

**SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT**

**MELAMCHI WATER SUPPLY PROJECT**

**IN THE**

**KINGDOM OF NEPAL**

**August 2000**

## CURRENCY EQUIVALENTS

(as of 16 August 2000)

Currency Unit	–	Nepalese (Rupee/s (NR/NRs))
NR1.00	–	\$0.0138
\$1.00	–	NRs72.55

- (i) The Nepalese rupee is pegged to the Indian rupee (Re) at NRs1.60 to Re1.00. It is fully convertible on all current transactions.
- (ii) For calculations in this report, an exchange rate of NRs70.00 = \$1.00 has been used. This was the rate prevailing at the time of loan fact-finding.

## ABBREVIATIONS

ADB	–	Asian Development Bank
BDS	–	bulk distribution system
DDC	–	district development committee
DN	–	distribution network
EIA	–	environment impact assessment
EMP	–	environmental management plan
ERSDD	–	Environment Resettlement and Social Development Division
LNP	–	Langtang National Park
MDS	–	Melamchi Diversion Scheme
MLD	–	million liters per day
MWSDB	–	Melamchi Water Supply Development Board
MWSP	–	Melamchi Water Supply Project
NGO	–	nongovernment organization
NWSC	–	Nepal Water Supply Corporation
RAP	–	resettlement action plan
SEIA	–	summary environment impact assessment
SUP	–	social uplift program
SWWR	–	Shivapuri Watershed and Wildlife Reserve
VDC	–	village development committee
WTP	–	water treatment plant
WWI	–	wastewater improvements

## NOTE(S)

In this report, the symbol "\$" refers to US dollars.

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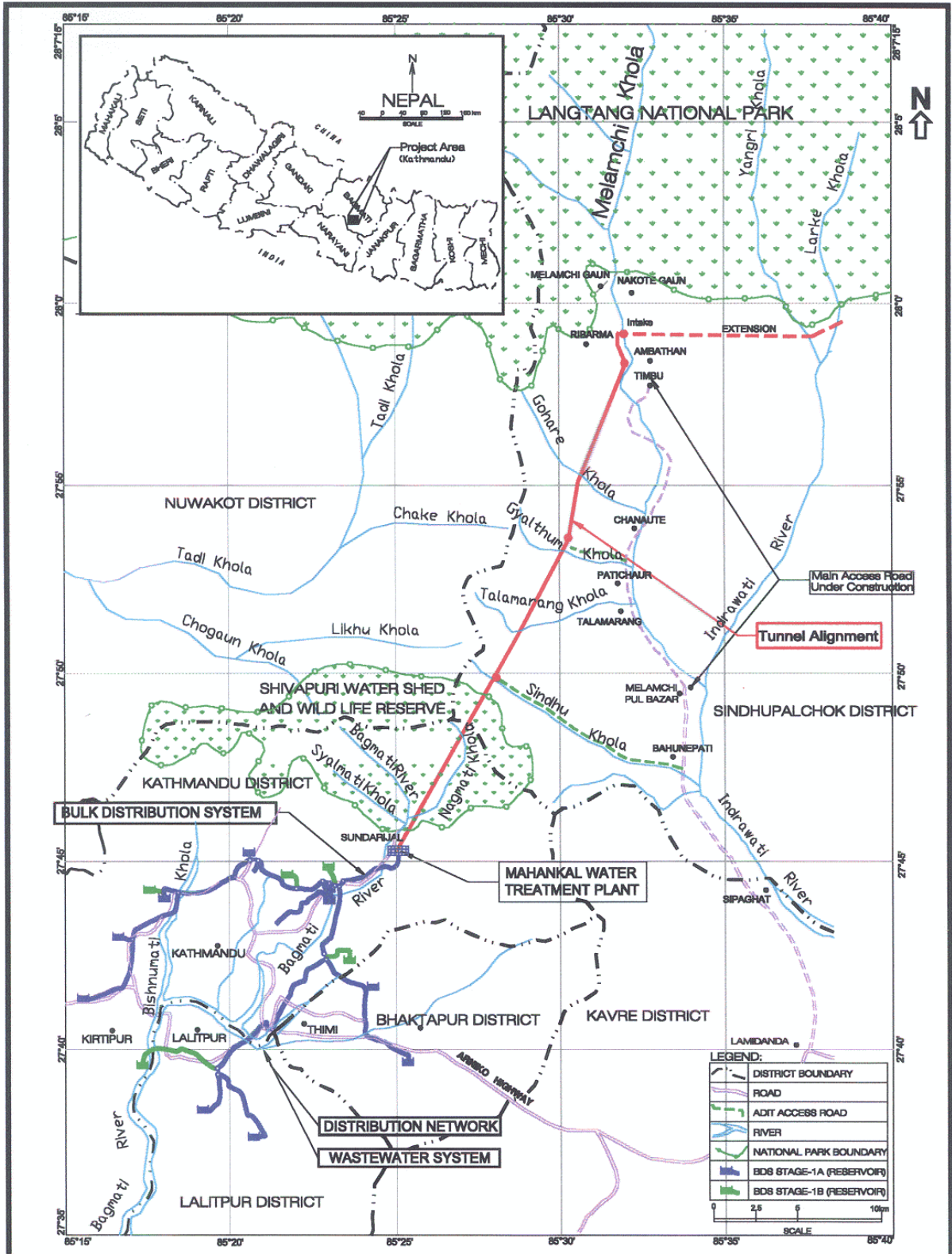


Figure - 1  
PROJECT LOCATION MAP

MELAMCHI WATER SUPPLY PROJECT  
ADB SUMMARY EIA

His Majesty's Govt. of Nepal  
Melamchi Water Supply Development Board

## I. INTRODUCTION

1. Nepal's capital, Kathmandu, is facing a serious water supply crisis. Nepal Water Supply Corporation (NWSC) has tapped most surface and groundwater sources within the Kathmandu Valley, and can only supply 140 million liters per day (MLD) during the rainy season and 90 MLD during the dry season; the average daily demand is 180 MLD. The deficiency of water supply has affected public health and economic activity in Kathmandu. This situation will worsen as Kathmandu's population is increasing at 3.3 percent per annum naturally and from migration, and water demand is projected to increase to 510 MLD in 2018. Since 1973, the Government has explored alternatives to address the water supply problem, and in 1988 Binnie and Partners of the United Kingdom identified the Melamchi Valley as the best option technically. In 1990, Stanley and Associates of Canada made a preliminary environmental assessment, and in 1992 the Snowy Mountains Engineering Corporation of Australia carried out a full feasibility study, and confirmed the Melamchi Valley as the best alternative technically, environmentally, socially, and economically. An integrated Environmental Impact Assessment (EIA) was prepared based on these earlier studies as well as investigations under funding by the Norwegian Agency for Development Cooperation (NORAD) and the Asian Development Bank (ADB) over the last two years. A summary of the various reference reports are in Appendix 1. The purpose of this summary environmental impact assessment (SEIA) is to allow concerned stakeholders to review the assessed environmental impacts of the Melamchi Water Supply Project (MWSP) and the proposed mitigation measures.

2. The MWSP has five main components: (i) Melamchi diversion scheme (MDS), (ii) water treatment plant (WTP), (iii) bulk distribution system (BDS), (iv) distribution network (DN), (v) and wastewater improvements (WWI).<sup>1</sup> The MWSP is estimated to cost \$436 million equivalent and be completed in September 2006. ADB, World Bank, Japan Bank for International Cooperation, NORAD, Swedish International Development Agency, Organization of Petroleum Exporting Countries (OPEC), and Nordic Development Fund have made commitments "in principle" to help finance the Project. The location of the Project and its components is shown on the Map. Reflecting the level of commitment of the various funding agencies, the components are at different levels of preparation. Detailed information is available on some, while information is still scarce on others. The MDS final design report is due in November 2000. The WTP design report is not expected until 2002. The BDS design has been completed. The DN improvements will not be known in detail until 2002, and the WWI component is at the concept stage. The ADB loan is being processed now because ADB is the lead provider of external assistance and other providers of assistance who are responsible for critical parts of the MWSP, including the tunnel and access roads, await ADB's commitment. Also there is a need to establish the project management unit as soon as possible.

3. The MDS and WWI components of the MWSP have potential significant environmental impacts if not properly mitigated, and are classified Category A under ADB environmental guidelines. Thus the SEIA must be circulated 120 days prior to ADB's Board considering the loan. The BDS, DN, and WTP components have limited potential environmental impacts, which are mostly related to construction and are temporary in nature. ADB would classify them under Category B, requiring an initial

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<sup>1</sup> Initially the Project had six components. The sixth component, a 25 megawatt hydropower plant, was dropped for economic and environmental reasons. Details are given in para. 36.

environmental examination (IEE). Since, the MDS and WWI are Category A projects, the environmental assessment for the three other components are integrated for the whole Project, and their environmental impacts are consolidated in this SEIA. The preparation of detailed environmental analyses and protection measures is ongoing and will continue in tandem with detailed engineering design. The ADB Board document will include updated relevant comments as well as suggestions received from the public within the 120-day period. The Nepali translation of this SEIA is available at the project office of the Melamchi Water Supply Development Board (MWSDB) and ADB's Nepal Resident Mission. The complete EIA and IEE reports are available at ADB's project office on request.

## **II. DESCRIPTION OF THE PROJECT**

### **A. Location and Design**

4. The general location and basic layout of the MWSP (see Map) has been set since the late 1980s due to the relative elevations of the Melamchi and Kathmandu valleys and by local topographical features within the Kathmandu Valley. Final locations of the BDS pipelines were carefully selected to avoid direct impacts on houses and to maximize lengths constructed on existing road rights-of-way. Thus significant mitigation actions are incorporated in the location and basic design parameters set for the MWSP.

### **B. Melamchi Diversion Scheme**

5. The main structure of the MDS at the headwork consists of the diversion weir, river-training structures, intake structure, and sediment exclusion basin. A gravity concrete weir dam 5-7 meters (m) high with an indicated crest at 1,425 m<sup>2</sup> will be built across the Melamchi River. The control system and the sediment exclusion basin have a design capacity of 6 cubic (m<sup>3</sup>)/second (sec). The dual sediment exclusion basins have a total length of 70-80 m.

6. The main diversion tunnel is 25.8 kilometers (km) long with a cross-sectional area of approximately 10 square meters (m<sup>2</sup>). The tunnel intake is at an elevation of about 1,425 m and the outlet is about 1,411 m. Most of the tunnel length is expected to be unlined. Consideration may be given to grouting and selective tunnel lining in sections with weak rock formation or faults and cracks, to reduce high water losses into the tunnel from overlying groundwater tables. Tunnel excavation wastes or spoil will be disposed of at four sites located at either end of the tunnel and at the two central adits. With bulking factors, the total quantity of spoil for the main tunnel plus adits is estimated at 460,000 m<sup>3</sup>. The existing access road in the Melamchi Valley to Melamchi Pul Bazar will be widened and upgraded to cater for increased volumes of heavy traffic. The main access road up to the Timbu quarry area is being constructed to feeder road standard by the Government. All access roads into Ambathan (1.8 km), Gyalthum (5.1 km), Sindhu (15.3 km), and Mahankal (1.6 km) will be built as a separate contract package. A new and separate 33 kilovolt (kV) line will be constructed from the Mahankal WTP site linking the tunnel adits at Sindhu and Gyalthum and the Ribarma intake site.

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<sup>2</sup> All elevations in this paper are based on mean sea level.

### **C. The Water Treatment Plant**

7. The water from the diversion tunnel outlet will be transferred to the 170 MLD WTP through an open channel or pipelines. The WTP will occupy approximately 12.5 hectares (ha) of land, with this area being sufficient to accommodate future expansion to 510 MLD, including basic utilities and infrastructure such as the administration building, site roads, and material storage facilities. The WTP will use conventional treatment processes.

