSDB) and Ministry of Water Resources (MWR), the ongoing flow gauging in the Melamchi River, IUCN's Regulating Growth in Kathmandu Valley (1995), etc. The 2001 population census data should be available early for inclusion in the model. Data from the field will include farmer interviews about land prices and willingness to trade water rights, updated inventories of springs and water spouts, the costs and practicality of domestic rainwater harvesting, and results from the ongoing pilot artificial recharge project. Good topographic maps of Kathmandu Valley are available and will be supplemented and updated with the latest satellite imagery. The TA consultants will assess the accuracy of the data being collected and propose ways and means for it to be continually refined.

16. The main elements will be input into the computer model, with each input factor having a range of values between the most optimistic and most pessimistic scenarios. The relationships among factors – how one will or can affect any other factor – will be agreed upon and input as an assumption. A most reasonable scenario will then be derived for any given point in time. Some time may be required to iron out links in the model; it may be necessary to revisit assumptions and ranges of factors.

17. Presenting the computer model to key stakeholders will give the opportunity to recheck the validity of assumptions (including the realities of making recommended actions feasible). This will be the time to include politicians as stakeholders and to obtain commitments for the future. It will be important that a number of "what if" scenarios be demonstrated to promote discussion on the best path to pursue.

[3] Greater Kathmandu Water Supply Project, Snowy Mountains Engineering Corporation Ltd. (SMEC), et al. Nov. 1992.

18. After the model has proven to be a useful tool in developing and managing water resources, stakeholders from the main water sector agencies will be trained in using and maintaining the model and in pursuing improvements in the database and data collection.

19. An action plan for improved water resource management will be developed at a workshop of key stakeholders, after discussion of the "what-if" scenarios. The various responsibilities will be distributed, the activities timed and costed, and funding secured.

C. Cost Estimates and Financing Plan

20. The Project is estimated to cost $0.925 million equivalent and will be funded on a grant basis from the Japan Special Fund, funded by the Government of Japan ($0.775 million), and the Government ($0.150 million equivalent). Foreign exchange costs are estimated at $0.500 million and local currency costs at $0.425 million equivalent, of which the Government will finance the equivalent of $0.150 million through the provision of logistical support (Appendix 3).

D. Implementation Arrangements

21. This TA is about setting up a process and making it operational, i.e., the continuous computer modeling of water availability, supply, and use in Kathmandu Valley. The information will be used by a task force of stakeholders, all of whom will be invited for training during the TA: representatives of Government departments dealing with water supply, irrigation, meteorology and hydrology, urban development, environment, groundwater, forestry, etc. as well as the MWSDB and the Water and Energy Commission Secretariat (WECS). Nongovernment organizations such as the Forum of Environmental Journalists and members of civil society such as the Nepal Water Conservation Foundation who champion the cause of water management; a representative from the Federation of National Chambers of Commerce and Industry; and representatives of the major local governments in the Kathmandu Valley.

22. The Government has already appointed a project director to promote the Project. The appointee has had a career in MWR and was a former executive director of WECS. The Executing Agency will be MPPW and the Implementing Agency MWSDB, which will continue to be responsible for the computer model until the Kathmandu Valley Water Authority (KVWA) is established. The steering committee for the TA will comprise a chairman, a member of the National Planning Commission (for Water), the secretary of the Ministry of Physical Planning and Works (MPPW), and the secretary of MWR. The steering committee's role is to ensure cooperation and coordination among the interacting government agencies and to ensure that such agencies provide adequate budgets for appropriate generation and collection of data. The committee will also play a key role in helping to define government policy based on the findings of computer modeling. The project director will report to the steering committee at least every three months regarding progress, but specifically to ensure interagency cooperation and support.

23. The project director will also be the consultant deputy team leader during TA implementation and the caretaker of the computer model until it is properly established in the KVWA. He will liaise closely with the task force of stakeholders throughout that period. The task force will have three main roles: first, to give views on the assumptions to be adopted as a base for computer modeling; second, to learn how to use the model for generating "what-if" scenarios as inputs to government policy and planning; and third, to pursue the gathering of better data for continued refining of the model.

