ECONOMIC ANALYSIS – HOI AN CITY

A. Introduction

1. This financial and economic analysis aims to assess the economic viability of the subproject through standard cost benefit analyses. The analysis has been undertaken separately for the two subprojects—the Hoi An Water Resources Subproject and the Hoi An Climate Change Adaptation Subproject—that comprise the overall Hoi An Climate Change Adaptation Output. The wastewater subproject comprises two sets of activities: (i) upgrading of the Lai Nghi reservoir and water transmission pipeline, and (ii) reduction in the level of non-revenue water through improved management and establishment of a management information system. The climate change adaptation subproject comprises four sets of activities: (i) improvement to flood management in Phap Bao Lake and implementation of non-structural flood management measures; (ii) construction of the access road to Cua Dai Bridge; (iii) infrastructure investment for the Co Co Urban Development Area (UDA); and (iv) raising of a section of Provincial Road 608 to improve flood protection and permit travel during flood periods. Financial and economic benefits were identified and quantified for each of these sets of activities and the analysis was conducted separately for each subproject. The results were then combined to produce an overall economic analysis. The extent to which benefits could be quantified was limited by the availability of specific data, which likely resulted in an underestimate of the subproject's economic viability.[1] The results of the economic analysis are detailed in this chapter.

B. Subproject Rationale

2. Hoi An is a rapidly developing urban area with tourism as the major, and strongly growing, sector due to the listing of the old city area as a World Heritage Site. This trend is expected to continue into the foreseeable future. As the city's resident and tourist population continues to expand and living standards increase, the demand for domestic and industrial water, particularly for the tourism sector, is expected to substantially increase. If this demand cannot be satisfied, the rate of economic development will decline with negative impacts, particularly on tourism. The demand for water is also affected by climate change, which has potential to increase salinity in specific raw water sources, and the current high rates of non-revenue water. The subproject consequently needs a well-developed and integrated approach to supplying additional water through the upgrading of existing facilities, in particular the Lai Nghi reservoir, and reducing the level of non-revenue water to a rate comparable to the best water supply systems in Viet Nam and the region.

3. Tourist activities also place considerable pressure on the urban area to supply the many goods and services required, particularly by international tourists. Due to a combination of rapid development and the specific location of Hoi An on a flood plain the city suffers from regular flooding during the wet season, which has a negative impact on overall economic development, including tourism. The proposed subproject will address the issues of flooding and sustainable development through a series of interventions aimed at climate change adaptation when addressing the key issues. In addition to the conventional approaches of raising road levels to reduce flood impact, development of the Co Co urban development area (UDA) will address flood management by ensuring zoning of areas is done such that valuable infrastructure is not constructed in the vicinity of the river and a flood buffer area is developed alongside the river,

[1] In the case of the Co Co urban development area the lack of data on transportation meant that a benefit transfer approach had to be adopted using information from the Dong Hoi subproject.

thus minimizing flood risk. Planned construction will also take into account the need to limit run-off and manage draining. Support for this subproject is considered necessary as it involves several climate change adaptation procedures that have not previously been adopted in Viet Nam and will thus produce an outcome that can be used as a demonstration for other similar cities. Without ADB support, the government is unlikely to be able to successfully manage these complex issues.

C. Major Assumptions and Methodology

4. The economic analysis has been conducted using *Guidelines for the Economic Analysis of Projects,*[2] the *Workbook on Economic Evaluation of Environmental Impacts,*[3] and *Cost-Benefit Analysis for Development: A Practical Guide*[4] of the Asian Development Bank (ADB). The major assumptions of the analysis are:

(i) economic analysis was carried out over 30 years starting in 2015 and including the 5-year implementation period;
(ii) basic costs and prices are the same as those used in the financial analysis;
(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 US dollars using the *world price level numeraire* in constant 2013 terms;
(v) local currency costs are converted to US dollars using an exchange rate of VND20,800 per US$1;
(vi) economic costs and benefits for non-tradable inputs and outputs were derived by excluding taxes and duties and then adjusting their values by a standard conversion factor (SCF) of 0.90 which is consistent with the SCF used in recent ADB projects for Viet Nam;[5]
(vii) the economic value of agricultural land acquisition costs, as a part of land acquisition and resettlement costs, was estimated based on the expected economic value of the agricultural production forgone, while all other land acquisition and resettlement costs were treated as non-tradable and the financial value, excluding taxes, was assumed to reflect the actual economic value of the land;
(viii) the proportion of costs for skilled and unskilled labor could not be separated from other non-tradable costs and a single conversion factor was therefore applied, implying a shadow wage rate factor (SWRF) based on an opportunity cost of labor (scarce or surplus) of 1.0 and a SCF of 0.9;[6] and
(ix) the economic opportunity cost of capital is assumed to be 12%.

