Chapter 5 Wehda-Irbid Water Supply

5.6 Cost Estimate

5.6.1 Construction Cost

Summary of the construction cost of water treatment plant and transfer pump system including pump station and pipe line are as follows:

(1) Water Treatment Plant

		2,005	2,010
Direct cost	Land acquisition	12,000	
	Civil works	7,446,000	6,092,000
	E&M works	6,144,000	5,027,000
	Sub total	13,702,000	11,119,000
Indirect cost		3,631,000	2,946,500
Total		17,333,000	14,065,500

(2) Transfer System

		2005	2010
Direct cost	Land acquisition	124,800	
	Pump station	3,125,000	2,688,000
	Reservoir	657,000	
	Pipe line	12,272,800	
	Sub total	16,179,600	2,688,000
Indirect cost		4,287,600	712,000
Total		20,467,200	3,400,000

5.6.2 Operation and Maintenance Cost

Summary of the operation and maintenance cost of water treatment plant and transfer pump system including pump station and pipe line are as follows:

(1) Water Treatment Plant

	2,005	2,010
Maintenance cost	160,110	131,000
Staff cost	66,500	21,000
Energy cost	1,012,656	1,012,656
Treatment cost	803,000	657,000
Total	2,042,266	1,821,656

(2) Transfer System

	2,005	2,010
Maintenance cost	117,774	45,570
Staff cost	10,500	10,500
Energy cost	845,535	693,338
Total	973,809	749,408

5.6.3 Unit Prices for Construction Cost Estimate

The adopted unit construction prices are established based on the following information and documents:

- Several previous study reports of MOWI
  - Domestic Water Project North Jordan; PART-2 Northern Region
    Technical and financial assessment; Dec. 1979(Stanley Consultant)
  - Conveyance Systems Project;
    Final interim report; March 1999 (IWACO)
  - Others
- Latest price list of the Ministry of Public Works and Housing,
  version 1999(The Government Tender Directorate Annual Report)
- Quotation and consultation with local contractors and manufactures
- Experience of the Consultant

Unit prices include all the costs for construction works including belonging and all indirect prices except owner's engineering cost and physical contingencies. The prices given in the previous study reports of MOWI mentioned above are converted to year 2001 prices considering the annual escalation ratio of 3% per annum.

(1) Unit construction cost for water treatment plant.

The approximately unit construction cost for water treatment plant is estimated as 618JD/1,000m3, based on consultant's experience, considering the in-flow water quality from Wahda dam, the geographical feature and geological conditions around the plant site, treatment water capacity (22MCM/a:2005, 44MCM/a:2010) of plant, etc and obtained from the site reconnaissance and the study.

(2) Unit construction cost for transfer system.

Table 5.6.3-1 shows the basic construction cost for civil works taken into account for unit price estimation.

Table 5.6.3-2 summarizes the compound unit prices for the estimate of base construction cost for transfer facilities.

Fig. 5.6.3-1 shows the estimate base construction cost for water pumping station.
All tables and figure are based on price of the year 2001.

Table 5.6.3-1 Basic Construction Cost for Civil Works

	Unit	Unit price (JD/ unit)
Land acquisition		
North Jordan Valley	ha	16,000
Middle and South Jordan Valley	ha	12,000
Others	ha	8,000
Earth work		
Site leveling	m^2	2.0
Excavation Common	m^3	3.5
Rock	m^3	8.5
Backfill	m^3	2.5
Concrete		
Lean concrete	m^3	45
Mass concrete	m^3	70
Reinforced concrete	m^3	140
Anchor block	m^3	115
Steel		
Steel bar	t	520
Structural steel	t	1,570
Building		
High quality	m^2	350
Middle quality	m^2	200
Low quality	m^2	160
Road pavement	m^2	9.5
Fence and gate	m	25

Table 5.6.3-2 Unit Prices for Water Transfer Facilities.

Component	Unit	Unit cost(JD/unit)
Transmission Main-Steel pipe		
DN 1100	m	
DN 1200	m	529
DN 1350	m	610
DN 1500	m	725
Water Reservoir		
$8,000m^3$	m^3	75
$9,000m^3$	m^3	73
$10,000m^3$	m^3	71