### **D. Bulk Distribution System**

8. The BDS delivers water from the WTP to the service reservoirs located around the urban area of the Kathmandu Valley. The BDS will be built in two stages, the 53.9 km of main pipeline and 10 reservoirs from 2002 to 2006, and the remaining 4.5 km of pipeline and 5 reservoirs from 2007 to 2011. The BDS consists of (i) 5.2 km of 1,400 millimeter (mm) ductile iron main pipeline from the WTP to Gokarna Junction, where the pipeline will split into two main sections of 1,000 mm diameter. At its furthest sections, the pipeline diameter is reduced to 300 mm.

### **E. Water Supply Distribution Network**

9. The present water supply distribution network consists of (i) pipelines connecting existing service reservoirs to the distribution network, (ii) main pipelines in the service network, (iii) secondary lines, and (iv) household connections. The designation and scheduling for rehabilitation of the distribution network will be set by the private sector management contractor (PSMC) under a Government agreement. This component will also include leak detection and repair, repair and installation of household meters, network meters, additional household connections, and standpipes for poor areas.

### **F. Wastewater Improvements**

10. The existing WTPs and sewerage system were built in the late 1970s to mid-1980s. The sewerage system consists primarily of 198 km of sewer lines, plus 7 km of brick drains and 13 km of interceptors, with an additional 8.7 km of interceptors under construction. There are three main sewage treatment plants located at Dhobighat (15.4 MLD), Kodkhu (1.1 MLD), and Sallaghari (2MLD). The former is nonfunctional and the latter two only partially functional. The Guhyeswari WTP is presently under construction with a design capacity of 17.3 MLD. The wastewater improvement component will involve provision of additional septage trucks and septage treatment, provision of additional public toilets, cleaning of the sewer system including house connections, rehabilitation of the lift stations and sluice gates at the WTPs, strengthening of the embankments, selective dredging of silted lagoons, and construction of one or two interceptor sewers.

## **III. DESCRIPTION OF THE ENVIRONMENT**

11. Nepal, a land-locked country, is located between the People's Republic of China and India, and includes the mountains and frontal ranges of the Himalaya Mountains. Many of the world's highest mountain peaks are located on the country's northern border. Perpendicular to these mountain ranges are deep valleys draining to the Indian border. Kathmandu is located in the central part of the frontal range, with the Himalaya

Mountains to the north and the Mahabharat Range to the south. The Melamchi Valley is typical of a valley formed by a fast-eroding stream in young mountains. The Kathmandu Valley is a former lake. Human factors such as deforestation, agricultural practices, unsuitable land utilization, and uncontrolled urbanization have accelerated the natural process of landform changes in the lower and middle parts of these valleys.

## **A. Physical Environment**

### **1. Melamchi Diversion Scheme**

12. The Melamchi Valley is a typical narrow, v-shaped, rocky, and steep Himalayan Valley. It rises above the snow line. In its middle mountain region there are ridges and near the valley bottom there are alluvial terraces. These alluvial terraces and the hillsides at the lower end of the Melamchi Valley have human settlements and agriculture. The elevation difference between the ridges and the bottom of the valley exceeds 1,000 m. The MDS intake lies in the lower section of a rocky river gorge with shear and overthrust cliffs. The MDS tunnel will pass through metamorphic rock formations consisting primarily of gneiss, magnetites, schists, permatites, and quartzites. At least four major faults have been mapped across the tunnel alignment between the Melamchi and Kathmandu valleys. One of the fault lines, commonly called the Gyalthum fault, is suspected to bifurcate across the tunnel route. Deep weathering of local rock formations is expected below the deeply incised valleys and in saddles between ridges where the cover over the tunnel is shallow. These are of concern for tunnel stability and construction difficulties. The overlying hills are used for rainfed highland agriculture. Erosion and land instability are also concerns in the Melamchi Valley with the sandy top soils readily washed away by heavy rain. Langtang National Park (LNP) is a designated protected mountain area that protects the watershed and minimizes erosion and sedimentation in the upper half of the Melamchi Valley. Except for the buffer zone it is unaffected by the Project.

13. The rainfall patterns also change rapidly from one area to another depending on elevation and exposure. At Bahunepati, the average annual rainfall from 1991 to 1996 was 1,670 mm, while upstream of the MDS intake site, it was 3,410 to 4,070 mm. The rainy season is from June to September and the dry season from October to May.

14. The Melamchi River originates from the Jugal Himal range at an elevation of 5,875 m and joins the Indrawati River at Melamchi Pul Bazar at 940 m elevation. The total length of the Melamchi River is 41 km and the total catchment area 330 square km (km<sup>2</sup>). The catchment area for the intake structure is approximately 157 km<sup>2</sup>. Downstream of the intake structure more than 50 tributaries flow into the Melamchi River. Snowmelt and rainfall are the two main sources of water for the river. During the wet season numerous local springs occur, only to disappear as the dry season progresses.

### **2. The Water Treatment Plant**

15. The proposed site of the WTP is at the foot of the Shivapuri Range on sloping terraced land, immediately south of Mahankal, and approximately 20 to 30 m above the Bagmati riverbed. The agricultural land in the area has been under irrigated cultivation for several generations. The Bagmati River floodplain south and west of the WTP is gradually widening as a result of lateral erosion. Degradation of the boundary area of

Shivapuri Watershed and Wildlife Reserve (SWWR) has resulted in gully formation east of Mahankal. The soil cover at the WTP site is a mixture of sand and silt. Geologically the soil is recent alluvial deposits overlying gneiss. The Mahankal area, like the rest of the Kathmandu Valley, is vulnerable to earthquakes.

### 3. BDS, DN, and WWI

16. The bulk distribution system, water supply distribution network, and the wastewater improvements are located in the semiurban and urban areas of Kathmandu Valley, except for the BDS pipeline between the WTP and Gokarna Junction. Here the pipe passes through agricultural land. The Kathmandu urban area is located in the southwest central part of the Kathmandu Valley. The valley floor has an average elevation of 1,300 m and is dissected by the Bagmati River and its tributaries. The surrounding hills rise to 2,760 m. The hills to the north and south act as topographic barriers, whereas the hills to the east and west are relatively lower with passes to the Indrawati and Trisuli valleys. The general topographic gradient in the valley is towards the center. Deep gullies are typical erosion features. The hills are made up of consolidated deposits, whereas the valley floor is made up soft quaternary deposits. The bulk distribution system, water distribution, and sewerage collection systems are located in quaternary deposits made up of layered sand, silt, and black clay deposits. The SWWR forests adjacent, to the WTP site, are in relatively good condition, although excessive grazing, quarrying, and intensive cultivation practices, without proper watershed management, has caused extensive erosion on its fringes. Within parts of the SWWR, slope failures, landslides, and rock falls are common.

17. The Bagmati River has its origin in the Shivapuri Range, and the whole Kathmandu Valley forms the watershed of the Bagmati River. Approximately 12 percent of the Bagmati's total catchment area of 558 km<sup>2</sup> is within the SWWR. The water sources of the Bagmati are rainfall and spring flows. The minimum river flow takes place in April and May, starts to increase with the onset of the monsoon season, and peaks in July and August. The average annual flow of the Bagmati River is 15.5 m<sup>3</sup>/sec, with a maximum of 195 m<sup>3</sup>/sec and minimum of 0.15 m<sup>3</sup>/sec. The entire Bagmati River south of Jorpati is polluted from human and industrial waste discharges.

18. The sediments of the Kathmandu Valley are horizontally bedded gravels, sands, silts and clays, associated with the old lake bed. Vertical permeability is limited. Recharge of aquifers occurs at the boundary between the valley sediments and the rock of the valley rim. Also horizontal recharge of the shallow aquifer can occur from rivers, and where local soil conditions are favorable. The shallow aquifers are highly vulnerable to groundwater contamination, especially from the sewerage system, septic tank overflows, and poor land sanitation practices in and around Kathmandu.

## B. Biological Environment

### 1. Melamchi Diversion Scheme

19. The natural vegetation in the Melamchi Valley ranges from semitropical around the junction of the Indrawati River, to alpine at its origin in the Himalaya Mountains. At elevations of 1,000 to 2,000 m where the adit access roads, spoil disposal sites, and camps are located, the main forest cover is the *Schima-Castanopsis* forest, with broad-leaf and chir pine at higher elevations. Above 2,000 m in the LNP, oak, laurel, and

rhododendron composite forests are found, depending on elevation and exposure. Upper sections of the LNP are in the alpine zone and noted for high meadow-type vegetation, including numerous mountain wildflowers and grasslands. The forests in the national park are protected from human impact except for summer grazing in certain areas and trekking activities. However, the forest areas below Timbu are highly degraded, often patchy, and mainly confined to steep slopes. Under the revised Forest Act (1993), and Regulations (1995), tracts of degraded forest are being allocated to the local communities for reforestation. There are currently 67 community forests covering 2,538 ha in Melamchi Valley. Many of these community forests are located in the Buffer Zone of the LNP, which extends down the Melamchi Valley to the Timbu area. This Buffer Zone was declared in 1997 and its management plan is under preparation. Construction works in the Buffer Zone are dependent on the approval of the warden, and works for the MWSP are being designed in consultation with the warden. Ongoing community forestry projects are gradually improving the extent of tree cover.

20. Outside of the LNP, the main rare and vulnerable species identified during the EIA are butterflies and Snow trout. Within the LNP, the identified rare and endangered species are plants and wildlife associated with the denser high elevation forests and alpine areas that are not affected by the MWSP.

21. Recent consolidation of data from all previous EIA studies confirms the presence of at least 25 species of fish, 14 species of phytoplankton, 6 species of zooplankton, and 17 species of water insects in the Melamchi Khola. Five of the fish species of the lower Melamchi are mid- to long-distance migrants. The majority of the fish species are local residents and are mainly Snow trout, which are known to survive both above and below river structures. The migratory fish use the Melamchi Khola for spawning during the early monsoon season from May to July and again at the end of the monsoon season when the fish move downstream. Gohare is the indicated uppermost limit for fish migration of mid- and long-distance migratory species. Subsistence fishing is practised by many near-river residents and seasonally by commercial fisherfolk from the Indrawati in the lower Melamchi, when fish are migrating and/or river levels are high in the Indrawati area. This type of commercial fishing occurs mainly from September to October. Illegal fishing practices using explosives, poisons, and electric shock have been recorded. These plus the use of small-mesh gill nets have caused extensive depletion of the Melamchi River fish population in recent years.

## **2. The Water Treatment Plant**

22. The WTP site is primarily agricultural land under double and triple cropping, with rice as the main crop. A few shade and fruit trees are scattered over the proposed site. There are no rare and endangered species within the proposed WTP site. However, the nearby SWWR contains several rare and endangered animal species in its forested areas well within the reserve. The proposed MWSP site is 200 m outside of the SWWR's southern boundary fence. Most of the nearby area in the southern sector of the SWWR is already degraded as result of human activities such as fodder and fuelwood collection. No wildlife other than occasional birds exist at the WTP site.

23. The Bagmati River can be broadly classified into three ecological zones, and the WTP site is not far from the transition zone between the upper two. The upstream section is characterized by rock outcrops, large river boulders, and a stony bottom with high stream gradient and velocity. The middle section has a gravel and sand bottom and

moderate water velocity. In 1999, studies recorded 12 fish species from 13 different sites in the Bagmati. The dominant fish species in the upper Bagmati River are carp. Eels and catfish are also found particularly in the lower sections. During the dry season, almost all available water in the middle reaches of the Bagmati is diverted for irrigation. The lower reaches of the Bagmati River are polluted with sewage and industrial waste discharge from Kathmandu's urban areas. Fish requiring high dissolved oxygen levels (>4.0 mg/l) have been virtually eliminated from below the Ring Road section of the Bagmati River and its tributaries.

