ECONOMIC ANALYSIS

A. Introduction

1. This economic analysis aims to assess the economic viability of the project through standard cost–benefit analyses. The analysis was undertaken separately for (i) the Bao Ninh urban development component in Dong Hoi, (ii) the water supply improvement component in Hoi An, and (iii) the Co Co urban development component in Hoi An. The two Hoi An components were then aggregated to assess the economic viability of the Hoi An output. The cost of project management was allocated between the Dong Hoi output and Hoi An output based on assessment of the expected needs of the two cities. The economic assessments for the two outputs were combined to assess the overall project economic viability. This appendix summarizes the results for the two outputs and the overall project. More detailed analyses are provided in the supplementary documents.

B. Demand Analysis

2. **Dong Hoi**. In 2011, Dong Hoi city had a population of 112,865 that would reach 124,033 in 2020 and 130,708 in 2025. The gross domestic product (GDP) of Dong Hoi city was D1,802 billion in 2011 compared to the GDP of Quang Binh province of D3,997 billion. Tourism currently provides only a small contribution to overall GDP and should not be considered a driving force for future economic growth. The master plan provides for future development of Dong Hoi in several major directions: (i) northwest from the current urban area, together with an industrial area; (ii) a new southern development area; and (iii) the Bao Ninh peninsular.

3. **Hoi An**. The master plan for Hoi An projects the population to reach 111,300 in 2020 and 132,500 in 2030, of which 87,600 in 2020 and 104,900 in 2030 would be urban populations. The economy of Hoi An is dominated by the trade and services sector, accounting for more than 60% of GDP in 2011. Annual GDP growth was 11.42% between 2007 and 2011, fuelled primarily by the tourism sector, which grew at almost 15.00% per year and is expected to continue to grow strongly. On the other hand, the city is has been severely affected by climate change impacts. While future projections are not clear, existing observations in the central coastal region suggest that wet periods are becoming wetter and dry periods are becoming drier, exacerbating the impact of both floods and droughts.

C. Economic Rationale

4. Dong Hoi and Hoi An both represent rapidly developing mid-sized cities, albeit at different stages of development. Both currently focus on tourism as a driver of development, although Hoi An has progressed much further along this path. To promote the planned expansion in tourism both cities will need to ensure that urban infrastructure is completed in a sustainable manner, in particular the wastewater collection and treatment system in Dong Hoi and the water supply system in Hoi An. In addition, there is a need to develop new urban areas—Bao Ninh in Dong Hoi and Co Co in Hoi An—that will directly and indirectly support the needs of increased tourism. Hoi An also needs to address the issue of flood management in many areas of the city, particularly with respect to Phap Bao Lake and Provincial Road 608. It is critical that these interventions are implemented with attention to climate change adaptation.

5. The Dong Hoi investment will assist the city in achieving the envisaged benefits from the substantial investments that have already been made both in wastewater collection and treatment infrastructure, and in developing urban infrastructure in Bao Ninh to support

development of the tourism industry. Without project support, a significant portion of the wastewater collection and treatment benefits anticipated for the World Bank investments are unlikely to be achieved since the facilities will be operating at below capacity. With the project, additional households will be connected and more benefits achieved. It is unlikely that the Bao Ninh peninsula area, in particular the grant-aided hydrodynamic study and dune restoration, can be sustainably developed without the project support.

6. In Hoi An, as the city's resident and tourist population continues to expand and living standards increase, the demand for domestic and industrial water is expected to increase. If demand cannot be satisfied, the rate of economic and tourism growth will decline. Water availability is also affected by the current high rates of nonrevenue water and climate change, which has potential to increase salinity of raw water sources. The project will implement an integrated approach to improving water availability through upgrading existing facilities, in particular the Lai Nghi reservoir, and reducing wastage by reducing water delivery losses. The project will also address flooding and sustainable development through a series of interventions that take account of climate change. In addition to the conventional approaches of raising road levels to reduce flood impact, investment in the Co Co urban development area will address flood management by ensuring that zoning precludes construction of valuable infrastructure in the vicinity of the river and takes into account the need to limit run-off and manage drainage requirements.