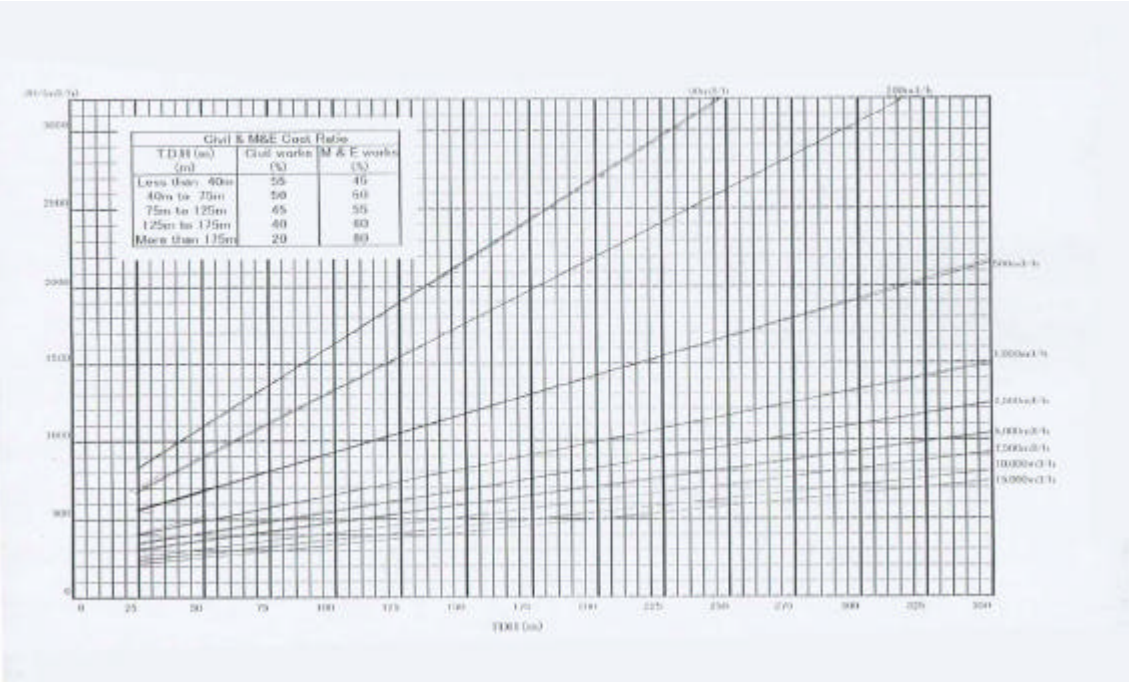

Figure 5.6.3-1 Estimated Base Construction Cost for Water Pumping Station.

5.6.4 Estimation of Investment Cost

For preliminary estimates of investment cost it was distinguished between base construction cost, administration cost, engineering cost and physical contingencies as described in the following.

(1) Basic design assumptions for base construction cost estimation

Cost shall be estimated for all the facilities of the Wahda-Irbid water supply system.

Base construction cost estimate considers all the required facilities between the water treatment plant and the reservoir of Zabda near to Irbid. This means that they will be comprised of a water treatment plant, water transmission pump station with balancing /regulation reservoir, water transmission pipeline facilities and water distribution reservoir.

The unit base construction cost for pump station is given in Fig 5.6-1, according to this figure, unit base construction cost will be settled by parameter of Total Dynamic Head (TDH: in meter) and pumping capacity (m^3/h). For the ratio of cost each (electrical equipment and civil works) will be settled by parameter of TDH.

For transmission pipes steel with coating pipes shall be adopted.

(2) Cost for administration, engineering and physical contingencies.

-Administration costs include the cost for the administrative works such as internal planning and budgeting, the administration of engineering and construction contracts, legal services, and liaison with funding agencies etc... The administrative costs are assumed to be about 5% of the base construction costs.

- Engineering costs include the cost for the engineering services such as surveys, planning, designs, site supervision etc.. The amounts of these services are estimated as 10% of the base construction costs according to the experience of the consultant.
- Due to the limitation that the cost estimation at this stage of the project is based on a rough plan, allowance is taken into account for unpredictable variation in constructions and other unforeseen difficulties that may increase the final construction costs. The amount of these physical contingencies are estimated as 10% of the total of base cost, administration cost and engineering cost.

5.6.5 Unit Costs for Operating and Maintenance

5.6.5.1 Operation costs.

Operation costs will be estimated for the staff cost, treatment cost, power cost and maintenance cost.

(1) Personnel cost

Two types of staff costs have to be distinguished, i.e. water treatment plant and pump stations.

- Staff for water treatment plant

The treatment plant will need administrative, operating and maintenance staff on site of various skills, in order to ensure proper operation of the plant.

It is assumed that a total of followings 25 staffs are required.

Plant superintendent.	1
Administrative staff.	2
Laboratory staff.	4
Operating staff.	4
E & M specialist.	4
Labours.	8
Guard staff.	2
Total	25

- Staff for pumping station

The following criteria are applied to estimate required staff for operation and maintenance of pumping stations.