### 3. BDS, DN, and WWI

24. The sites covered by these components are in the semiurban and urban areas of Kathmandu. A number of trees have been planted along the Ring Road, mostly eucalyptus, poplars, grevilleas, and other large ornamental trees. The fauna in the area are mostly domesticated animals, resident and common birds and insects that thrive on domestic wastes. There are no rare and endangered species in the areas covered by these components.

## C. Socioeconomic Environment

### 1. Kathmandu Valley (BDS, WTP, and DN)

25. The Kathmandu Valley (550 km<sup>2</sup>) with a population of 1.4 million comprises five municipalities, including three major ones: Bhaktapur, Kathmandu, Lalitpur. Its population grew by 2.4 times over the last two decades, and it is expected that its relatively better infrastructure and social services, and employment opportunities will keep on attracting migrants from rural Nepal and neighboring countries. In terms of ethnicity/caste, the Newars are dominant, followed by the Brahmins and the Chhetris and many other groups. The MWSP will not selectively affect any specific ethnic/caste group. The livelihood pattern in Kathmandu Valley is that 86 percent of the households are engaged in urban-based activities, such as manufacturing, construction, commerce, transport, communication, finance, and other businesses. Only 10 percent work in agriculture. Access to health, education, services, and basic infrastructure is far better than the national average, although overcrowding, and poor maintenance and deterioration of facilities are widely observed. There are pockets of poverty in Kathmandu Valley, mostly found in slums (established legal settlements), squatter settlements<sup>3</sup>, or rented accommodation. Street children are also a growing concern for their vulnerability.

26. **Nepal Water Supply Corporation Water Supply.** Currently, 86 percent of the population in the Kathmandu Valley are the customers of NWSC-supplied piped water, through about 100,000 private connections and/or 1,300 community standposts. Because of insufficient and rationed supply (supply every other day) in the dry season, many have to resort to alternative sources including tankered supply. NWSC customers also use diverse secondary sources such as tubewell/rowing pump well, *hiti* (traditional water spout fed by a spring), neighbor's tap, water vendor, public standpipe, and others to supplement their needs. Non-NWSC customers (14 percent of population) in general

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<sup>3</sup> A 1996 survey by the nongovernment organization, Lumanti, found 47 squatter settlements with 1,783 households, 20 percent of which were headed by women.

belong to lower income groups; they use the alternative sources of NWSC customers as their primary sources, except tankered water.

27. **Gender.** Water collection, storage, and treatment are predominantly perceived as women's roles across all income levels and ethnic/caste groups. In addition to physical stress, the mental anxiety due to unreliable water supply, and the pressure to manage their basic needs falls disproportionately on women. The time of rationed NWSC water supply is often at odd hours (e.g., midnight to 3 a.m.), which jeopardizes women's safety.

28. **Hygiene and Sanitation.**<sup>4</sup> Waterborne diseases due to poor water quality are common in the Kathmandu Valley, especially among children. However, 90 percent of valley residents state that they do not frequently suffer from water-related disease; this indicates a need to increase hygiene awareness. The prevalence of latrines is low. Although there have been some recent attempts to introduce more public toilets, including pay toilets, in general they have not been successful due to poor maintenance and inadequate water to flush. With regard to food hygiene knowledge, even those who are more hygiene conscious, exhibit a gap between awareness and practice, mostly due to lack of sufficient water to practice good hygiene. Among the low-income communities, latrine coverage is increasing with the assistance of local authorities and nongovernment organizations (NGOs). The Government and the municipality are working together to solve the Kathmandu Valley's well-known solid waste problem.

## 2. Melamchi Valley (MDS and Main Access Road)

29. The population in 14 villages of the direct impact zone in Sindhupalchok District is about 40,000. The districtwide ethnic/caste composition is Tamangs, Chhetris, and Brahmins, Newars, and others. Among them, the Tamangs (usually marginal landholders) and lower castes (usually landless) are economically disadvantaged. The economy is predominantly rural, with 90 percent of the Sindhupalchok District population engaging in farm/fishing activities and 85 percent living at the subsistence level. Land fragmentation and the topography in the hills, combined with lack of access to agricultural inputs, extension, technology, credit, and markets, are impediments to improving agricultural productivity. In much of the project area, there is a lack of basic educational facilities and teachers. The health situation and sanitary condition are poor, and malnutrition is common, especially among women of reproductive age and children. Women are disproportionately affected by the daily hardship of poverty due to their multiple tasks in domestic and productive arenas.

30. **Trafficking of Girls and Women.** Sindhupalchok District, especially the Tamang community, is historically known for trafficking of girls and women. The push factors are complex, encompassing established recruitment over centuries, alleged backing by high-ranking officials and politicians, poverty, cultural perceptions and low status of women, and lack of community awareness. Over the last five years, there has been much investment by external funding agencies and NGOs in antitrafficking programs.

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<sup>4</sup> Mainly drawing upon from Hygiene Survey (Nippon Koei, 2000).

## IV. ALTERNATIVES

### A. Do-Nothing Alternative

31. The do-nothing alternative will result in continuing environmental degradation in the Kathmandu Valley, including depletion and lowering of deep groundwater tables with possible local land subsidence in severely overdrawn zones, cumulative contamination of shallow wells, deterioration of the Bagmati River and tributary stream water quality, and increased risks to the health of users of shallow wells and rivers. The water shortage will be aggravated by increased population growth in Kathmandu and surrounding urban areas. Kathmandu, as the capital city, will continue to attract migrants searching for employment opportunities that are not available in other parts of the country. The continuing water shortage will probably most adversely affect disadvantaged groups such as the urban poor and migrants who cannot afford, or do not have access to, alternative water sources. At present, numerous households are paying for nonpiped supplies through private wells or bores, roof and underground tanks, and tanker-delivered water, plus the required boiling or use of bottled water. This is because of the unreliability and poor quality of the present water supply. In the long run, the do-nothing option will be a constraint to development of Kathmandu. The continuing economic decline in Kathmandu will also affect the overall development of Nepal, including adjacent areas such as the Melamchi Valley.

### B. Alternative Water Sources

32. The upper Bagmati River and its tributaries' surface water sources are completely utilized during the dry season. Although the maximum flow in the upper Bagmati River is more than 20 times higher than the average daily demand of the Kathmandu urban zone, building a dam to store the excess water during the rainy season has been ruled out because it would have impacts on the SWWR and its forest areas. While a dam could be properly designed to withstand known earthquake intensity in the Kathmandu Valley, the Snowy Mountains Engineering Corporation feasibility study<sup>5</sup> found that such a dam would be economically less attractive than extending tunnels to divert water from the Yangri and Larke kholas.

33. The groundwater resources in the Kathmandu Valley are overutilized at present and depletion is evident. Expansion of groundwater-based supplies will result in long-term resource depletion and possible serious impacts on shallower bores including many private ones. For this reason, groundwater monitoring was instigated and institutionalized by the Groundwater Resources Development Board.

34. Water resources in all nearby river systems were evaluated. Any project based on pumping from out-of-valley rivers is considered uneconomical due to high pumping and associated maintenance costs. The Melamchi River provides the most cost-effective and reliable water supply source for augmenting and expanding the long-term raw water supply to the Kathmandu Valley.

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<sup>5</sup> SMEC et. al. 1992. Greater Kathmandu Water Supply Project - Volume 1.

### **C. Optimizing Water Use in the Kathmandu Valley**

35. Notwithstanding that it would be nearly impossible to meet the water supply needs of the inhabitants of the Kathmandu Valley from sources within the valley, there is considerable scope for optimizing use of this water. Several options will be developed as part of the MWSP. These include rainwater harvesting, recycling of wastewater, storage of wet season river flow, rehabilitation of catchments, groundwater monitoring and licensing, artificial recharge of groundwater, reduction of water losses in irrigation and water supply, and pollution control. Within the next two years, a Kathmandu Valley water authority will be created to be responsible for comprehensive water resource management and development. It will be the main vehicle for implementing the various project options to maximize use of existing water in the valley.

### **D. Melamchi Diversion Scheme**

36. Upstream of Timbu, the Melamchi River elevation rises abruptly by more than 300 m within 3-4 km. This provides an opportunity for a dual-purpose water supply/hydropower project, and a 25 megawatt hydropower plant was incorporated in the MWSP plans as proposed in December 1999. However, inclusion of this power source in the national expansion plans would have deferred the next project by no more than six weeks, and most energy would have been generated in the wet season when NEA has many alternative sources of power. A serious review of this component was undertaken from February to April 2000, and resulted in elimination of the hydropower component. This was mainly due to (i) a substantial reduction in the size of the MDS features, resulting in approximately 30 percent less rock waste disposal requirements and one less disposal site; (ii) reduced length of adit access roads from 34 km to 25 km, plus elimination of a 4 km ropeway; (iii) marked reduced impacts on the river regime and hence the natural fish population of the Melamchi River downstream of the intake (due to the lower level intake); (iv) reduced environmental risks of creating a temperature barrier and long-term alteration to the aquatic ecology of the Bagmati River due to cold water releases in excess of WTP needs; and (v) assurance that the future extensions to the Yangri and Larke rivers can be located outside the boundary of LNP. A diagram showing Indicated Relative Flows in the Melamchi River is at Appendix 2.

## **V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

37. There are a number of beneficial and negative impacts that have low to very low significance and/or are short term, as they occur primarily during construction. These impacts are given in detail in the main EIA and IEE reports, and are not discussed in this summary.

### **A. Physical Environment**

#### **1. MDS Construction and Operation**

38. Access roads, transmission lines, and construction camps will be built. The existing road from the Arniko Highway to Melamchi Pul Bazar and Timbu will be improved to accommodate increased heavy traffic and 23.8 km of new roads constructed to the MWSP's intake and adit sites. During road upgrading and new construction, hillsides will be cut, slopes altered, and spoil material dumped, thereby affecting local stability. Potential road grade and affected area instability will be improved

by reducing the slope of embankments, use of both upslope and downslope gabions, proper drainage, and stabilization through bioengineering. Road design will be based on balanced cut and fill, to the extent practical, and on properly stabilizing upslope excavations. Major road construction, spoil disposal, and borrow material sites have been identified and tested, and locally required smaller ones will be confirmed during detailed road design. In principle, these sites have and will be selected to avoid erosion-prone or flood-prone local streambed areas. The disposed materials will be properly compacted and stabilized, including use of suitable trees or grasses. Road construction spoil will not be dumped along the roadside or into rivers or ravines. If the local people require fill materials, they will be permitted to take road spoil on a "take for free" basis. After the construction of the MDS, the main access and adit roads will improve access to the upland and near-river areas along the Melamchi River with more than 2,000 households benefiting directly or indirectly. The new MDS 33 kV transmission line, to be built for the camp and for the construction work, has been specifically located to maximize local benefits by also serving as the main supply for rural electrification to adjacent upland areas.

39. Another main environmental impact of the MDS construction is the disposal of spoil from the three tunnel adits and its outlet portal. This spoil, which will be mainly rock wastes, is calculated at 460,000 m<sup>3</sup>. The spoil will be disposed of at four sites located near the tunnel adits. The sites will be selected based on the following criteria: (i) proximity to the tunnel adit openings (ii) availability of sufficient and geologically stable areas (iii) use of barren or unused land if possible and (iv) minimization of potential adverse aesthetic effects from the main trekking routes (i.e., disposal behind ridges or in local valley bottoms). As rock is used locally for construction materials for road and track fill, fencing, and house foundations and walls, it will be made available free to local communities. However, the anticipated use is small in comparison with volumes to be disposed except at the tunnel outlet where reuse of spoil as aggregates is being considered.

