ECONOMIC ANALYSIS

A. Methodology and Assumptions

1. **Methodology.** Economic analysis has been conducted in accordance with the Asian Development Bank's (ADB's) *Guidelines for the Economic Analysis of Projects* and *Guidelines for the Economic Analysis of Water Supply Projects* .[1] Economic internal rates of return (EIRRs) were computed by estimating the incremental benefits and costs in economic prices over the project's life.

2. The project will contribute to the government's goal of improved access to more reliable and sustainable water supply for Dhaka. Gandharbpur Water Treatment Plant (WTP) will supply water to four areas of Dhaka City: Badda, Gulshan, Mirpur, and Uttara. The water sourced from Meghna River and treated will be distributed by replacing the groundwater-sourced production wells. Dhaka Water Supply and Sewerage Authority (DWASA) does not compile separate records for different zones of its service areas, and only consolidated figures for the whole service areas are available. However, figures for the existing operations in the four areas have been estimated from management information system (MIS) reports and annual reports of FY2012.

3. **General assumptions.** The following approach and assumptions have been used in the analysis:

(i) All prices are expressed in 2012 prices and economic analysis is conducted at FY2012 constant prices.
(ii) An average exchange rate of Tk80 = $1.00 is employed when converting foreign exchange costs to local currency equivalent.
(iii) Economic prices of capital works and annual operation and maintenance (O&M) are calculated from the financial cost estimates, and later adjusted to allow for transfer payments and to correct for any market distortions.
(iv) Price contingencies and interest during construction (as a result of any debt financing) are excluded in the calculation of EIRR but physical contingencies are included because they represent real consumption of resources.
(v) Taxes and duties are excluded because they represent transfer payments.
(vi) All costs are valued using the domestic price numeraire; tradable inputs, net of duties and taxes, are adjusted by the shadow exchange rate factor of 1.06 while unskilled labor is adjusted by a conversion factor of 0.8 of the market wage rate to estimate the shadow wage rate.[2]
(vii) The economic opportunity cost of capital (EOCC) is assumed at 12% in real terms. The purpose of the economic analysis is to determine if the subproject's EIRR exceeds its EOCC, in real terms. If the subproject's EIRR exceeds its EOCC, it can be concluded that the subproject is economically viable.
The useful economic life is assumed to be 50 years.

[1] ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila; ADB. 1998. *Guidelines for the Economic Analysis of Water Supply Projects*. Manila.

[2] Conversion factors for labor and the shadow exchange rate factor are based on the recently approved ADB-supported Power System Expansion and Efficiency Improvement Investment Program (2012) in Bangladesh. ADB. 2012. . *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility and Administration of Grant to the People's Republic of Bangladesh for the Power System Expansion and Efficiency Improvement Investment Program.* Manila.

4. **Specific assumptions (without-project scenario).** To assess the existing situation, the following estimations have been made:

(i) The total population of the project area has been estimated from the 2011 census data as 3 million, with an annual growth rate of 3%.
(ii) Annual production of water has been obtained from the end of June 2012 MIS report.
(iii) Water production will reduce under the without-project scenario because it is assumed the current level of overextraction of groundwater will not be sustainable. Production capacity has been assumed to drop gradually from 566 million liters per day (MLD) in 2013 to 350 MLD in line with 1,260 MLD sustainable yield of groundwater as assumed in the water balance analysis.
(iv) Nonrevenue water (NRW) is estimated at 30% in 2013. DWASA has an ongoing distribution network improvement project covering most of its distribution system, and NRW will be gradually reduced to 20%.
(v) The number of domestic and non-domestic connections has been derived from MIS reports (2012), and the ratio is kept constant throughout the analysis.
(vi) Water consumption of 153 liters per capita per day (lpcd) has been assumed to be unchanged.
(vii) Water tariff increases are at the current level of 5% per year. The tariff in 2012 was Tk6.99 per cubic meter (m^3) for domestic water and Tk23/m^3 for non-domestic water.[3]

5. **Specific assumptions (with-project scenario):** To assess the with-project scenario, the following assumptions have been made:

(i) Production of treated surface water replaces about 150 MLD of groundwater. An additional 350 MLD becomes available from the year of operation of the WTP, and this level is kept constant throughout the analysis.
(ii) Per capita water consumption drops in accordance with the water balance analysis.
(iii) Reduction in NRW is similar to the without-project scenario because of DWASA's ongoing program.

6. **Quantification of benefits.** Gandharbpur GTP will supply bulk water to DWASA for distribution to the four zones in Badda, Gulshan, Mirpur, and Uttara. About 3 million people, 20% of whom are poor, will benefit from the project. Water supply in these areas relies on groundwater, which is rapidly depleting to meet rising demand created by population increase and urbanization. The current mode of water generation is inefficient, inadequate, and environmentally unsustainable. The project will mitigate the depletion of groundwater resources by reducing the amount of groundwater abstraction. The main benefit to be derived from the project is a sustainable water supply for the future to a growing population—including improved accessibility, convenience and reliability of water supply, as well as increased volume of water and improved water quality.