Criteria	Required staff
Transmission volume of pump station <5,000m^3/d Transmission volume of pump station 5,000 to 20,000m^3/d	1 2
Transmission volume of pump station 20,000m^3/d or more	3

The estimate of personnel costs are based on current salaries paid including all overhead costs (e.g. allowances, pension fund etc.) Average annual cost for one staff member are estimated to be 3,500JD/a based on the data from Department of Statistic Data Bank 1998.

(2) Treatment cost

Water treatment costs have been estimated on the basis of assumed chemical dosing rates and chemical costs collected from the actual records of Zai Water Treatment plant.

Annual average main chemical dosing rates in Zai Treatment Plant and costs are as follows.

	Annual average dosing rates	Chemical Cost
Activated carbon	23.0 mg/l	0.647 JD/kg
Ferric sulfate	37.0 mg/l	0.194 JD/kg
Sodium Chlorine	3.5 mg/l	1.715 JD/kg
Cationic Polymer	1.7 mg/l	1.120 JD/kg
Potassium permanganate.	0.9 mg/l.	2.185 JD/kg
Powdered activated carbon.	2.5 mg/l.	0.84 JD/kg

According to above data, annual dosing costs are estimated as 36,500 JD/MCM.

(3) Power cost

Electrical energy is consumed by transmitting water by pumps to water reservoir or booster pump station. Power consumption is calculated according to the transmission volume and pumping height and an efficiency of 70% is assumed. The present average compound rate per kWh for water supply sector is 0.034JD.

5.6.5.2 Maintenance cost

Annual maintenance costs are calculated as a following percentage of the investment costs.

0.5% per annual for civil works
2.0% per annual for mechanical and electrical works
0.5% per annual for transmission mains including distribution networks.

These percentages are based on experience and are widely accepted as representative of typical conditions.

5.7 Economic and Financial Analysis

5.7.1 Socio-Economic Conditions

(1) Population

Population and its Growth in the Past

Item	1979 Census	1994 Census	Inter-Censual Growth Rate/a
Jordan	2,149,177	4,139,458	4.5%
Irbid Governorate	409,739	751,634	4.1%
Irbid City	113,048	208,329	4.2%

Source: Department of Statistics

The 1994 population of Irbid City was 208,329. It accounted for 28% of the governorate population. It grew during the inter-censual 15 years 1979 to 1994 at the average annual rate of 4.2%, which was slightly higher the governorate average, but a little lower than the national average as shown in the above table.

(2) Employment

Employment

Item	Employment, 1997	Population, 1997	Employment/1,000 Population
Jordan	410,136	4,600,000	89
Amman Governorate	269,499	1,751,680	154
Jordan (excl. Amman Governorate)	140,637	2,848,320	49
Irbid Governorate	34,184	835,360	41

Source: Statistical Yearbook of Jordan 1998, Department of Statistics

Employment per 1,000 population was 41 in the Irbid Governorate in comparison with its outside Amman Governorate average of 49 in 1997. It shows that the economy of this governorate is less active than the rest of the country excluding the Amman Governorate.

5.7.2 Economic and Financial Analysis

(1) Methodology

1) Financial Analysis

(a) Preparation of cost benefits streams

a) Project life for financial analysis was set at 30 years.

b) Preparation of cost streams
The estimated initial cost of the project was spread over the implementation period. Also, the annual recurrent cost for the operation and maintenance (O & M) of the facilities was entered annually after the implementation up to the end of the project life.

c) Incorporation of production cost of water
The unit cost of water to be produced at the Wahda Dam was calculated, which was multiplied by the quantity of water to be transported by the proposed pipelines to arrive at the production cost of transported water. This cost was incorporated in the O & M cost.

d) Preparation of water streams
The gross quantity of water to be transported was annually entered after the implementation of the project. Then, the estimated physical and administrative loss of water was annually subtracted from the gross quantity of water. This way, the net quantity of water to be transported and billed was annually determined up to the end of the project life.

e) Estimation of unit values of water
The shares of the transported water according to its uses (municipal, industrial and irrigation) were estimated. Then, the financial values of the unit quantity of water according to its uses were estimated based on the existing water tariffs and future needs for raising them.

f) Preparation of benefits streams
From items d) and e) benefits streams was worked out up to the end of the project life.

(b) Calculation of Financial Criteria and Financial Evaluation

a) The discount rate was assumed as 5%.

b) Using the cost benefits streams, FIRR, NPV and the water price were calculated.

c) Based on the values of financial criteria, taking into consideration qualitative factors as well, the judgment on the financial feasibility of the project was passed.