40. During construction of the MDS, explosives will be used. A "cradle-to-grave" accounting system for explosives will be a contractual obligation. A geologist will be present at construction sites to determine blast sizes and placement to minimize potential landslides from weak rock formation. All tunnel workers will be properly trained in tunneling safety, precautions, emergency procedures, and first aid. Emergency drills will be carried out to ensure adequacy of worker training and response. Explosives will be stocked in bunkers with 24-hour security.

41. During operation, the MDS will divert 2 m<sup>3</sup>/sec of water from the Melamchi River to the WTP. During the dry season from February to April, approximately 55 percent of the Melamchi River flow at Kiul, upstream of the first major irrigation intake, will be diverted leaving some 45 percent as residual flow. This is illustrated in Appendix 2, which shows flows in the Melamchi River in the lowest flow month (March) with and without diversion of 2 m<sup>3</sup>/sec. All existing water demands for the Melamchi River for irrigation, water mills, and domestic purposes, can be met safely in this month, and therefore on a year-round basis with the water supply provided by the MDS. During the rest of the year a much larger percentage of environmental flows are retained in the Melamchi. This is particularly important for the May-June and October-November periods when fish are migrating. The impact of flow reduction in the Melamchi will be evident only as far downstream as Melamchi Pul Bazar (20 km), as the Indrawati River flow is much higher. For the succeeding phases when diversion to the Kathmandu Valley

reaches 6 m<sup>3</sup>/sec, additional water will be abstracted from the Yangri and Larke rivers. The estimated percentage reductions in the Yangri and Larke rivers are indicated to be slightly higher, as these are based on 2 m<sup>3</sup>/s each from smaller catchments, and hence, lower flow rates than those of the Melamchi. Additional hydrological analysis and environmental assessment including revised impacts for the Yangri and Larke schemes, such as potential cumulative effects, are being undertaken in the revised MDS investigations.

## **2. WTP Construction and Operation**

42. Maximum use of the natural slope of the ground will be made for gravity flow through the WTP. Nevertheless there will still be significant cut and fill. This will require adequate and proper mitigation measures relating to site runoff and erosion controls throughout the construction period, similar to those mentioned in paras. 38 and 39, until the works area is stabilized through soil rehabilitation and landscaping.

43. The main environmental impact during operation is the possible need to dispose of up to 15,000 m<sup>3</sup> of sludge per year from the sedimentation tank and sand filter backwashing. The sludge will be thickened to a specified minimum water content for disposal. The sludge will contain clay and silt particles, aluminum hydroxide compounds, plus traces of polyelectrolyte, and will be a colloidal material. Consolidated sludge is often used as part of road base material, for reclamation, and for landfill, provided it is top dressed. The objectives of these types of disposal are to render the sludge inert. The WTP design will incorporate this approach and ensure that the demand for this material during the foreseeable future will be sufficient to adequately and safely dispose of the sludge.

## **3. BDS, DN, and WWI Construction and Operation**

44. The BDS, DN, and WWI will be constructed within the semiurban and urban areas of Kathmandu. For BDS construction, trenches will be dug along road rights-of-way and across intervening sections of mainly agricultural land. All reservoir construction will be located on either rural or semiurban open land. Environmental management, particularly as it relates to controlling site erosion and runoff, and implementing on-site remedial measures to minimize localized impacts associated with temporary disruption to access, road traffic, other infrastructure, and utilities, will be required throughout the construction phase and in all construction zones. Dust, noise, and vibrations from heavy construction equipment and trucks will have limited site-specific, short-term impacts requiring both contractual conditions and on-site inspection and monitoring. Rehabilitating all types of roads used for construction and infrastructure, such as drains and canals, to proper working condition, plus restoring land to its former agricultural capability, and any property damage or temporary loss of crops and income, will be the primary mitigation and contractual obligations for all BDS, DN, and WWI contractors. A main requirement will be for all main contractors to employ competent line officers to deal with other agencies and local communities, and initiate any on-the-spot environmental management or immediate mitigation needs.

45. The long-term environmental impacts of operation of the water supply system relate to the increase in the wastewater generation rate. Under a fully sewerage service area, an estimated 70 percent of water supplied is collected as wastewater. Thus an additional 115,000 -120,000 m<sup>3</sup>/day of wastewater will be generated under the MWSP and pass into the sewerage collection and treatment facilities, if the sewerage system is fully developed. Rehabilitation of existing sewerage systems and treatment plants is required as part of the MWSP. Development of long-term plans, funding, and implementation of the rehabilitation schemes are needed to reduce the current unacceptable situation relating to the wastewater collection and treatment, and its effects on the ecology of the Bagmati River. Constraints on the Government's financial resources is the primary reason that large-scale wastewater disposal cannot be pursued simultaneously with water supply development, as would be desirable. The before and after environmental conditions related to wastewater generation and disposal from the MWSP will be specifically monitored under contract.

## **B. Biological Environment**

### **1. MDS Construction and Operation**

46. The number of trees to be cut due to the construction of the various adit access roads, portal and spoil disposal sites and borrow areas was initially estimated at about 1500. This figure must be recalculated due to alterations to the MDS alignment. Most of the trees affected are located in degraded community forests. Once road centerlines and construction work area boundaries are determined by updating studies of the MDS, all affected trees on private and public property will be properly inventoried, and owners compensated. Any replacement afforestation required by the Department of Forestry will be negotiated and implemented during the construction phase. The MWSP includes adequate contingency funds to cover these costs. Several community forest user groups are operating in the Melamchi area with bilateral and NGO assistance; these groups will be consulted and supported as appropriate in implementing forestry-related mitigation.

47. Runoff control measures to reduce sediment loads from all MDS construction sites will be made mandatory for contractors. This is required to protect not only water quality but also aquatic life, both in tributary streams and in the Melamchi River itself, particularly from March through early June and October-November, the fish breeding and migration periods.

48. The operation of the Melamchi diversion weir will only marginally affect the fish population. Reductions in water flow will occur between the intake and the confluence of Indrawati River, but residual flows in the critical periods for fish breeding in the main areas used, from Gyalthum downstream, will be adequate to maintain suitable habitats similar to the existing ones, where sand and gravel bank distribution change annually due to flood flows. Also as noted, the present river fishery is already overexploited. It is recommended that stocking of Snow trout in the Melamchi be based on use of fingerlings from existing hatcheries. Thus a project-assisted, river, water use, and fisheries management program is planned, involving local user groups, including irrigators, water mill owners, fisherfolk and local community-based organizations. This will be set up during construction and continue as the main long-term commitment by the MWSP in the Melamchi for the mitigation of natural resources.

## **2. WTP Construction and Operation**

49. Approximately 40 trees will be removed from the agricultural land to be cleared for the WTP. Owners of economic trees will be compensated, and the river-bank buffer zone proposed for the east bank of the Bagmati will be planted with trees. In addition, the WTP site boundary zone will be landscaped with larger trees, as both aesthetic and noise buffering mitigation. Preventive protection measures for the resident troop of Rhesus monkeys frequenting the MDS outlet portal and SWWR boundary area near the Mahankal WTP site are required, and will be made as contractual obligations for both the MDS and WTP (e.g., fenced enclosures of ground-located transformers, and ring enclosures on electricity poles).

50. The risk from accidental spillage of WTP sludge into the Bagmati River is very low, provided the disposal lagoons are properly located and banded with adequate freeboard, and accumulated sludge is regularly removed to environmentally approved locations or uses. The entire question of sludge thickening, desiccation (or not), and disposal for the operation phase will be addressed in the WTP detailed design phase. This will include a review of the environmental effects and management needs based on the nominated WTP design, and will require the long-term disposal program to be explicitly incorporated into the WTP operating plan and manuals to form part of the operator's agreement.

## **3. BDS, DN, and WWI Construction and Operation**

51. The construction of the BDS will require the cutting of numerous nonindigenous trees, most of which are either poplars or eucalyptus along the Ring Road and other public road rights-of-way. In several locations affected by the BDS pipelines, these fast-growing species are causing problems due to wind breakage with resulting damage to frontage road properties. Their removal and replacement with more suitable species will be locally acceptable. Tree cutting at the reservoir sites will be limited. To mitigate this impact, the MWSP will replace all trees as required by, and agreed with, the relevant authorities such as the Department of Roads, district development committees, village development committees (VDCs) or community-based organizations involved in their establishment and maintenance.

52. The impacts during operational phases of the BDS and DN are negligible. After rehabilitation of the various WTPs, the waste load from the urban area to Bagmati River will be temporarily reduced. However, the continued extension of the sewer system and treatment plants to planned levels is essential to reduce biochemical oxygen demand and suspended solids to acceptable target levels of 20 mg/l and 200 mg/l, respectively. By achieving these targets, and by additional clean-up and implementation of river management, the water quality of the Bagmati River can be restored to environmentally acceptable levels, so that the wider range of aquatic plants and fish can reestablish over the long-term. During detailed planning of the wastewater improvements, due consideration will be given to the potential reuse of treated effluents and sludge as fertilizer for plantation forestry.

## **C. Socioeconomic Environment**

### **1. The Kathmandu Valley**

53. The primary beneficiaries of the MWSP are 1.4 million people (180,000 households) in the Kathmandu Valley (1.15 million direct beneficiaries and 0.25 million indirect). They will benefit from improved water supply services with better water quality, increased quantity (and reduced unaccounted for water) and timely supply, extended service areas, more equitable water distribution, and better customer services. The issue of the potential negative impact of the raised water tariff on the poorer and lower income households will be addressed through an equitable tariff structure.

54. Some land and property will need to be acquired for the construction of the WTP in Kathmandu at Mahankal in Sundarijal village, which will result in the displacement of some families (para. 57 and Appendix 3).

### **2. Melamchi Valley**

55. From the early stage of the MWSP conceptualization, concerns of potential adverse impacts have been raised by the local communities and leaders. A series of public and NGO consultations identified their major concern, besides direct mitigation of Project impacts, as poverty reduction in the zone of impact. The needs will be addressed through the social uplift program (SUP) component of the MWSP.

56. As a result of project infrastructure construction and the SUP, the following socioeconomic and poverty reduction benefits will accrue to the 70,000 population in the 17 villages in the project area in the Melamchi Valley: (i) improved access to Kathmandu and within the Melamchi Valley through access roads; (ii) increased incomes through the expanded market and upgraded skills; (iii) availability of electric power; (iv) reduced workload for women; (v) increased gender awareness in the community; (vi) increased adult literacy rates; (vii) more children with better education; (viii) greater health and family planning awareness and improved health conditions, especially for women and children; and (ix) reduced incidence of trafficking of girls.

### **3. Resettlement and Land Acquisition**

57. The location and design of infrastructure have been carefully considered to avoid, or if not, minimize land acquisition and resettlement. Permanent land acquisition is expected for the MDS (i.e., for the main access road and access roads to adits), WTP and BDS (i.e., for reservoirs and the pipeline route), and DN (pipeline route) and sewerage system improvements. Altogether about 131 ha of mostly agricultural land will be affected. Temporary land acquisition of 101 ha is also expected for construction camps, borrow pits, and other construction-related areas. About 98 structures of 91 households will be affected either partially or entirely, including 25 households that will be displaced. Some community facilities and common property resources (e.g., irrigation channel, community forest, and community hall) will be also affected. Loss of income directly due to the MWSP (e.g., loss of crops and commercial businesses) will be also compensated; and the MWSP will provide rehabilitation assistance for severely affected persons. The project-affected people and the identified vulnerable groups will have highest priority access to any employment opportunities, as part of their entitlement. A resettlement action plan (RAP) has been developed for the MWSP (Appendix 3), and its

policy framework, already agreed to by MWSDB and ADB, is being reviewed by the Ministry of Physical Planning and Works for approval. The final draft RAP is expected before project appraisal. The overall estimated cost for RAP implementation is \$15 million, and adequate funds have been provided in the MWSP budget.