7. Asian Development Bank (ADB) support for the project is critical because of the wide range of technical assistance to be provided and the technical capacity that will be developed. The project will strengthen the capacity of both cities to address climate change adaptation issues and provide examples for other coastal cities.

D. Least-Cost Analysis

8. To evaluate the cost effectiveness of project options, least-cost economic analysis was undertaken for the various options for the improvement of water supply in Hoi An. Each option was compared on the basis of the net present value of the estimated capital and operating costs for each option over 30 years taking into account the estimated increase in load up to full load in 2040, since each option would deliver the same level of benefits. Costs common to all options, including distribution systems, house connections, design, and supervision, were excluded. The analysis confirmed that dredging and improving the Lai Nghi reservoir would be significantly less expensive than extending the existing intake to upstream on the Thu Bon River. This is essentially because of significant savings in operational costs. Operational costs are also projected to be reduced compared to the near-future situation.

E. Major Assumptions and Methodology

9. The economic analysis has been conducted using ADB's Guidelines for the Economic Analysis of Projects and Workbook on Economic Valuation of Environmental Impacts.[1] The major assumptions of the analysis are as follows:

(i) economic analysis was carried out over 30 years starting in 2015 and including the 6-year implementation period;
(ii) basic costs and prices are the same as those used in the financial analysis;

[1] ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila, and ADB. 1996. *Economic Valuation of Environmental Impacts: A Workbook*. Manila.

(iii) financial costs and revenues are based on prevailing prices in mid-2013 and are expressed in constant 2013 terms;
(iv) economic costs and benefits are valued in dollars using the world price numeraire in constant 2013 terms;
(v) local currency costs are converted to dollars using an exchange rate of D20,800 = $1;
(vi) economic costs and benefits for nontradable inputs and outputs were derived by excluding taxes and duties and then adjusting their values by a standard conversion factor of 0.90;[2]
(vii) the economic value of land acquisition costs was estimated based on the expected economic value of the agricultural production forgone;
(viii) the proportion of costs for skilled and unskilled labor could not be separated from other nontradable costs and a single conversion factor was therefore applied, implying a shadow wage rate factor based on an opportunity cost of labor (scarce or surplus) of 1.0 and a standard conversion factor of 0.9; and
(ix) the economic opportunity cost of capital is assumed to be 12%.

F. Economic Evaluation

1. Costs and Benefits

10. **Investment costs.** The output and overall project investment costs were developed in association with the project management office. The base cost plus physical contingencies was estimated at $132.0 million, distributed over 6 years, comprising $94.5 million for Hoi An and $37.5 million for Dong Hoi. Economic costs for each output and the overall project were derived from the financial costs by adjusting their values as detailed in the assumptions. The economic cost was estimated at $119.0 million—$85.5 million for Hoi An and $33.5 million for Dong Hoi.

11. **Operation and maintenance costs.** Operation and maintenance (O&M) costs were estimated based on Circular 11/2012/TT-BXD dated 25 December 2012 relating to allocation of funds to O&M by type of construction work. For wastewater investments, O&M costs are expected to be around 1% of the investment cost, which is considered reasonable for the investments to be supported by the project. For urban development, the circular indicates that industrial work should be allocated 0.60%–0.10% of investment costs, civil construction work 0.08%–0.10%, and urban infrastructure work 0.18%–0.25%. According to Decision 114/2010/ND-CP dated 6 December 2010 on maintenance of construction works, maintenance should applied every 5 years after completion of construction. For urban infrastructure works, O&M costs are suggested to be a maximum of 0.25% of investment cost every 5 years, which was considered insufficient to ensure the expected project life. Consequently, 1% of the investment cost was used for the economic analysis. O&M costs for the water resources interventions in Hoi An were determined as the difference between O&M costs with and without the project as used in the least-cost analysis. Similarly, net savings in investment costs were estimated based on the additional investment with and without the project used in the least-cost