2) Economic Analysis

(a) Preparation of cost benefits streams

a) Project life
(Same as in financial analysis)

b) Preparation of cost streams
The estimated initial cost was divided into foreign and local components. The standard conversion factor was applied to the local components, except land acquisition cost, which was annualized based on land rent.
The initial cost of the project was spread over the implementation period. Also, the annual recurrent cost for the operation and maintenance (O & M) of the facilities was entered annually after the implementation up to the end of the project life.

c) Incorporation of production cost of water
(Same as in financial analysis)

d) Preparation of water streams
The gross quantity of water to be transported was annually entered after the implementation of the project. Then, the estimated physical loss of water was annually subtracted from the gross quantity of water. This way, the net quantity of water to be transported was annually determined up to the end of the project life.

e) Estimation of unit values of water
The shares of the transported water according to its uses (municipal, industrial and irrigation) were estimated. Then, the economic values of the unit quantity of water according to its uses were estimated.
The economic value of the unit quantity of municipal water was worked out by considering the affordability of a household to pay for water supply and the water demand per household. The economic value of the unit quantity of industrial water was surmised from the industrial gross output, industrial water demand and the contribution of water in realizing industrial output. The estimation of the economic value of the unit quantity of irrigation water was made from agricultural gross output, irrigation water demand and the contribution of irrigation water in realizing agricultural output.

f) Preparation of benefits streams
From items d) and e) benefits streams were worked out up to the end of the project life.

(b) Calculation of Economic Criteria and Economic Evaluation

a) The opportunity cost of capital was assumed as 10%.

b) Using the cost benefits streams, EIRR, NPV and the water price were calculated.

c) Based on the values of economic criteria, taking into consideration qualitative factors as well, the judgment on the economic feasibility of the project was passed.

(2) Preconditions

1) Water to be Transported (Unit: M m^3/year)

Year	2005	2010
Water Transported	22	40

2) Investment Costs (Unit: M JD)

Investment Costs	Local Components		Foreign Components	
58.312	32 %	18.562	68 %	39.750

3) Implementation Schedule

2003	2004	2005	2006	2007	2008

4) O & M Costs (Unit: M JD)

Year	2005	2010
O & M Costs	2.183	4.183

5) Municipal Water Tariff (Unit: Fils/m^3)

2003	2004	2005	2006	2007	2008	2009	2010
294	294	303	312	321	331	341	351

Starting in 2005, the average municipal water tariff per m^3 was assumed to be increased at the annual rate of 3% up to 2010.

6) Unit Benefits of Municipal Water : 735 Fils/m3

(3) Results of Financial Analysis

FIRR	NPV (M JD)	Unit Water Price (Fils)
4.5%	-3.2	356

Note: Discount Rate=5%

(4) Results of Economic Analysis

EIRR	NPV (M JD)	Unit Water Price (Fils)
20.3%	53.1	477

Note: Discount Rate=10%

(5) Evaluation

This project is financially not feasible with the FIRR of 4.5%, NPV of –3.2 million JD and the unit water price of 356 fils per m^3. However, it is economically remarkably feasible with the EIRR of 20.3%, NPV of 53.1 million JD and the unit water price of 477 fils per m^3.

The financial analysis of the project was performed on conditions that the municipal water tariff be raised at the annual rate of 3% since 2005 up to 2010. As a result, the tariff will be 351 fils per m^3 in 2010. It is to be noted also that the financial analysis was conducted on the premise that the cost of the Wehda Dam construction project is fully considered.

The value of FIRR (4.5%) is only by 0.5% less than the assumed discount rate (5.0%), and also the financial unit water price (356 fils per m^3) is only slightly higher than the assumed ultimate municipal water tariff in 2010 (351 fils per m^3). Besides, the value of EIRR is more than two times the OCC, and the economic NPV is as much as 53 million JD.

It is to be added here that the benefits of power generation accompanying the construction of the Wehda Dam are not considered in our analysis.

Therefore, it can be fairly judged that the project is sufficiently worthwhile and suitable for implementation.

5.7.3 Projected Financial Statements

(1) Preconditions

The projected financial statements, namely the income statement, the funds statement and the balance sheet were prepared.
In preparing projected financial statements, the following preconditions were set:

Item	Values, etc.
Financing resources	80% : External; 20%: Local
Financing terms	Repayment period: 30 years
	Grace period: 5 years
	Annual interest rate: 4%
Inflation rate	2%/a
Executing Entity	Public
Corporate Tax	0%

(2) Evaluation of Projected Financial Statements

The financial statements for the Wehda Irbid water supply project shown in Table 5.7.3-1 are summarized by the representative managerial indices as follows:

(Unit: %)

Project	Profit/ Revenues		Working Capital/ Revenues		Profit/ Liabilities and Capital	
	To 2020	To 2030	To 2020	To 2030	To 2020	To 2030
Wehda Irbid Water Supply	6.7	12.7	1.2	7.6	1.6	3.3

For the sake of comparison analysis, it can be stated that the standard level would be 10% for the profit to revenues ratio, 10% for the working capital to revenues ratio, and 5% for the profit to liabilities and capital ratio.