24. The TA will be implemented over eight months (commencing January 2002), by a consulting firm recruited in accordance with ADB's *Guidelines on the Use of Consultants*. A total of 18 person-months of international consultants and 52 of domestic consultants will be required, with expertise in water supply engineering, sanitary engineering, irrigation engineering, water resource economics, hydrogeology, hydrology, financial analysis, sociology, urban development, database

management, computer modeling, and environment. The 14 person-months of international consulting services for the water supply engineer, computer modeler, and database expert will be input in Nepal, and the 4 person-months for other disciplines will be tapped at the home office as and when required. Government counterpart personnel in similar or related disciplines will provide 48 person-months support to the Project and will be in place before the consultants are mobilized. Skills transfer from the international to domestic consultants and Government counterparts will be formalized and comprise no less than 10 percent of the total international consultant input time. Outline terms of reference for consulting services are in Appendix 4. The consultants will procure equipment in accordance with ADB's *Guidelines for Procurement*.

25. An initial workshop for the stakeholders concerned, will be conducted at the end of the first month to review the inception report, identify and summarize all relevant previous studies, and comment on the consultant's proposed approach. A second stakeholders workshop will be convened after four months to review the supply and demand factors and their quantification. A final workshop will be held after seven months to review the consultant's computer model and draft final report. The final report will be submitted at the end of eight months in 50 copies as well as on diskette (soft copy). At the same time, the computer model will be handed over to the Government.

26. The Government will provide appropriate modern office space in the same building or close to other consultants working on the Melamchi Water Supply Project.

27. The transition period of about 18 months between the TA's conclusion and the KVWA take over of responsibility for computer modeling will be handled as follows: the project director will be responsible for computer modeling during this phase. His position will be funded by MWSDB. He will not need any extra assistance from human resources, since the task force of stakeholders responsible for improving and gathering data will have specifically targeted government budgets.[4] The steering committee will remain in place, with the project director reporting to it. Day-to-day matters will be handled by MWSDB, which also has on its board, representatives from MWR, Ministry of Finance, and MPPW. The KVWA will be in its formative stage during the transition period. Legislation will be passed, staff recruited and premises established. The main players are likely to be MWR, MPPW, and the local governments in Kathmandu Valley. Since the formation of the KVWA will have a high political profile, and computer modeling will be the centerpiece of future development and management in the Kathmandu Valley, it is certain to attract both support and interest. Indeed civil society has already given notice it wishes to be an active participant in defining future policy and plans based on computer modeling. Because the setting up of the KVWA is a time-bound loan covenant under the Melamchi Water Supply Project, MWSDB will also be working to establish the KVWA.

28. For the long-term sustainability of the Project, the computer model will be owned by the KVWA, which will have its own sources of funds for comprehensive management of water resources within Kathmandu valley. The funds are expected to be derived from water user charges for groundwater, piped water, and irrigation.

IV. THE PRESIDENT'S DECISION

29. The President, acting under the authority delegated by the Board, has approved the provision of technical assistance, on a grant basis, to His Majesty's Government of Nepal in an amount not exceeding the equivalent of $775,000 for the purpose of Optimizing Water Use in Kathmandu Valley and hereby reports such action to the Board.

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4 Groundwater monitoring is expected to be funded by user fees from groundwater licensing even before the formation of KVWA.

Appendix 1

TECHNICAL ASSISTANCE FRAMEWORK

Design Summary	Project Targets	Monitoring Mechanisms	Assumptions and Risks
I. Sector Goal			
Enhance human development through appropriate water development and management	Optimizing water use in Kathmandu Valley	Nongovernment organizations and water consumer Groups will monitor.	Control of water resources and use with many agencies
II. Project Objectives			
Optimal management of water within the Kathmandu Valley based on all sources and all uses Immediate improvements to the water situation in Kathmandu Valley	Create a tool for optimal use of water within Kathmandu Valley based on an accurate knowledge of all sources and all demands, and identify immediate improvements to the water supply situation in Kathmandu Valley	Steering Committee Melamchi Water Supply Development Board (MWSDB) Stakeholder Task Force	Sustainable data collection Sustainable computer modeling Decision-makers to act on model findings
III. Components			
Database for sources including interbasin, rainwater, surface water, and groundwater Database for demands including agricultural, industrial, domestic, and environmental PC hardware and software	Advisory TA to be completed over 8 months commencing January 2002 Main outputs are (i) a computer model (ii) an agreed upon action plan	ADB missions Ministry of Physical Planning and Works MWSDB	Funding may be required to improve database. Computer modelers may need incentives.
IV. Activities			
(i) Review the literature (ii) Define relevant factors (iii) Collect data/ survey (iv) Evaluate factors/ data (v) Input data to model (vi) Demonstrate model (vii) Train staff (viii) Prepare action plan for water resource management	Consultant inputs (person-months) International 18 Domestic 52 Computer model hardware+software+ human resource team	ADB missions Ministry of Physical Planning and Works MWSDB	Appropriately motivated counterpart staff