[2] This standard conversion factor is consistent with those used in other recent ADB projects, e.g., ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Grant to the Socialist Republic of Viet Nam for the Central Mekong Delta Region Connectivity Project*. Manila; ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of a Grant to the Socialist Republic of Viet Nam for the Greater Mekong Subregion Corridor Towns Development Project.* Manila; ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loans, Grant, and Administration of Grant to the Lao People's Democratic Republic and Socialist Republic of Viet Nam for the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project.* Manila.

analysis. All financial costs for O&M and capital savings were converted to economic values using the same methodology as for investment costs.

12. **Benefits.** The analysis was undertaken through comparison of without-project and with-project scenarios. In Dong Hoi, the without-project scenario envisages the existing land use to continue; with the project there will be substantial savings as the main city communities connect to the wastewater system, and increased economic values in the Bao Ninh new urban area as measured through the economic benefits of improved urban roads, health, and water supply. Additional benefits, including improved urban drainage and flood protection, were treated as nonquantifiable because of lack of data. The Bao Ninh master plan also suggests a substantial increase in the number of tourists, but the benefits from these were limited to health and water supply, which probably underestimates their magnitude. In Hoi An, the without-project scenario was defined as (i) a poorly developed water supply system that will require additional capital investment in the near future and will be expensive to operate and maintain, and (ii) ongoing poor flood management resulting in substantial annual losses from flooding and slow development of new urban areas with poor adaptation to climate change. In the with-project scenario, (i) reduced nonrevenue water and dredging of the Lai Nghi reservoir will increase water availability to consumers, reduce the need for incremental capital investment, and reduce O&M costs; (ii) improved flood management will result in a decrease in annual losses due to flooding; and (iii) climate-resilient development of the Co Co urban area will facilitate the economic development of Hoi An. The economic value of the urban development area investments was estimated based on the economic value of the services provided, in particular water supply, wastewater treatment, and urban roads. A benefit transfer approach had to be used for the economic value of the urban roads since no data were available for the specific developments. This approach used the traffic estimates from Bao Ninh with the volume adjusted to reflect the differences in expected populations. The economic values of solid waste collection and flood management were treated as nonquantifiable because of the lack of data. Quantification of benefits is detailed in the supplementary documents.

2. Economic Analysis Results

13. The economic analyses of the urban environment and climate change adaptation outputs for Dong Hoi and Hoi An indicate that they are both economically viable, with economic internal rate of return (EIRRs) of 18.4% for Dong Hoi and 13.2% for Hoi An. The economic net present values (ENPVs) are $17.5 million for Dong Hoi and $7.8 million for Hoi An. Combining the two outputs provides an assessment of the economic viability of the overall project. The EIRR of the overall project is estimated at 14.8% and the ENPV at $27.8 million (see following table), confirming the economic viability of the overall project.

3. Sensitivity Analysis

14. Sensitivity analyses were conducted for each of the outputs as well as the overall project, including estimation of switching values and sensitivity indexes for the cost increase and benefit decrease scenarios. The results indicate that the EIRR of the overall project would be reduced to 13.7% with a 10% cost increase and to 13.6% with a 10% benefit decrease, both above the 12.0% economic viability cut off. A 10% cost increase combined with a 10% benefit decrease would reduce the EIRR to 12.5% with an ENPV of $5.4 million, which is still marginally viable. The switching values indicate that it would require a 28% cost increase or a 22% benefit decrease to render the project economically nonviable. A 1-year lag in benefits would reduce the EIRR to 13.2% while a 50% increase in O&M costs would reduce it to 14.5%, confirming the project is not sensitive to increased O&M costs.