Regarding the profit to revenues ratio, the project has been found to be short of the standard value up to 2020, but to be better than it in the long run. With regard to the working capital to revenues ratio, the project will be below the standard level for a long time, but will approach it as years go by.

With respect to the profit to liabilities and capital ratio, the project would not be up to the standard level. However, this point should not be overemphasized because this undertaking of social nature is essentially not profit-oriented and, therefore, the estimated value should be regarded as acceptable.

In conclusion, it can be stated that the project would be financially sustainable in the long run under the afore-mentioned preconditions, although it should be noted that it might face liquidity problem in the initial years, which must be overcome by either the fund on hand or by borrowings.

Table 5.7.3-1 Financial Statements of Wehda-Irbid Water Supply Project

(Unit : Million JD at Current Prices)

Item	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
(1) Income Statement												
Revenues	0.000	0.000	0.000	5.243	5.661	6.108	11.975	12.651	12.651	12.651	12.651	12.651
O & M Cost	0.000	0.000	0.000	4.704	4.865	5.032	7.448	7.576	7.576	7.576	7.576	7.576
Depreciation	0.000	0.000	0.000	0.000	0.000	0.000	1.749	1.749	1.749	1.749	1.749	1.749
Interest Payment	0.524	1.048	1.762	1.952	2.142	2.332	2.239	2.146	2.053	1.959	1.866	1.773
Expenditures	0.524	1.048	1.762	6.656	7.008	7.364	11.436	11.471	11.378	11.284	11.191	11.098
Profit Before Tax	-0.524	-1.048	-1.762	-1.413	-1.347	-1.256	0.539	1.180	1.273	1.366	1.460	1.553
Tax	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Profit After Tax	-0.524	-1.048	-1.762	-1.413	-1.347	-1.256	0.539	1.180	1.273	1.366	1.460	1.553
	(up to 2020)	(up to 2030)										
Average Profit Before Tax to Revenues Ratio	6.7%	12.7%										
Average Profit After Tax to Revenues Ratio	6.7%	12.7%										
(2) Funds Statement												
Profit After Tax	-0.524	-1.048	-1.762	-1.413	-1.347	-1.256	0.539	1.180	1.273	1.366	1.460	1.553
Loans+Budget	13.101	13.101	17.853	4.752	4.752	4.752	0.000	0.000	0.000	0.000	0.000	0.000
Depreciation	0.000	0.000	0.000	0.000	0.000	0.000	1.749	1.749	1.749	1.749	1.749	1.749
Sources	12.577	12.053	16.091	3.339	3.406	3.497	2.288	2.929	3.022	3.116	3.209	3.302
Capital Works	13.101	13.101	17.853	4.752	4.752	4.752	0.000	0.000	0.000	0.000	0.000	0.000
Payment of Principal	0.000	0.000	0.000	0.000	0.000	2.332	2.332	2.332	2.332	2.332	2.332	2.332
Working Capital	-0.524	-1.048	-1.762	-1.413	-1.347	-3.588	-0.044	0.597	0.690	0.783	0.877	0.970
Applications	12.577	12.053	16.091	3.339	3.406	3.497	2.288	2.929	3.022	3.116	3.209	3.302
	(up to 2020)	(up to 2030)										
Average Working Capital to Revenues Ratio	1.2%	7.6%										
(3) Balance Sheet												
Liabilities	10.481	19.651	32.148	35.475	38.802	39.796	37.464	35.131	32.799	30.466	28.134	25.801
Capital	2.096	4.978	8.572	8.585	8.664	8.834	9.373	10.553	11.826	13.192	14.652	16.205
Liabilities and Capital	12.577	24.630	40.721	44.060	47.466	48.630	46.837	45.684	44.625	43.659	42.786	42.006
Current Assets	-0.524	-1.572	-3.334	-4.747	-6.094	-9.682	-9.726	-9.129	-8.439	-7.656	-6.780	-5.810
Fixed Assets	13.101	26.202	44.055	48.807	53.560	58.312	56.563	54.813	53.064	51.315	49.565	47.816
Assets	12.577	24.630	40.721	44.060	47.466	48.630	46.837	45.684	44.625	43.659	42.786	42.006
	(up to 2020)	(up to 2030)										
Average Profit Before Tax to Liabilities and	1.6%	3.3%										

5.8 Initial Environmental Examination (IEE)

5.8.1 Project Components and Activities

The project will use the source water from the Al Wehda Dam for water supply to Irbid. Table 5.8.1-1 shows the main components of the project, and Fig. 5.8.1-1 shows the approximate locations.