58. Potential indirect adverse social impacts could include social disruption caused by the influx of outside workers including sexually transmitted diseases, loss of employment or income due to changes in the economic structures, increased trafficking in girls, and child labor. These will be addressed through the SUP. A clause to not allow child labor will be included in all contract documents. No specific ethnic or caste groups will be especially adversely affected, but vulnerable groups (e.g., severely affected persons and households headed by women) have been identified for special assistance.

#### 4. Social Strategy

59. **RAP and SUP.** Social mitigation measures will be implemented under the RAP (direct adverse impact) and the SUP (indirect adverse impact). The SUP will include development activities for the Melamchi Valley covering five areas: buffer zone development, rural electrification, health, education, income generation and community development. Women's special needs for reproductive health, adult literacy, skills development and income generation, legal awareness raising, and measures to stop trafficking in girls will also be addressed.

60. **NGO Participation Plan and Social Monitoring and Evaluation.** An NGO participation plan, developed in close consultation with NGOs working in the Melamchi and Kathmandu valleys, will be implemented by the MWSP. NGOs will act as facilitators to strengthen the capacity of local government bodies through the implementation of the SUP, hygiene awareness raising in the Kathmandu Valley and project monitoring and evaluation. Independently from the NGO participation plan, one or several NGOs will also be contracted to provide external monitoring for the resettlement and compensation, and community-based activities.

61. **Hygiene Education and Promotion Program.** The program was developed based on surveys, and a good practice model in urban Nepal (e.g., Bhaktapur and Pokhara). Comprehensive hygiene awareness-raising activities will be conducted in two phases: a pilot phase (10 sites for one year) and a full-fledged stage (valleywide for three years).

62. **Implementation Arrangements.** The MWSP will launch a proactive public relations campaign, given the Project's high profile and potential public concerns that could jeopardize implementation. To coordinate activities to ensure that all project components are implemented adequately, and appropriately address social concerns, an environment resettlement and social development division has already been established in MWSDB. NGOs will be mobilized to assist local government agencies in implementing community-based activities. To ensure ownership and sustainability, the SUP will (i) take a participatory approach through direct participation of beneficiaries; (ii) utilize the institutional structure of the ongoing Local Governance Program, whereby capacity building for the DDCs and VDCs will be conducted through the programs, assisted by experts; and (iii) be run by royalties paid by the Kathmandu Valley water users in the postconstruction stage (from the seventh year).

## **VI. ECONOMIC ASSESSMENT**

63. The economic assessment for the MWSP was completed based on a project cost of \$436 million. The analyses indicate an economic internal rate of return of approximately 13.5 percent.

64. Several major noncosted mitigation measures for the MWSP are incorporated in the decision to switch to a water-supply-only development alternative. Mitigation costs for tasks to be undertaken by the contractors have been included in the cost estimates of the respective components, including environmental management for camps and construction activities, work-site monitoring, and safety and land restoration, as specified. It is proposed that external to work sites, environmental management and monitoring, plus inspection and auditing of contractor's compliance, be undertaken by a combination of supervising engineers and the Environment Resettlement and Social Development Division (ERSDD) of the Project Management Unit. The estimated cost for implementing an environmental management plan (EMP) (Appendix 4) including institutional strengthening and training of ERSDD over five years is \$3.8 million. The other major mitigation measures relate to (i) the SUP for the MDS, estimated at \$6.4 million for its 10-year program and (ii) the RAP which is estimated at \$15.4 million. Thus the total indicated mitigation cost, excluding contractors' built-into-contract costs, is \$25.6 million. The cost estimate for direct environmental mitigation is given in Table A4.2 of Appendix 4.

## **VII. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PROGRAM**

65. The initial tasks of ERSDD, relate to land acquisition and compensation required to effectively initiate MWSP construction. The basic framework for an EMP, based on designated roles and contractual responsibilities, has been prepared (Appendix 4). The role of the Environmental Management and Monitoring Unit within ERSDD includes Government liaison, supervision and auditing of construction phase monitoring, plus implementation of the river, water use, and fisheries management plan. The supervision of the day-to-day environmental mitigation and management being executed by the different contractors, and most on-site and off-site monitoring during construction, will be the responsibility of the supervising engineer or the designated environmental consultant, as per the EMP. Contractors' responsibilities will be defined in the tender documents, and agreed to according to common and project-specific environmental and mitigation needs. Institutional strengthening of ERSDD is required, and this will be executed by advising, supervising, and training of MWSDB staff. Senior environmental and resettlement advisers will be appointed in the Project Management Unit to put this into effect. The basic objective is to use the construction phase for training and strengthening ERSDD. During this phase ERSDD staff will plan how to meet the environmental management and monitoring needs during the operational phase.

66. A list of parameters to be monitored, frequency of monitoring, sampling method, and analysis has been prepared, is being refined, and will be an integral part of the EMP. The mitigating measures for impacts during construction, as indicated in this SEIA and included in the main EIA report, will be incorporated in the tender documents of the contractors, and will therefore be contractual obligations. Monitoring will be primarily executed by the engineers and ERSDD, using consultants for both field and laboratory testing. Progress reports submitted by the contractor and engineers will include

contractors' compliance with the mitigation measures, monitoring results, and complaints and resolution records. All resolution of public complaints and authorizations requiring additional mitigation measures by contractors will be undertaken through the respective engineer's office, except those directly specified as the responsibility of contractors, such as those for temporary use of land.

67. Contractors will be required to provide operating manuals to the client (MWSDB), and train the operators for proper management of all facilities prior to turnover. The operating manuals and training will highlight any required mitigation measures during the operation phase of the various project components. The Government and its assigned operator of the facilities will submit to ADB an annual report on compliance with the mitigation measures identified in the approved manuals and the operation phase of the EMP, or as required by Nepal's relevant environmental laws, regulations, standards, and safety permits. In the event of official notification of violation of any environmental or safety laws, regulations, or standards, an incident report, including verification from the relevant environmental protection agency that the deficiency has been corrected, or acceptance of guarantees by the relevant Government agency, will be prepared and submitted to ADB and the lending agencies involved with that component.

68. Within a reasonable period to be established by ADB and the Government, the MWSP will exert its best effort to secure ISO 14000 certification, and to maintain such certification for the duration of the loan and to the satisfaction of ADB or any of the cofinancing agencies.

### **VIII. PUBLIC INVOLVEMENT**

69. In accordance with Nepal's Environmental Protection Regulations 1997, a series of public consultations were carried out during the preparation of the various EIAs in the areas concerned, including the villages affected by the MDS, BDS, and WTP. The required public notices were published relating to EIA scope and terms of reference for both the WTP and the integrated EIA, and for public review of the WTP EIA in local daily newspapers on 30-31 July and 23-24 September 1999, respectively. All of the 17 meetings have involved representatives of MWSDB, consulting engineers, VDC and DDC representatives, and regional and local NGOs and community-based organizations. An extensive study and four major workshops involving approximately 70 NGOs were included and completed under the MWSP's Public Participation Program. Numerous other public consultations and seminars, including those for the urban water supply reforms in the Kathmandu Valley have been completed. Focus group discussions were used to develop the RAP entitlement policy and the MWSDB RAP team is about to embark on public discussions relating to land acquisition and compensation issues at the ward/ VDC level, involving potentially directly affected households. Only the holding of public meetings at Timbu and Melamchi Pul Bazar to inform Melamchi area residents of the revised MDS and associated impacts, and a general stakeholders meeting for the MWSP's integrated EIA remain outstanding as of August 2000. Public involvement will be effectively completed as required by Nepal's environmental legislation.

70. During the loan Fact-Finding Mission, two public meetings were held, one for stakeholders from the Melamchi Valley and one for stakeholders from the Kathmandu Valley. Stakeholders were provided with an update of MWSP progress and questions, submitted in writing, were answered. For the Melamchi Valley, the major concern related to the amount of water extraction. For the Kathmandu Valley, the main concerns related

to tariffs and private sector management of the water supply. Formal responses to all questions were provided by MWSP in their newsletter.

## **IX. CONCLUSIONS**

71. The EMP outlined in Appendix 4 establishes objectives, including that of ensuring all mitigation measures and monitoring requirements specified in the approved EIA report for the MWSP will be carried out. It identifies the parties responsible for implementation of the EMP, their roles, and the timing of their inputs. The summary of environmental impacts and mitigation measures described in this SEIA is given in Appendix 5. The main activities requiring mitigation of environmental impacts are (i) water extraction from the Melamchi Khola, (ii) construction of access roads, (iii) disposal of spoil from the tunnel, (iv) use of explosives, (v) establishment of construction camps, (vi) tunnel construction, (vii) water treatment plant operation, (viii) bulk distribution construction, (ix) wastewater improvements, (x) private sector management, (xi) increased water tariffs, and (xii) construction near protected areas. The total estimated cost of environmental mitigation is \$25.6 million. This will be financed partly under the financing of the separate components and partly under the financing of the overall project management. Finally, it must be recognized that the various components of this Project are at different stages of preparation and this SEIA represents the best effort at this time commensurate with approval of an ADB loan in December 2000.

**APPENDIXES**

<b>Number</b>	<b>Title</b>	<b>Page</b>	<b>Cited on (page, para.)</b>
1	Main EIA Documents Relating to MWSP	21	1, 1
2	Indicated Relative Flows in Melamchi River	23	10, 36
3	Summary Resettlement Plan	24	15, 54
4	Environmental Management Plan	27	17, 64
5	Environmental Impacts and Mitigation Measures	34	19, 71