7. The benefits of the project component have been quantified in terms of the following:

(i) Resource cost savings associated with the replacement of non-incremental water consumed, previously obtained from non-piped alternative sources[4] with the

[3] The tariff was increased by 5% in July 2013, bringing the domestic tariff to Tk7.34/m^3.

piped water supply system—valued in terms of the average supply price from existing non-piped water sources estimated at about Tk13/m^3.

(ii) Access to water supply, reflected in the incremental water consumed in the four project zones and in other DWASA zones—valued in terms of the price of water of existing domestic and non-domestic water consumption. Per capita water consumption will gradually decrease each year from about 150 lpcd in 2012 to 125 lpcd in 2040, based on the water balance analysis.

(iii) Consumers' benefits and satisfaction, derived from better quality water and regular supply of water compared to the without-project scenario. Consumers will save costs from not boiling water—valued in terms of the consumption of water and costs foregone for boiling it.

(iv) Health benefits likely to occur have been assessed as a 3% reduction of household health expenditures.

(v) Other indirect benefits arise from the employment of skilled, semiskilled, and unskilled workers in the construction of the WTP, access roads, and pipelines.

(vi) Efficiency gains will be created from institutional changes and rationalization of water tariffs.

B. Results and Sustainability

8. The estimated EIRRs with sensitivity analyses are in Table 1. Sensitivity analyses have been undertaken to test the robustness of the economic results to adverse changes in conditions. The following adverse changes have been analyzed:

(i) a capital cost overrun of 10%;
(ii) an increase in the O&M cost by 10%;
(iii) a reduction in the benefits by 10%; and
(iv) project component benefits delayed by 1 year.

9. The project is found to be economically viable under the base case scenario[5] and under various adverse changes in conditions. The EIRR is most sensitive to a delay in project benefits and a reduction in benefits. In all cases, the EIRR remains above the EOCC of 12%.

Table 1: Economic Internal Rate of Return and Sensitivity Analyses

Scenario	NPV (Tk'000)	EIRR (%)	SI[a]	SV[b] (%)
Base case	34,709,298	20.36		
10% increase in capital costs	30,921,256	19.48	16.23	6.16
10% increase in O&M costs	31,646,886	20.09	16.74	5.97
10% decrease in benefits	27,003,093	19.12	15.94	6.27
Project benefits delayed by 1 year	26,069,649	18.40	15.34	6.52

EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance, SI = sensitivity indicator, SV = switching value.
[a] Ratio of the percentage change in internal rate of return above the cutoff rate to the percentage change in the selected variable.
[b] Percentage change in the selected variable to reduce the internal rate of return to the cutoff rate.
Source: Asian Development Bank estimates.

[4] Alternative sources include shallow tube wells, ponds, and bottled water sold by vendors.

[5] The base case assumes the capital cost is Tk29,600 million, the existing O&M cost per m^3 is Tk3.72, the additional O&M cost is from the project finance model, the cost per m^3 of current untreated water is Tk12, and the cost per m^3 of boiling water is Tk3.92.

10. A willingness-to-pay survey was conducted in the project area. The results show that consumers are willing to pay higher tariffs for reliable and improved quality of water supply.[6] In each income decile, the willingness to pay is substantially higher than the current tariff—supporting the project's economic sustainability.

11. The project finances are assured, and adequately reflect the project expenditure (both capital and operation) requirements. Over 30% of the project costs will be met from the government budget. Past experiences and the government's commitment to this project ensure these funds will be made available as required and without delays.

12. The project will strengthen sustainable water resource management in Bangladesh—switching from groundwater to surface water supply, and reducing groundwater abstraction to a sustainable level. Water quality monitoring and management will ensure that the reasonably good quality of surface water from Meghna River will be maintained.

C. Distribution Analysis

13. A distribution analysis to determine to what extent the poor will benefit from the project is difficult to undertake, mainly because disaggregated data on household income for the four zones are not available. However, the household survey carried out during the project preparatory technical assistance[7] facilitates some qualitative observations (para. 14).

14. The benefits of the project, as outlined in the economic analysis, will accrue to the poor. The survey indicates that 14% of the sample households are unconnected to piped water; they are the poorest decile of the population, with an average household monthly income of Tk6,282.75. Currently, these households pay Tk20.12/m^3 for water obtained from vendors. Significant resource cost savings are obtained by the poor being connected to and accessing water from the project. Similarly, benefits from health cost savings and increased consumption of water can be estimated.[8] Taking into account resource cost savings from piped water availability and benefits from health cost savings, it is estimated that about 20% of the total net benefit of the project will accrue to the poor.

[6] The average willingness to pay is Tk377.3 per month per household (equivalent to Tk11.43/m^3).

[7] ADB. 2013. *Technical Assistance to Bangladesh for Preparing the Khilkhet Water Treatment Plant Project Consultant's Report.* Manila.

[8] The incidence of poverty in the urban population of Dhaka division in the Household Income and Expenditure Survey 2010 was 18%.