Table 5.8.1-1 Main Project Components

Project Components		Description
1	Water Intake Facilities	Water intake and pumping station; storage tank and raw water pumping station; pipeline to the water treatment plant
2	Water Treatment Plant	Coagulation/flocculation – sedimentation – filtration system
3	Water Transfer Pipeline	Approximately 25 km long, 1100 mm diameter
4	Bayt Ras Reservoir	For water supply to the north part of Irbid and newly developed area, approximately 9,000 m^3 storage volume
5	Zabda Reservoir	For water supply to Irbid City, utilizing the existing reservoir 110,000 m^3 storage volume

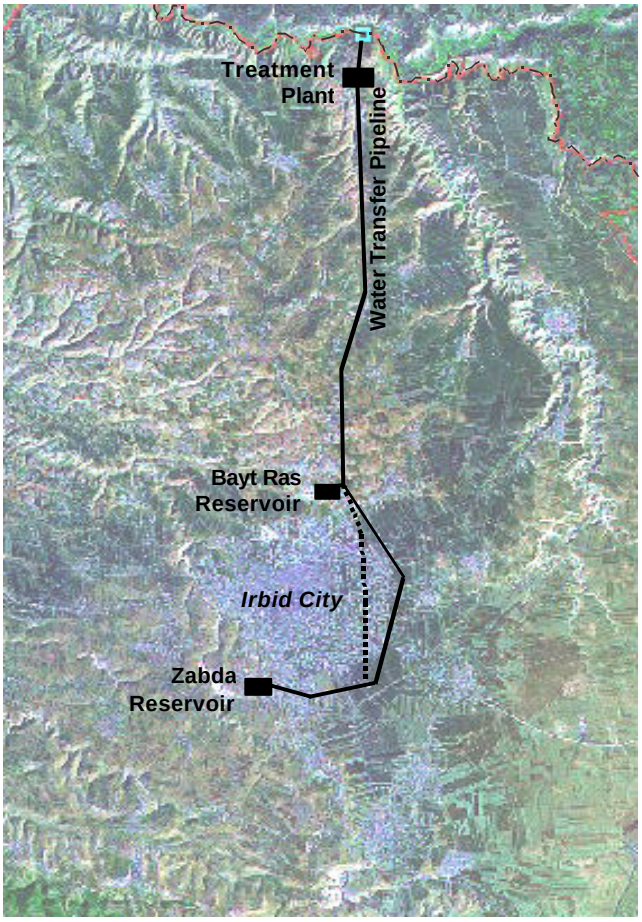

Fig. 5.8.1-1 Approximate Location of the Project

5.8.2 Environmental Examination Matrix

Using the main project activities shown in Table 5.8.1-2 and the environmental elements specified in the JICA guideline, an environmental examination matrix is obtained as below.

Table 5.8.1-2 Environmental Examination Matrix for Wehda-Irbid Water Supply Project

Environmental Elements / Project Activities		Social Environment									Natural Environment								Environmental Pollution						
		Resettlement	Economic Activity	Traffic & Living Facilities	Community Separation	Archaeological & Cultural Properties	Water Right / Right of Common	Public Health & Sanitation	Solid Waste	Risk of Disaster	Topography & Geography	Soil Erosion	Groundwater	Lake and Rivers	Coastal Area	Flora & Fauna	Meteorology	Landscape	Air Pollution	Water Pollution	Soil Pollution	Noise & Vibration	Ground Subsidence	Offensive Odor	Hazardous Substances
Construction Phase	Water Intake Facilities										×	×													
	Water Treatment Plant		△			△			△		△	△				△									
	Water Transfer Pipeline		△	△		△										△						△			
	Reservoirs		△			△			△							△									
Operation Phase	Water Intake Facilities																								
	Water Treatment Plant																								
	Water Transfer Pipeline																								
	Reservoirs																								

×: Significant Negative Impact   △: Moderate Negative Impact   Shade: No Negative Impact

5.8.3 Rational of Environmental Impacts Screening

(1) Areas to be Under the Impacts of the Project

As shown in Fig. 5.8-1, the water intake facilities will be constructed in the Wehda Dam area. The raw water will be sent to the water treatment plant about 1.5 km from the intake. The initial segment of the project site is in the Yarmouk River valley which is characterized by extreme topographic change. The ground elevation increases from about 100 m at the intake site to about 400 m at the water treatment plant site. In this area, the predominant land use is grazing of sheep and goats.