(Reference in text: page 1, para. 1)

INDICATIVE WATER SUPPLY SCENARIO
Table A2.1: Primary Sources

Source	Year	Volume (m^3/d)	Cost ($m)	Influence or Risk Factors
Rivers in KV	0	50,000	0	UFW, season small-scale providers
Groundwater in KV	+5	65,000	15	UFW, season, industry, licensing
Reduction in UFW	+10	25,000	15	Regulatory/PSP distribution rehabilitation
Springs in KV	+10	50,000	25	Irrigation, cropping, efficiency, trading water rights
Shallow Wells in KV	0	25,000	0	Season, pollution
Spouts in KV	0	25,000	0	Season, bottled water, small-scale providers
Rainwater in KV	+5	10,000	20	Season, socioeconomics storage
GW recharge in KV	+10	30,000	60	Season/location
Recycled Wastewater	+10	100,000	150	Pollution
Watershed Rehab KV	+12	50,000	25	Season, socioeconomics
Dams KV	+15	60,000	80	Season, land cost
Tanks KV	+5	30,000	20	Season, land cost
Transbasin Melamchi	+7	170,000	450	Trading water rights
Transbasin Yangri	+11	130,000	50	Trading water rights
Transbasin Larke	+18	150,000	50	Trading water rights
Watershed Rehab MYL	+18	100,000	30	Season, socioeconomics

GW = groundwater, KV = Kathmandu Valley, m^3/d = cubic meter per day, MYL = Melamchi, Yangri, Larke, PSP = private sector participation, UFW = unaccounted for water.
Note: Figures given are illustrative only, and are not to be taken as a guide for design.
Example: Rivers in KV and Influence of Season on Supply
Assumption: Dry Season Volume of Water Supply = 50,000 m^3/d
Wet Season Volume of Water Supply = 80,000 m^3/d

(Reference in text: page 3, para. 13)

Table A2.2: Primary Demand

Demand	Year	Volume m^3/d	Influence or Risk Factors
Domestic HC	+10	150,000	Price, tariff structure, connection fee, plumbing, alternative sources, income
Domestic YT	+10	25,000	Public awareness, regulatory, alternative sources
Domestic SP	+10	25,000	Public awareness, regulatory, alternative sources
Domestic SSSP	+10	25,000	Town planning, regulatory Alternative sources
Domestic SW	+10	30,000	Water quality, awareness
Domestic DTW	+10	5,000	Income, licensing
Institutional	+10	15,000	Regulatory
Commercial	+10	20,000	Price
Industrial	+10	30,000	Relocation of industry, bottled water, licensing of GW/price
Irrigation	+10	15,000	Trading of water rights, land in agriculture change in crops
Environment	+10	25,000	Religious, biological, recreational, aesthetics, pollution
Others	+10	5,000	Public parks and reserves, etc.
Total	**+10**	**370,000**	**Population**

DTW = deep tube well, m^3/d = cubic meter per day, HC = house connection, SP = standpipe, SSSP = small-scale service provider, SW = shallow well, YT = yard tap.
Note: Figures given are illustrative only and are not to be taken as a guide for design.

Example: Domestic HC and Influence of Price on Demand

Current: Average Tariff NRs10/m^3 — Demand = 100,000 m^3/d

Assumptions:

A. Average Tariff NRs20/m^3 — Demand = 95,000 m^3/d
B. Average Tariff NRs40/m^3 — Demand = 50,000 m^3/d
C. Average Tariff NRs80/m^3 — Demand = 10,000 m^3/d

For "what-if" scenarios, assumptions A, B, C can be used directly or can be produced as a curve and interpolations of intermediate results used.