## MAIN EIA DOCUMENTS RELATING TO MWSP

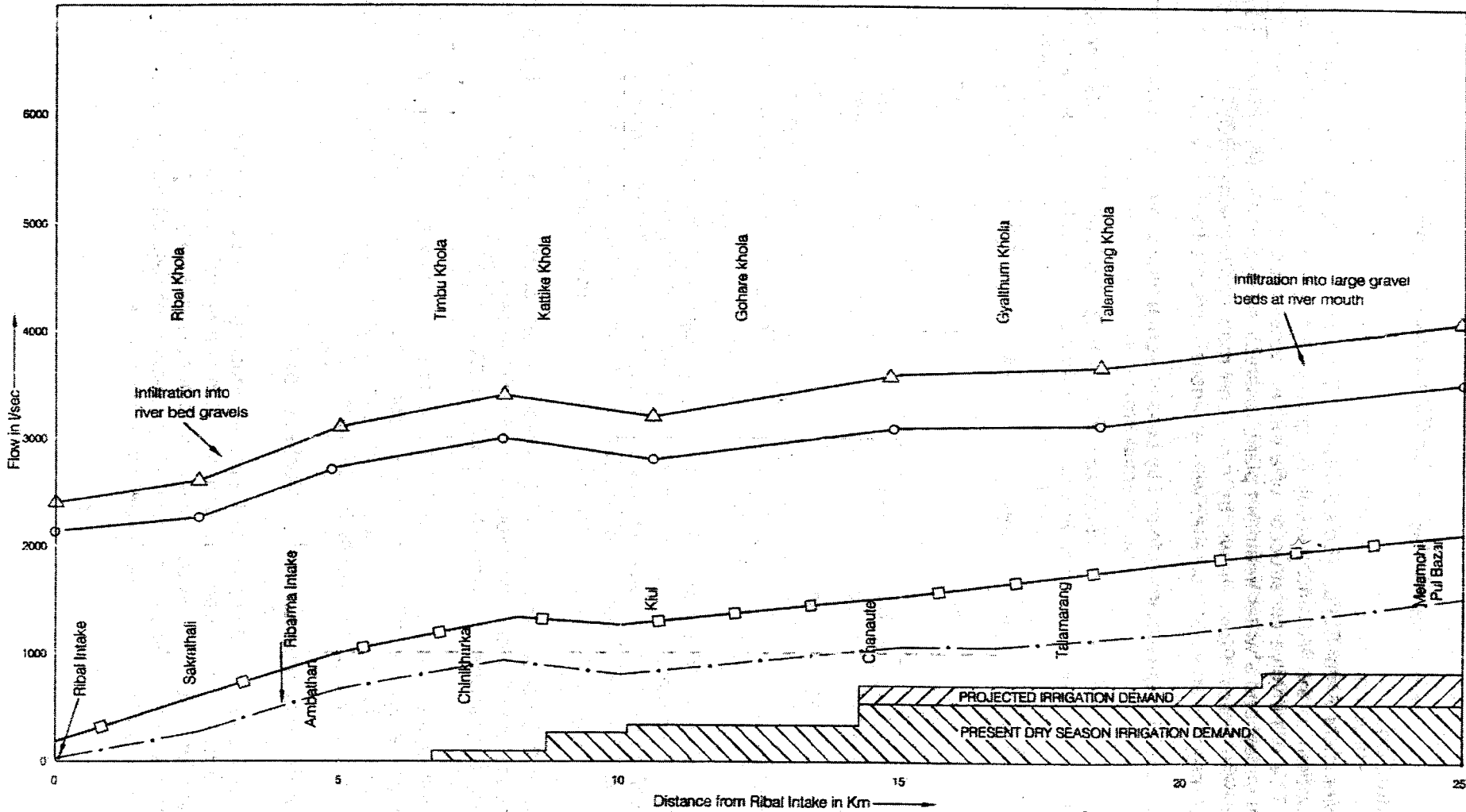
1. The main environmental impact assessment (EIA) documentation containing previous information relating to the Melamchi Water Supply Project includes

- Binnie and Partners, 1988. Water Supply for Kathmandu-Lalitpur from Outside the Valley, Prefeasibility Study, Final Report.
- Stanley Associates Engineering Ltd. and East Consult (P) Ltd., 1990. Environmental Impact Study, Future Water Supply From Outside the Valley for Kathmandu-Lalitpur.
- SMEC et. al. 1992. Greater Kathmandu Water Supply Project. Volume 1 (Sections 6,7,8 & 10); and Volumes 6A & 6B – Environmental Appendices.
- BPC Hydroconsult et. al. 1996. Technical Assistance to Melamchi Diversion Scheme-Bankable Feasibility Study. Volume 3; Appendix I - Environment.
- Boehmer, W. and Euroconsult. 1997. Melamchi Water Supply Project – Artificial Recharge of Groundwater in Kathmandu Valley.
- Balloffet and Associates. 1998. Environmental Impact Assessment, Melamchi Water Supply Project-Nepal.
- NORPLAN A.S.. 1999. Melamchi Diversion Scheme, Main Technical Report. Sections 9 &10.
- World Conservation Union (IUCN)/Metcon. 1999. Melamchi Diversion Scheme, Environmental Impact Assessment, Final Report.
- BPC Hydroconsult. 1999. Melamchi Diversion Scheme, Supplementary Environmental Impact Assessment - Quarry Sites.
- BPC Hydroconsult. 2000. Melamchi Diversion Scheme, Supplementary Environmental Impact Assessment – 33 kV Transmission Line (Sundarijal-Ribal).
- BPC Hydroconsult. 2000. Melamchi Diversion Scheme, Supplementary Environmental Impact Assessment – Gokarna – Sundarijal 132 kV Transmission Line.
- Nippon Koei et. al. 1999. Melamchi Water Supply Project, Inception Report for Environment.
- Nippon Koei et. al. 1999. Melamchi Water Supply Project, Due Diligence Report for IUCN/Metcon Draft EIA for Melamchi Diversion Scheme (September,1999).
- Nippon Koei et. al. 1999. Melamchi Water Supply Project, Physical, Fishery and Water Quality Aspects of Bagmati River – Part II – Fishery & Ecological Study.
- Nippon Koei et. al. 2000. Melamchi Water Supply Project, Physical, Fishery and Water Quality Aspects of Bagmati River – Part I – Water Quality.
- Nippon Koei et. al. 1999. Melamchi Water Supply Project, EIA Scoping and Terms of Reference for Integrated EIA.
- Nippon Koei et. al. 2000. Melamchi Water Supply Project, EIA for Water Treatment Plant.
- Nippon Koei et. al. 2000. Melamchi Water Supply Project – Draft Report for Environmental and Social Issues. (contains information comparing with and without

- hydro alternatives for MDS).
- NORPLAN A.S. 2000. Melamchi Diversion Scheme (MDS) Social Uplift Programme – Implementation Plan.
  - Nippon Koei et. al. 2000. Melamchi Water Supply Project, Draft Integrated EIA for MWSP.
  - Nippon Koei et. al. 2000. Melamchi Water Supply Project, Addendum to Final IUCN/Metcon EIA for Melamchi Diversion Scheme (December 1999).
  - Nippon Koei et. al. 2000. Melamchi Water Supply Project, Initial Environmental Examination for Bulk Distribution Scheme.

2. In addition to the above documents there are numerous earlier draft reports of some documents and separate sections and/or environment-related contributions to main engineering reports. These include environmental sections relating to both distribution network and wastewater improvement components as investigated by other consultants during 1990-1995.

## Indicated Relative Flows in Melamchi River with 2m<sup>3</sup>/s Diversion and Irrigation Demands (Dry Season - March)



### LEGEND

—▲—	Mean Flow (Estimated) 1995 & 1996 BPC Measured
—○—	80% Reliable Flows (Estimated) from BPC Measured
—□—	Mean Flow (Estimated) with 2m <sup>3</sup> /s Diverted
— — —	80% Reliable Flow (Estimated) with 2m <sup>3</sup> /s Diverted



Original Source: The World Conservation Union, Nepal/METCON Consultants  
Melamchi Diversion Scheme Environmental Impact Assessment,  
December 1999 (Adjusted)

## SUMMARY RESETTLEMENT PLAN

### A. Introduction

1. The Melamchi Water Supply Project (MWSP) involves diverting water from the Melamchi Khola at Ghwakan in the Melamchi Valley by gravity to the Kathmandu Valley at Mahankal (Sundarijal). This will involve construction of a tunnel, access roads, and transmission lines in the Melamchi Valley, and a water treatment plant, reservoir sites, and a bulk distribution system in the Kathmandu Valley. Pipelines will be run along road rights-of-way (ROWs) and across private land. An estimated 40,913 persons will be variously affected by the MWSP.

**Table A3:1: Households Affected by Loss of Agricultural Land and Residential and Commercial Structures**

Project Component	Agricultural Land		Structures on Private Land	House/Shop on Public Land	Shops on Public Land	Total Families and Persons Affected	
	PAF	SPAF	SPAF	SPAF	SPAF	PAFs	PAPs
<b>MDS</b>							
Permanent	1,295	200	118	7		1,620	9,072
Temporary	502					502	2,811
<b>BDS</b>							
Permanent	1,555	478	127		230	2,390	13,384
Temporary	2,684					2,684	15,030
<b>WTP</b>							
Permanent	30	48	1			79	616
<b>Total</b>	<b>6,066</b>	<b>726</b>	<b>246</b>	<b>7</b>	<b>230</b>	<b>7,275</b>	<b>40,913</b>

BDS = bulk distribution system, MDS = Melamchi Diversion Scheme, PAF = project-affected families, SPAF - severely project-affected families; WTP = water treatment plant.

2. The overall impact of the MWSP is limited. The majority (83 percent) of project-affected families (PAFs) will be marginally affected by loss of agricultural land, while only 10 percent (726 households) will be severely affected by loss of agricultural land. Three percent of PAFs (253 households) will lose their houses, 7 of which have shops attached. Another 3 percent (230 vendors) have encroached into road ROWs along the bulk distribution system pipeline route.

3. A total of 253 households, or 1,428 project affected persons (PAPs) will be displaced when their houses are affected. The incomes of 230 households (1,288 persons) will be affected when their temporary shops are cleared from public ROWs.

4. The draft resettlement action plan (RAP) identifies the (i) extent of losses; (ii) number of PAPs in various categories; (iii) policies and legal framework applicable; (iv) arrangements made for compensation payments, relocation, and income restoration assistance; and (v) responsibilities for delivering and monitoring the implementation measures.

### B. Socioeconomic Impacts on the Affected People

5. A census survey of 100 percent of affected households is being carried out as detailed designs become available for each component. This survey will serve as the cut-off date for eligibility for entitlements. The census survey combines an inventory of losses, ownership, and land tenure status with a collection of baseline socioeconomic data on each household as well as preferences for compensation and rehabilitation assistance.

### **C. Objectives, Legislation, Policy Framework, and Entitlements**

6. Land acquisition for public purposes in Nepal is largely governed by the Land Acquisition Act 2034 (1977), which sets out compensation standards and benefits such as compensation for lost assets at market value, provision for alternative land, and compensation for standing crops and trees. However the provisions are inadequate. To cover resettlement-related needs of the PAPs, Melamchi Water Supply Development Board (MWSDB) has prepared a resettlement policy framework for approval by the Ministry of Physical Planning and Works and the Cabinet. The framework provides benefits to nontitled persons such as encroachers and squatters, displacement allowances for relocation, and income restoration assistance. In summary, the policy framework for resettlement in the MWSP is similar to the Asian Development Bank's (ADB's) policy on resettlement. Basic principles of the MWSP resettlement policy include (i) avoidance of land acquisition and involuntary resettlement where feasible or minimization to the extent possible through the incorporation of social considerations into project design options, and (ii) where population displacement is unavoidable, payment of full compensation and assistance to people losing assets, livelihood, and other resources so that they can improve or at a minimum restore their former economic and social conditions.

7. The RAP contains 11 compensation categories: for land, crops and trees, loss of house and/or commercial enterprises, compensation for damages caused during construction, mitigation for loss of water due to diversion of the Melamchi River, displacement allowances, rehabilitation measures, loss of community facilities and resources, and group losses. These categories are listed in an entitlement matrix.

### **D. Consultation, Participation, and Grievance Mechanism**

8. Public consultation for the MWSP began with the census survey of each PAF during which focus group discussions have served as a forum for participation and consultation. The MWSP has also held coordination meetings with local nongovernment organizations (NGOs) and local governments. MWSDB senior management have carried out an information campaign and consultation with area residents in the Melamchi Valley.

9. A public relations consultant is being hired by MWSDB to keep project area residents fully informed about the MWSP and to make sure that public concerns are communicated to MWSDB. The Board will prepare and distribute brochures outlining the resettlement policy and compensation packages for PAPs and will involve community-based organizations (CBOs) and PAPs in the information campaign, and implementation and monitoring of the resettlement plan.

10. The PAPs and other people in the project areas will be able to make complaints or queries to the MWSP and know that they will be heard and addressed fairly. The field office of the Project in the Melamchi valley and the Resettlement and Social Development Division of the Project Management Unit will be responsible for handling initial grievances of the PAPs, with the assistance of the local consultative groups and particularly the local community liaison assistants (CLA) who will help the PAFs to file their complaints and concerns to the Board.