The water treatment plant will be at a place just out of the river valley. The site will cover an area about 5 hectares at a ground elevation about 400 m. The site is within an area that contains some olive trees, but most of it has not been farmed. The nearest village is Al Yarmouk which is about 1.5 km to the south. In and near the plant site, there is not any house or public building.

The water transfer pipeline will be about 25 km from the pumping station at the treatment plant to the existing Zabda reservoir at southwest of Irbid City. For a distance about 14 km from the treatment plant down to Bayt Ras, the pipeline will be along the main road as was proposed by Stanley Consultants in 1979. This section of the road passes by the villages of Yarmouk, Barashta, Al Khurayba, As Sila and Al Qasfah. However, there are few houses at the road side. Land along the road is either undeveloped or planted with olive trees. The ground elevation gradually increases from about 400 m to about 550 m.

For water supply to the north part of Irbid and the newly developed densely populated towns such as Bayt Ras, a storage reservoir will be constructed at Bayt Ras. Therefore, part of the water from the transfer pipeline will be sent to this reservoir, and then the pipeline will continue to the south and to reach the existing Zabda Reservoir.

From Bayt Ras, the pipeline will pass the densely populated area. The route proposed in 1997 (doted line in Fig. 5.8-1) is thought to be no longer suitable because the central area of Irbid City has widely expanded since then and the originally proposed route is already inside the central area. In order to reduce the impacts of pipeline construction on the populated area, especially on the traffic condition at the north entrance of Irbid City, it is proposed in this study that the route of the pipeline will turn about 1 km to the east at Bayt Ras and make a detour along the eastern and southern boundary of the central Irbid area. The route will still be along the existing road, and the ground elevation almost keeps unchanged between 550 – 600 m.

(2) Social Environmental Factors

The possible impacts of the project on the social environment are mainly related to the selection of the construction sites for the water treatment plant and the route of the water transfer pipeline. As mentioned in 5.8.3.1, the site for the water treatment plant will need acquisition of a land about 5 ha. At present, there are only olive trees at the site, but development of agriculture may happen in the near future. In that case, certain impacts are anticipated on economic activity when the land is used for plant construction. The area affected by the construction of the water transfer pipeline will be approximately 10 m in width along the whole route. Considering the length of the

pipeline as about 25 km, the total area affected will be about 25 ha. Most of this area will only be temporarily affected during the construction work, but no permanent land acquisition will be required. The temporary use of land will unavoidably affect certain cultivated land (mostly for trees and some for crops) and cause loss of production. On the other hand, the project will also have positive impacts on economic activities in the project area because it may provide opportunity of employment during project construction and operation.

Because most of the pipeline construction sites are along the existing road, the impacts on traffic condition are anticipated. Certain impacts are also anticipated on the residential houses or public facilities near the pipeline construction site, especially in the Irbid City area.

The north part of Jordan is rich in archaeological sites and antiquities. Impacts on these properties may be resulted from the project if the construction sites were not well selected.

Solid wastes will be generated from project construction. Most of these solid wastes are soils from excavation. In the case of water transfer pipeline, the soil will be used to fill up the excavated ditch to bury the pipes and therefore none will be left for final disposal, but in the construction site for the water treatment plant, final disposal of the solid wastes has to be considered.

Regarding other social environmental factors such as resettlement, community separation, water right and right of common, public health and sanitation, risk of disaster, no impacts are anticipated from the project.

The abovementioned impacts are mainly in the construction phase of the project. In the operation phase, only the disposal of sludge from the water treatment process should be considered.

(3) Natural Environmental Factors

Within 1.5 km distance from the water intake to the water treatment plant, the topographic change is more than 300 m. Therefore the construction of the raw water pipeline will cause the most concern and create the majority of the construction problems. Related to the steep topography, soil erosion may possibly happen during the excavation for the construction of the raw water pipeline. Similar problem may also need to be considered for the construction of the water treatment plant.

For the water transfer pipeline from the treatment plant to the terminal reservoir, the topographic changes are moderate, and the abovementioned problem may not be significant.

Preparation of the construction sites for the project may unavoidably affect the flora originally grow at the sites, but unlikely to have impacts on the fauna. Regarding the other natural environmental items, the impacts are thought to be negligible taking into account the scale and location of the project.

In the operation phase, no negative impacts are anticipated on the natural environment.