Appendix 3

COST ESTIMATES AND FINANCING PLAN
($'000)

Item	Foreign Exchange	Local Currency	Total Cost
A. Asian Development Bank Financing[a]			
1. Consultants			
a. Remuneration and Per Diem			
i. International Consultants	360.0	0.0	360.0
ii. Domestic Consultants	0.0	130.0	130.0
b. International and Local Travel	15.0	20.0	35.0
c. Reports and Communications	7.0	5.0	12.0
2. Equipment and Supplies[b]	30.0	25.0	55.0
3. Surveys and Data Collection	0.0	40.0	40.0
4. Workshops	0.0	20.0	20.0
5. Representative for Contract Negotiations	3.0	0.0	3.0
6. Contingencies	85.0	35.0	120.0
Subtotal (A)	**500.0**	**275.0**	**775.0**
B. Government Financing			
1. Office Accommodation and Utilities	0.0	36.0	36.0
2. Remuneration and Per Diem of Counterpart Staff	0.0	24.0	24.0
3. Workshops (2)	0.0	20.0	20.0
4. Transport	0.0	10.0	10.0
5. Communications	0.0	10.0	10.0
6. Administration	0.0	30.0	30.0
7. Contingencies	0.0	20.0	20.0
Subtotal (B)	**0.0**	**150.0**	**150.0**
Total	**500.0**	**425.0**	**925.0**

[a] Financed by ADB on a grant basis from Japan Special Fund.
[b] Includes computer hardware and software, photocopier, river gauging equipment, rain gauging equipment, groundwater monitoring equipment, and aerial photos, maps, satellite imagery.
Source: Staff estimates.

(Reference in text: page 4, para. 20)

OUTLINE TERMS OF REFERENCE FOR CONSULTING SERVICES

A. Objective

1. The consultants will prepare a computer model and train counterpart staff to help in developing and managing water resources within Kathmandu Valley on a long-term sustainable basis.

B. Scope

2. The consultants will

(i) review existing information to understand the water resource situation in Kathmandu Valley;

(ii) identify and quantify sources of water potentially available for use within Kathmandu Valley;

(iii) identify and quantify factors that can influence the demand for water use within Kathmandu Valley, including ranges of values and a most likely value for a given point in time;

(iv) discuss (i)-(iii) with key stakeholders in the sector through workshops;

(v) undertake data collection and surveys to ascertain more comprehensive and updated information on sources and demand;

(vi) analyze the results of the surveys and workshops;

(vii) set up a basic computer model for supply and demand that allows different "what-if" combinations of supply and demand to be evaluated in terms of cost, water volume, timing, and risk;

(viii) agree on the most likely scenarios with stakeholders in a workshop;

(ix) train stakeholders in operating the computer model;

(x) prepare an action plan for implementing the initial findings from the computer model; and

(xi) provide initial policy and planning recommendations.

C. Consulting Services

3. There will be 3 fielded international consultants and 13 domestic consultants. Other international consultant experts for 4 person-months of input will be available at the home office of the international consulting firm for consultation by e-mail as and when required. Flexibility will be retained for one or two additional international consultants to visit Nepal, if the team leader finds that necessary. The consultants' tasks and period of service (person-months in parenthesis) follow.

1. Hydrologist (domestic, 3)

4. The hydrologist will (i) examine the hydrological records for the Melamchi, Yangri, and Larke catchments and all catchments inside Kathmandu Valley; (ii) forecast yields considering reliability, especially with respect to the dry season; (iii) assess yield variations that could occur with appropriate watershed rehabilitation; (iv) examine the reliability and sustainability of the existing hydrological data collection; and (iv) propose, if necessary, interventions to ensure such reliability and sustainability.

(Reference in text: page 5, para. 24)

2. Water Resource Economist (domestic, 3)

5. The water resource economist will (i) examine the possibility of water rights being traded between irrigation and other water supply uses on economic grounds for a number of scenarios, including private sector leasing of land for constructing Sri Lankan-style tanks, seasonal trading, part trading, etc.; (ii) analyze sociological and technical aspects with other members of the consulting team; (iii) establish the factors that control the viability of this option and a range of quantitative values for those factors that may be reasonable; and (iv) recommend actions that can be taken to facilitate this option.

3. Irrigation Engineer (domestic, 3)

6. The irrigation engineer will (i) examine the use of water for irrigation in Kathmandu Valley, quantifying amounts and seasonal variation and identifying locations; (ii) examine the efficiency of use of irrigation water and practicable improvements that can be made and their costs; (iii) record the historic addition or loss of use of irrigation water in Kathmandu Valley; (iv) establish a reasonable range of water savings that can be made each year per season based on more efficient irrigation and alternative cropping; and (v) recommend actions to improve the accuracy of data collection.