4. Benefit Distribution and Poverty Impact Analysis

15. Given the relatively low incidence of poverty in the project area, estimation of the poverty impact ratio was not considered appropriate. However, the project will clearly have significant benefits for the poorer sectors of the community in both cities who will benefit most from improved sanitation, water availability, and flood management, as well as from cost savings associated with the shift from use of septic tanks since it is the poorer communities who live in areas lacking these facilities. They are also expected to benefit from job creation, particularly during construction of the new urban areas, and increased employment following establishment of new commercial enterprises.

Economic Evaluation of the Overall Project
($'000)

	Investment Costs			Recurrent Costs				Benefits			
Year	Hoi An	Dong Hoi	Total	Hoi An	Dong Hoi	Total	Total Cost	Hoi An	Dong Hoi	Total	Net Benefits
2016	10,640	4,141	14,781	(55)	-	(55)	14,726	380	196	576	(14,150)
2017	25,560	9,082	34,642	(75)	13	(62)	34,580	402	230	632	(33,948)
2018	25,346	10,308	35,654	(94)	28	(67)	35,588	426	360	786	(34,802)
2019	16,272	10,193	26,465	(112)	45	(68)	26,398	2,103	3,966	6,070	(20,328)
2020	9,140	3,673	12,813	734	61	795	13,607	6,170	4,415	10,585	(3,022)
2021	7,506	147	7,652	642	375	1,018	8,670	8,429	4,893	13,322	4,652
2022	-	-	-	712	375	1,087	1,087	10,104	5,402	15,506	14,419
2023	-	-	-	707	375	1,082	1,082	11,912	5,968	17,879	16,797
2024	-	-	-	701	375	1,077	1,077	13,361	6,596	19,957	18,880
2025	-	-	-	696	375	1,072	1,072	14,631	7,296	21,927	20,855
2026	(3,147)	-	(3,147)	691	375	1,066	(2,080)	15,508	8,074	23,581	25,662
2027	-	-	-	692	375	1,067	1,067	16,419	8,929	25,347	24,280
2028	-	-	-	692	375	1,068	1,068	17,436	9,881	27,318	26,250
2029	-	-	-	693	375	1,068	1,068	18,574	10,943	29,517	28,449
2030	-	-	-	693	375	1,069	1,069	19,849	12,127	31,976	30,907
2031	1,559	-	1,559	647	375	1,023	2,581	21,278	13,448	34,725	32,144
2032	-	-	-	522	375	898	898	21,723	13,700	35,423	34,525
2033	-	-	-	522	375	897	897	22,180	13,961	36,141	35,244
2034	-	-	-	521	375	896	896	22,651	14,230	36,881	35,985
2035	-	-	-	520	375	896	896	23,134	14,509	37,644	36,748
2036	(492)	-	(492)	519	375	895	402	23,632	14,798	38,429	38,027
2037	-	-	-	518	375	893	893	24,142	15,071	39,213	38,320
2038	-	-	-	517	375	892	892	24,667	15,352	40,019	39,127
2039	-	-	-	515	375	891	891	25,207	15,642	40,849	39,959
2040	-	-	-	514	375	889	889	25,762	15,941	41,703	40,814
2041	-	-	-	512	375	888	888	26,332	16,249	42,581	41,694
2042	-	-	-	512	375	888	888	26,919	16,567	43,485	42,598
2043	-	-	-	512	375	888	888	27,522	16,894	44,416	43,528
2044	-	-	-	512	375	888	888	28,142	17,231	45,373	44,485
2045	-	-	-	512	375	888	888	28,779	17,579	46,358	45,471
ENPV (12%)	66,551	26,911	93,463	3,047	1,764	4,811	98,274	78,612	47,479	126,091	27,817
EIRR											14.8%
EIRR @ WACC	89,705	36,436	126,142	12,884	8,008	20,892	147,033	434,996	263,789	698,785	551,752

( ) = negative, EIRR = economic internal rate of return; ENPV = economic net present value.
Source: Asian Development Bank estimates.