### **E. Relocation of Housing and Settlements**

11. A total of 253 houses will be displaced and require relocation, as well as 230 shops with very temporary structures of bamboo poles and plastic roofs. The house owners prefer to receive cash, and they will make their own arrangements to rebuild, either on their remaining land or elsewhere. Group resettlement sites will not be required. For the vendors whose shops

are illegally encroaching within the ROW, MWSDB will assist the local governments to find permanent market sites in which they can rent stalls.

#### **F. Income Restoration Strategies**

12. Severely project-affected families (SPAFs), including households fully affected by loss of houses and/or commercial establishments and households severely affected by loss of agricultural land, will be entitled to allowances to restore their household incomes during the transition period. They will also be assisted to restore their income levels in the longer term through skills training, assistance to establish new income-generating activities, and access to microfinancing. SPAFs and vulnerable groups (e.g., households headed by women, ethnic minorities, disabled, elderly, and special interest groups) will be given priority in all income restoration or creation measures. SPAF farmers will be provided with agricultural extension services for increasing productivity on their remaining land.

#### **G. Institutional Framework**

13. The implementation of the RAP will be carried out by the Resettlement and Social Development Division of the Project Management Unit, assisted by the compensation determination committees and local consultative groups at the ward level. MWSDB will be responsible for ensuring the necessary cooperation of contractors, government departments, and PAPs.

#### **H. Resettlement Budget and Financing**

14. The estimated cost of land acquisition and resettlement is NRs1,088 million (\$15.55 million). The resettlement cost estimate includes all costs related to resettlement including compensation, relocation, transfer costs, displacement allowances, rehabilitation costs, administrative costs, resettlement training, and costs of monitoring and evaluation. MWSDB will allocate appropriate funds on the basis of construction priorities and resettlement needs for the different components.

#### **I. Implementation Schedule**

15. An implementation schedule for the RAP has been prepared to ensure the completion of resettlement activities before the beginning of the relevant civil works of the MWSP. Resettlement preparation activities have started. Land acquisition will begin during the latter part of 2000 and will continue until the end of 2004. Monitoring and evaluation of the impacts of RAP implementation will continue into 2005.

#### **J. Monitoring and Evaluation Plan**

16. The resettlement process will be monitored both internally and externally. The Environment Resettlement and Social Development Division will be responsible for internal monitoring and preparation of monthly and quarterly progress reports on the progress of resettlement implementation. MWSDB will hire a qualified independent external monitoring agency to conduct external monitoring biannually during MWSP implementation. The monitoring and evaluation process will involve the participation of affected people, communities and/or NGOs. A postresettlement evaluation will be carried out by the external monitoring agency to assess whether the resettlement objectives have been met, and lessons learned identified for future policy formulation and planning.

## **ENVIRONMENTAL MANAGEMENT PLAN**

1. An environmental management plan (EMP) has been prepared for the various components of the Melamchi Water Supply Project (MWSP) to set out environmental management requirements. It also develops procedural frameworks to ensure that all mitigation measures and monitoring requirements specified in the environmental impact assessment (EIA) study report will actually be carried out in subsequent stages of project construction and operation.

### **A. Objective of the EMP**

2. The basic objectives of the EMP are the following:

- (i) Formulate environmental management requirements to ensure that all mitigation measures and monitoring requirements specified in the approved EIA study report will actually be carried out in different stages of MWSP development.
- (ii) Define environmental management principles and guidelines for the preconstruction, construction, postconstruction, and operation phases of MWSP development.
- (iii) Establish environmental resource needs.
- (iv) Recommend a plan of action and a means of testing this plan to meet existing and projected environmental problems.
- (v) Establish the roles and responsibilities of all parties involved in project environmental management.
- (vi) Describe mitigation measures that will be implemented to avoid or mitigate adverse environmental impacts by maximizing the positive ones.
- (vii) Establish a supervision, monitoring, auditing, and reporting framework.
- (viii) Ensure implementation of recommended corrective actions aimed for environmental management and its enhancement.
- (ix) Ensure that the environment of MWSP construction sites and the region of influence is protected and developed to meet the needs of the local people, and the stakeholders, and safeguard the national interest.

### **B. Parties Responsible for EMP Implementation**

3. Parties to be involved for environmental management of the proposed MWSP components are:

- Ministry of Population and Environment;
- Assistance agencies
- Ministry of Physical Planning and Works;

- Melamchi Water Supply Development Board (MWSDB);
- Private Sector Participation Committee;
- Melamchi Water Supply project management consultant;
- private sector management contractors for Nepal Water Supply Corporation operations;
- supervising engineers for different MWSP components;
- construction contractors;
- regional and local level political and governmental institutions (village development committee, district development committee, municipalities, and line government offices, etc.); and
- regional and local level nongovernment organizations, community-based organizations, etc.

4. The primary responsibility for environmental management lies with MWSDB. However, the parties involved for different purposes have important roles and responsibilities for the effective implementation of the environmental action plan to minimize environmental disturbance. The main roles of the different parties are briefly summarized in Table A4.1 and the organization chart is shown in Figure A4.1.

### **C. Environmental Management and Monitoring during Different Phases of Project Implementation**

5. The environmental mitigation measures will be implemented progressively in the various stages of project implementation (preconstruction, construction, postconstruction, and operation stages). The management measures in the preconstruction phase include design modification to minimize environmental impacts; provisions for compensation, resettlement, and rehabilitation to the affected parties prior to acquisition of land and property; permits and approval; survey and pegging of project area; work area and camp establishment; environmental awareness and training; job opportunity to local area people, risk and hazard planning, including all relevant environmental protection requirements in the tender documents; and provisions to avoid disturbance to local services and facilities.

6. The construction phase management measures include provisions of site preparation; erosion and sediment control; top soil saving and reuse; drainage management; spoil management; blasting regulation; quarry site and borrow pit management; monitoring and control of air, water, and land pollution including noise and vibration; management of the labor force, traffic, storage and stockpile; occupational health and safety, and accident and emergency; monitoring of vegetation loss and degradation; aquatic life and ecology and Langtang National Park and Shivapuri Watershed and Wildlife Reserve areas.

7. The postconstruction management measures include provision of progressive demolition of support structures not required for project operation; progressive rehabilitation of construction sites including camp sites, spoil disposal sites, quarry and borrow pit areas using bioengineering measures; including revegetation, and other soil stabilization measures, and progressive reinstatement of services affected by the MWSP.

8. The operation phase management measures include monitoring the (i) environmental amenity flow in the Melamchi River; (ii) aquatic life and ecology downstream of the intake in the Melamchi River (it may prove desirable to initiate a fish-stocking program); (iii) incoming and treated water at the water treatment plant, terminal reservoir, and consumer taps; (iv) water

treatment plant sludge disposal; and (v) impact of increased waste water flow on the Bagmati River.

#### D. Records, Audits, and Corrective Actions

9. The construction contractor and supervising engineers of various MWSP components will keep all records pertaining to project environmental management, mitigation measures, corrective actions, and monitoring during the project construction phase. In the operation phase, keeping and maintaining the records of environment-related measures and monitoring, as per the EMP will be the responsibility of project operator.

**Table A4.1: Environmental Management Roles**

<b>Involved Parties</b>	<b>Responsibilities</b>	<b>Timings</b>
<b>MOPE</b>	Monitor the project design, construction and operation activities against the approved environmental impact assessment (EIA) and environmental management plan (EMP) measures and national environmental standards	At least once a year during construction
	Audit project general performance during operation phases	Every two years in the operation phase
<b>External Assistance</b>	Ensure that the EMP and EIA mitigation measures are included in the tender documents	Before construction contract
	Ensure that the compensation, resettlement, and rehabilitation measures are implemented as per EMP and resettlement action plan (RAP)	Prior to start of construction and construction phase
	Ensure that the environmental monitoring, auditing, and implementation of mitigation measures are implemented as per the EMP.	Construction and operation phase
<b>MPPW</b>	Monitor the project design, construction, and operation activities against approved EIA and EMP measures, national environmental standards, and license conditions	At least twice a year during construction and once a year during operation

<b>Project Owner MWSDB and Private Sector Participation Committee</b>	Ensure that the EIA and EMP measures are incorporated in the final project design.	Prior to contract award
	Acquire necessary permits and approval for project construction and operation.	Before construction
	Ensure compensation, resettlement, and rehabilitation to the project affected people	Before construction and during construction
	Ensure that the project construction activities are in accordance with EMP and other Government legislative requirements.	During construction
	Implementation of repair and maintenance of project components including environmental safeguards as recommended by MPPW, and MOPE	During operation
	Ensure monitoring and record keeping regarding environmental measures and impacts	During construction and operation
	Ensure implementation of environmental enhancement programs such as social uplift programs	Project period
Ensure public participation and involvement in all phases of project implementation	Construction and operation phases	
<b>Project Management Unit and ERSDD</b>	Review and recommend the final design of the project and ensure that the EMP measures are included in the tender documents and contract documents	Prior to contract award and during construction
	Review monitoring and auditing reports of the supervising consultants and recommend measures to meet the objectives of the EMP	During construction phase
	Recommend any additional corrective measures to minimize the environmental impacts to the project owner	During construction phase
	Coordinate with the MWSP subcomponent supervising engineers for matters of project design changes, EMP implementation, and monitoring	During construction phase
<b>Supervising Engineers and Private Sector Management Contractor</b>	Regular supervision and impact and compliance monitoring of the construction contractor's activities and environmental mitigation measures as per EMP and provisions stipulated in regular inspection reports of the engineers.	During construction phase
	Environmental audits of construction contractors' activities and audit reports	During construction phase every three months. Final audit report on the completion of construction works.

	Assist MPPW in implementing and supervising environmental enhancement programs and their monitoring and auditing as per the EMP.	During construction phase
	Ensure public participation and involvement in project construction as per the EMP	Construction period
<b>Construction Contractors</b>	Implement mitigation measures as specified in their contracts	During construction phase
	Monitoring and record keeping of environmental mitigation measures as per the EMP	Construction phase
	Implementation of the corrective actions as recommended by the supervising consultants	Construction phase
<b>NGOs, CBOs, VDCs, and DDCs</b>	Monitor that the environmental mitigation measures and enhancement measures are implemented in all stages of the project as per the EMP	Project period
	Monitor public participation in project implementation.	Project period

10. The supervising engineers will carry out compliance auditing regarding the environmental performance during every three months of construction. Besides, the project management consultants, MWSDB and funding agencies will audit works carried out by the supervising engineers. MOPE, and MPPW will annually review the audit reports, and if required may visit the project site and give their recommendations for action. The Project Management Unit will prepare an integrated audit report of the different MWSP components on completion of construction and postconstruction rehabilitation.

11. The Ministry of Population and Environment will prepare an environmental audit report after two years of the completion of construction. Project performance audit reports include a final assessment of the degree to which the MWSP satisfied the proposed environmental requirements, the effectiveness of mitigatory measures and institutional development, and whether any unanticipated effects occurred as a result of project activities.