4. Water Supply Engineer (international team leader, 8; domestic, 8)

7. The international water supply engineer will be the team leader for the project. He/she will be required to liaise closely with the identified stakeholders. The water supply engineer will (i) prepare an annotated bibliography of literature on water resources and their use in Kathmandu Valley; (ii) examine the potential for rainwater harvesting for both households and communities and also for major and multiple minor low-level storage in Kathmandu Valley; (iii) identify factors affecting the demand for water supply (including reducing unaccounted-for water) and estimate a range of quantitative values for such demand; (iv) recommend actions to reduce demand; (v) explore how demands could be met on the basis of conjunctive use of surface water, rainwater, and groundwater and the appropriate phasing of water harnessing from Melamchi, Yangri, and Larke catchments; and (vi) prepare an action plan for improving water supply situation in Kathmandu Valley.

5. Sanitary Engineer (domestic, 3)

8. The sanitary engineer will (i) examine the potential for treating and recycling/reusing wastewater in Kathmandu Valley, estimating costs in comparison with water derived from other sources; and (ii) examine and make recommendations on on-site sanitation and on-site stormwater management, as well as reed bed treatment of grey waters for Kathmandu Valley, considering similar developments elsewhere in the developed world.

6. Sociologist (domestic, 3)

9. The main tasks of the sociologist are to (i) explore the willingness of farmers to participate in trading water rights through altered cropping, noncropping, or private sector ventures for storage of water; (ii) record the willingness of domestic consumers to pay water tariffs to reduce demand (information should be available from surveys completed in 2001 under World Bank funding); (iii) explore the incentives that could make relocation of industries an attractive proposition for their owners; and (iv) explore the reaction of hotel and other industry owners/operators to licensing and control of groundwater use.

7. Hydrogeologist (domestic, 3)

10. The consultant will (i) examine the current groundwater extraction rates versus estimated sustainable yields; (ii) propose further monitoring arrangements if necessary to secure adequate data for future decision making; (iii) explore the potential for artificial recharge of aquifers and compare it

cost-wise with other options; (iv) estimate the amounts of groundwater available for conjunctive use with surface water on a seasonable basis; and (v) give recommendations on managing shallow wells for domestic use.

8. Financial Analyst (domestic, 3)

11. The tasks of the financial analyst will be (i) primarily to explore the impact of cost on various options for controlling demand and enhancing supply; (ii) to look at the cost implications of phasing developments for Yangri and Larke rivers; and (iii) to explore the role of tariffs in reducing demand.

9. Environmentalist (domestic, 3)

12. The consultant will (i) comment on the environmental implications of each option for controlling demand or increasing the supply of water; (ii) identify indirect environmental benefits and costs; and (iii) give special attention to watershed rehabilitation, pollution control, and wastewater recycling options.

10. Computer Modeling Specialist (international, 4; domestic, 8)

13. The model must be kept simple so that it can be operated by the stakeholders. The consultants will (i) on cost, volume of water, time, and risk set up the model so stakeholders can examine different scenarios to see the effect of all factors influencing supply and demand; and (ii) establish the computer model and train stakeholders in its use and maintenance (Appendix 2).

11. Database Management Specialist (international, 2; domestic 4)

14. Since the computer model will only be as good as the data fed into it, database management will be the key foundation on which this project is based. The consultants will (i) interact with the other specialists to identify the sources of data, evaluate accuracy, and recommend actions to improve the quality of data collection; and (ii) set up a computer-based data management unit for the project and train officers responsible for collecting and evaluating data.

12. Urban Development Specialist (domestic, 6)

15. The urban development consultant will (i) be responsible for summarizing urban development plans and projects in Kathmandu Valley and evaluating their impact on water resources supply and demand options; (ii) evaluate and recommend strategies for regulating growth in Kathmandu Valley; and (iii) consider the preservation of national heritage sites in their evaluations.

13. Communication Specialist (domestic, 2)

16. The consultant will (i) identify stakeholders; (ii) organize stakeholder workshops; (iii) talk to water consumer groups, farmer groups, and industry; and (iv) discuss with local governments and civil society in general, options for improving the water situation in Kathmandu Valley.

14. Pool of Experts in Home Office (international, 4)

17. International experts in the home office to be available for advice from time to time will include, but will not be limited to, those with expertise in urban planning, water resource engineering, financial analysis, hydrogeology, sociology, sanitary engineering, irrigation, water resource economics, hydrology, and environmental analysis.