(4) Environmental Pollution

Generally speaking, the project will not generate pollutants to the air, water and soil, nor offensive odor and hazardous substances. In the construction phase, noise and vibration will occur. However, because most of the construction sites are away from the residential area, the impacts will be ignorable except for several locations where some houses are near the route of the water transfer pipeline.

5.8.4 Consideration on Impacts Mitigation

As a result of the screening of the impacts on the environmental items from the project activities using the environmental examination matrix, significant negative impacts are anticipated on topography and soil erosion from the construction of the raw water pipeline from the water intake to the water treatment plant. Similar problems may also relate to the construction of water treatment plant, but the impacts are thought to be moderate.

Other impacts from the project in the construction phase include the followings:

Economic activity (for the construction of water treatment plant, water transfer pipeline and the storage reservoir at Bayt Ras)

Traffic and living facilities (for the construction of the water transfer pipeline)

Archaeological properties (for the construction of water treatment plant, water transfer pipeline and the storage reservoir at Bayt Ras)

Solid wastes (for the construction of the water transfer pipeline and the storage reservoir at Bayt Ras)

Flora (for the construction of water treatment plant, water transfer pipeline and the storage reservoir at Bayt Ras)

Noise and vibration (for the construction of the water transfer pipeline at certain locations)

No impacts are anticipated in the operation phase of the project.

In the construction phase, the impacts on the archaeological properties can be completely erased by a careful study or investigation of the archaeological sites in the related area before the detailed engineering design. Regarding the other items, the impacts may not be completely erased but can be reduced to the minimum. For example, the impacts on economic activity, as well as that on flora can be mitigated by careful selection of the construction site and the route of the water transfer pipeline to use as less cultivated land as possible. The impacts on the traffic and living facilities, as well as the problem of noise and vibration can be reduced by well arrangement of the construction work of the water transfer pipeline. Solid wastes from the construction of the treatment facilities can be well managed by selecting a suitable disposal site. The problem related to topography and soil erosion can also be mitigated by careful selection of the route of the raw water pipeline and well management of the construction work.

5.8.5 Recommendation of EIA for Project Construction

Although the Wehda Dam water supply project has been planned for many years, due to the unclear schedule for the dam construction, the plan is still at the pre-feasibility study phase. Many factors, such as the exact locations of the water intake facilities and the water treatment plant, are unclear as well. With the delay of the dam construction, situations will change a lot as what happened from 1979 when the former feasibility study was conducted by Stanley Consultants, and the plan formulated in this study may need modification again. For these reasons, it is recommended that a more comprehensive environmental impact assessment (EIA) be conducted before the engineering design stage. The factors to impose possible impacts on the social and natural environment, as has been discussed in the former sections, should be carefully studied.

5.9 Project Evaluation

5.9.1 Economic and Financial Evaluation

In performing financial analysis, it was premised first of all that the average municipal water tariff would be raised gradually every year from the current 294 fils per m^3 finally to 351 fils in 2010.

In performing financial analysis also, the discount rate was assumed as 5% in anticipation of the provision of a kind of soft loans for the implementation of the project. The summary of the economic and financial analysis of the project is as follows:

Economic/Financial Criteria

Project	FIRR (%)	Unit Water Price	EIRR (%)
Wehda-Irbid Water Supply	4.5	356	20.3

Note: Discount Rate: Financial=5%, Economic=10%

Managerial Indices (Unit: %)

Project	Profit/Revenues*	Working Capital/Revenues**	Profit/Liabilities and Capital***
Wehda-Irbid Water Supply	12.7	7.6	3.3

Note:Standard Levels :*=10%, **=10%, ***=5%; The figure are 2003 to 2030 averages.

As the above table shows, the FIRR of the project is only by 0.5% short of the assumed discount rate, and also the unit water price is only slightly higher than the set one. With regard to the EIRR, the project has an EIRR more than twice as high as the OCC. In terms of managerial indices, both profitability and liquidity are more or less on a par with the standard levels, attesting to the financial sustainability of the project.

In conclusion, the Wehda-Irbid water supply project can be said to be economically as well as financially sufficiently eligible for implementation.

5.9.2 Environmental Evaluation

According to IEE results, it is anticipated that no serious negative impacts will not happen by the construction of the pipeline and treatment plant. However, more comprehensive EIA is recommended to be done after the decision of the Wehda Dam Site because the locations of these facilities may be changed by the final setting of the Wehda Dam Site.

5.10 Preliminary Implementation Plan

Anticipated implementation schedule for the Phase-1 supplying 22 MCM/a in year 2005 and Phase-2 supplying 40 MCM/a to Irbid including Wehda dam construction are as shown below.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Dam Const.										
Phase-1										
Phase-2										