#### **E. Complaints and Grievances**

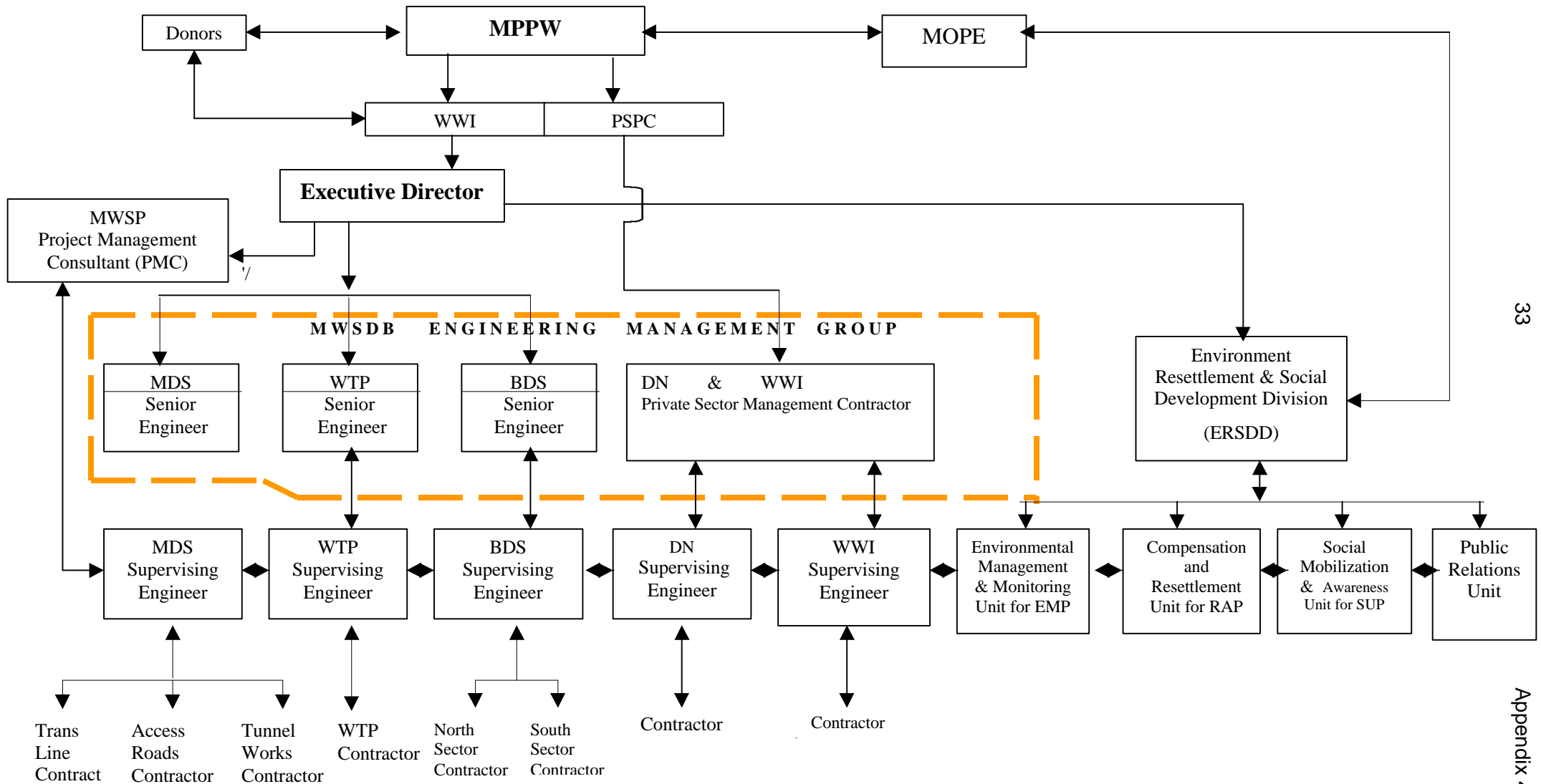
12. During the project construction, the construction contractor or the supervising engineer must promptly inform the public relations officer, MWSP office, of any complaints received from individuals or communities or institutions, so that actions as specified in the EMP can be taken. The public relations officer will take needed action on the complaints and grievances.

**Table A4.2: Basic Cost Estimate for Environmental Management Plan**

Component Environmental Management Aspect	Unit Cost \$'000	Cost Distribution					Total
		Year 1	Year 2	Year 3	Year 4	Year 5	
<b>1 MDS – Management and Monitoring</b>							
1.1 Capital test items, including vehicle, field test and survey equipment, computers, misc. equipment + 15% contingency	90	90	0	0	0	0	90
1.2 Annual operating and maintenance and 10% contingency							
* Adits and groundwater	45	30	45	45	45	45	210
* Construction site and external impacts monitoring	90	45	90	90	90	90	405
* Melamchi River water use and fisheries Management Program	40	20	40	40	40	40	180
* Community forest, LNP buffer zone and public relations	35	20	35	35	35	35	160
* Erosion control and land restoration and watershed management	50	25	50	50	50	50	225
* ERSDD strengthening, training and operating basic testing laboratory for water and soils	70	35	70	70	70	70	315
* Office administration, operation, and reporting costs	10	10	10	10	10	10	50
* Vehicle operations	10	10	10	10	10	10	50
<b>Subtotal (1)</b>		285	350	350	350	350	1,685
<b>2 BDS Management and Monitoring</b>							
2.1 Capital costs including vehicles	75	0	75	0	0	0	75
2.2 Environmental management and monitoring based on above for 4 years	240	0	120	240	240	240	840
2.3 Operating cost and vehicle	15	0	15	15	15	15	60
<b>Subtotal (2)</b>	330	0	210	255	255	255	975
<b>3 WTP Management and Monitoring</b>							
3.1 Capital costs excluding vehicle plus additional equipment	40	0	0	40	0	0	40
3.2 Environmental management and monitoring for 3 years	160	0	0	80	160	160	400
3.3 Operating costs and use of same vehicle as in 2 above	15	0	0	15	15	15	45
<b>Subtotal (3)</b>	215		30	135	175	175	485
<b>4 Miscellaneous Environmental Management and Monitoring for DN and WWI</b>	120	0	30	60	120	120	330
<b>Total</b>		285	620	800	900	900	3,475
<b>Estimated Total \$3.5 million</b>							

BDS = bulk distribution system, DN = distribution network, MDS = Melamchi Diversion Scheme, WTP = water treatment plant, WWI = wastewater improvements.

**Figure A4.1: Environmental Management Plan Organization Chart**



Code : BDS : Bulk distribution system  
 DN : Distribution network  
 EMP : Environmental management plan  
 MDS : Melamchi Diversion Scheme  
 MOPE : Ministry of Population and Environment  
 MPPW : Ministry of Physical Planning and Works  
 MWSDB : Melamchi Water Supply Development Board  
 PSPC : Private Sector Participation Committee  
 RAP : Resettlement action plan  
 SUP : Social Upliftment Program  
 WTP : Water treatment plant  
 WWI : Wastewater improvements

## ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

<b>Actions</b>	<b>Beneficial Impacts</b>	<b>Adverse Impacts</b>	<b>Mitigation Measures</b>
1. Extraction of Water from Melamchi Khola via Diversion Weir	(i) Eliminates current groundwater mining, which if continued would cause land subsidence (ii) Enables 24-hour potable piped water to all in Kathmandu Valley (KV)	(i) 45% of residual flow left in river during worst month of dry season (ii) Diversion weir will marginally affect fish population. Residual flows downstream will be adequate to maintain habitats suitable for fish breeding. River fisheries are already overexploited.	(i) No inundated area involved due to steep river gradient (ii) Existing demands of water for irrigation, water mills, and domestic use can be met in the dry season. (iii) Water extraction volume will be controlled, and water will be used for water supply purposes only. (iv) Social Uplift Program will be implemented in Melamchi Valley during construction and maintained permanently through a royalty payment from the KV consumers. (v) Permanent river water use and fisheries management program
2. Construction of Access Roads to Tunnel	(i) Provides access to markets for Melamchi Valley inhabitants	(i) Slope stability endangered (ii) Resettlement needed (iii) Trees to be cut down (iv) Construction noise and pollution (v) Requires permanent maintenance	(i) Balanced cut and fill design; spoil will be compacted and stabilized by planting; upslope and downslope gabions will be used; careful attention will be paid to drainage (ii) Compensation will be paid (iii) Replacement trees will be planted (iv) Limited construction hours and watering of dust-prone areas (v) Royalty from KV consumers will pay for road maintenance
3. Disposal of Spoil from Tunnel Excavation	(i) Rock available from excavation can be crushed to make aggregate for use in KV	(i) Unstable spoil slopes will endanger human and ecological life (ii) Pollution of river by erosion (iii) Visual scar for trekkers (iv) Use of arable land	(i) Preparation of spoil site to affect stable foundation on stable geology (ii) Compaction of spoil and effective drainage of spoil site (iii) Landscaping of completed site. (iv) Site selection of barren land where feasible
4. Construction of 33KV Transmission Main	(i) Will serve as permanent electrification for the inhabitants of Melamchi Valley as well as for construction	(i) Visual pollution in the countryside	Nil
5. Use of Explosives in Construction	(i) Main means of tunnel excavation	(i) May be used for insurgency or for dynamiting fish (ii) People may be accidentally injured or killed	(i) 24-hour security will be provided to the storage bunker and cradle to grave accounting for all explosives (ii) Training of tunnel workers
6. Establishment of Construction Camps	(i) Employment of local labor (ii) Income from sale of agriculture products	(i) Security problem including prostitution (ii) Disturbance of community life (iii) Local resources over-taxed	(i) Social Uplift Program (ii) Constant collaboration with leaders of affected communities including their involvement in project management

7. Construction near Parks and Reserves	Nil	(i) Potential damage to protected ecological region (ii) Potential for illegal wildlife hunting	(i) Minimized during design by elimination of the hydropower component (ii) Control of contractor workforce (iii) Liaison with Wardens
8. Construction of Tunnel	(i) Major local employment	(i) May dry up springs used by farmers (ii) Workers may be injured or killed in construction accidents	(i) Lining of tunnel to prevent infiltration at key locations; compensation where necessary (ii) Permanent Safety Officer
9. Construction of Water Treatment Plant	(i) Provides potable piped water to KV (ii) Provides permanent employment	(i) Land acquisition and resettlement (ii) Tree cutting (iii) Permanent noise (iv) Construction spoil runoff to river (v) Danger to wildlife in Shivapuri Watershed and Wildlife Reserve. (vi) Sludge disposal	(i) Compensation (ii) and (iii) Landscaping with large boundary trees (iv) Riverbank buffer-zone tree planting and contractor controls (v) Fenced enclosures of transformers and ring enclosures of power poles (vi) Drying of sludge before use in reclamation and landfill
10. Construction of Bulk Distribution	(i) Distributes water equitably around KV (ii) Provides temporary employment	(i) Land acquisition and resettlement (ii) Tree cutting (iii) Construction noise and pollution (iv) Temporary lack of access to properties	(i) Compensation (ii) Replacement of trees (iii) Restricted construction hours and watering of dust-prone areas (iv) Liaison with property owners and public relations program
11. Construction of Wastewater Improvements	(i) Will improve sanitary environment in KV (ii) Public toilets will provide convenience	(i) Land acquisition and resettlement (ii) May be inadequate to cope with all the extra wastewater created when the new water supply is commissioned	(i) Compensation (ii) Further wastewater improvements are planned for 2007; meanwhile the effect of added wastewater will be closely monitored and interim improvements introduced if needed.
12. Private Sector Management of Water Supply and Sewerage in KV	(i) Increased efficiency in delivery of water supply and sanitation services (ii) Increased capacity to implement water supply and sanitation development in KV	(i) Loss of jobs for Nepal Water Supply Corporation (NWSC) employees (ii) Higher tariffs perceived to be the result of private sector intervention	(i) Options are being given to NWSC staff, including golden handshake, working for NWSC outside KV, and working for private sector management contractor (ii) Regulatory body will monitor performance parameters and tariff; a public relations and public awareness program will be implemented this year
13. Increased Water Tariffs	(i) Is an effective demand management tool (ii) Helps to ensure sustainable service (iii) Should provide a better service	(i) Willingness to pay and affordability are questioned (ii) Urban poor may be vulnerable	(i) Several surveys have shown that for the projected tariffs there is willingness to pay and the tariffs are affordable; a public relations and public awareness program will help and increases will be staged (ii) Special studies are currently being undertaken to see how some 20,000 very poor people living in KV can be given access to water supplies under the private sector contract