5. The analysis was undertaken through examination of without- and with-project scenarios to determine the incremental benefits from the interventions. The without-project scenario for

---

[2] ADB 1997. Guidelines for *Economic Analysis of Projects*. Manila.
[3] ADB. 2005. *Workbook on the Economic Evaluation of Environmental Impacts*. Manila.
[4] ADB. 2013. *Cost-Benefit Analysis for Development: A Practical Guide*. Manila.
[5] 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 Grant to the Socialist Republic of Viet Nam for the Greater Mekong Subregion Corridor Towns Development Project.* Manila; and 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.
[6] The shadow wage rate factor for unskilled labor in Viet Nam is 0.75 and for skilled labor is 1.0.

the water resources subproject was defined as a continuation of the current situation with a poorly developed water supply system that will require additional capital investment in the near future and will continue to be relatively expensive to operate and maintain. In the with-project scenario, the reduction in non-revenue water will make available a substantial amount of water that is currently lost and thus reduce the need for incremental capital investment and operation and maintenance (O&M) costs. The dredging of Lai Nghi reservoir and installation of an improved raw water supply pipeline in the with-project scenario will also reduce operating costs and provide an improved and reliable source to consumers. The without-project scenario for the climate change adaptation subproject was defined as a continuation of the current situation with poorly developed flood management resulting in substantial annual losses from floods and slow development of new urban areas lacking adaptation to climate change. In particular, the proposed Co Co UDA is currently dominated by paddy fields cropped by farmers who are becoming older and whose children have little, if any, interest in continuing in farming due to the existence of more attractive employment opportunities. Without the project these farms are likely to decline rapidly over the next few years. With project, Hoi An will expand rapidly and provide an attractive location for an increasing number of more-affluent tourists. The new urban areas will provide a climate resilient location for urban development and critical areas of the city will become more flood resilient.

D. Economic Costs and Benefits

1. Investment Costs

6. The investment costs for each of the subprojects were derived from the agreed financial cost of the Hoi An component of the overall project by allocating specific costs for each subproject. Detailed costs by year, including physical contingencies of 5% for detailed design and 10% for all other costs, are summarized for the water resources subproject in Table 1, for the climate change adaptation subproject in Table 2, and for project management and climate change support in Table 3. For the purposes of the economic analysis the project management and climate change costs were allocated proportionately between the two subprojects. The subproject costs by component and year are summarized in Table 4. The overall component is estimated to cost $94.46 million including physical contingencies of which $8.22 million is the cost of the water resources subproject and $86.24 million the cost of the climate change adaptation subproject

Table 1: Financial Cost of Hoi An Water Resources Subproject Investment by Year

($000s)

Item	Totals Including Contingencies[a]						
	2016	2017	2018	2019	2020	2021	Total
I. Investment Costs							
A. Lai Nghi Upgrading							
1. Wastewater collection and pumping							
Wastew ater collection pipelines	-	37	37	-	-	-	75
Wastew ater pumping station	-	20	20	-	-	-	39
Subtotal	-	57	57	-	-	-	114
2. Lai Nghi Upgrading and raw water transmission pipeline							
a. Pumping Station and Intake							
Embankment and sidew alk	-	-	892	892	-	-	1,784
Crossing drains	-	-	73	73	-	-	145
Raw w ater pumping station	-	110	110	-	-	-	220
Horizontal pumps	-	-	-	94	94	-	187
Subtotal	-	110	1,075	1,058	94	-	2,336
3. Lai Nghi Dredging	-	-	1,284	1,323	1,284	-	3,891
Subtotal	-	167	2,415	2,381	1,377	-	6,341
B. Non-Revenue Water & Management Information System							
1. Non-revenue Water							
a. Equipment							
NRW equipment	-	28	-	-	-	-	28
b. Consultants							
International	-	83	83	28	28	-	220
National	-	17	17	6	6	-	44
Subtotal	-	99	99	33	33	-	264
Subtotal	-	127	99	33	33	-	292
2. Management Information System							
a. Equipment							
GIS Equipment	-	55	-	-	-	-	55
SCADA	-	-	165	-	-	-	165
Subtotal	-	55	165	-	-	-	220
b. Consultants							
International	-	55	83	55	28	-	220
National	-	33	17	6	6	-	61
Subtotal	-	88	99	61	33	-	281
Subtotal	-	143	264	61	33	-	501
Subtotal	-	270	363	94	66	-	793
F. Land Acquisition and Resettlement							
1. Lai Nghi reservoir	342	342	-	-	-	-	684
Subtotal	342	342	-	-	-	-	684
H. Engineering and Supervision							
1. Engineering and Management Overheads[b]							
Wastew ater collection and pumping	-	1	1	-	-	-	3
Lai Nghai upgrading	-	3	27	26	2	-	58
Subtotal	-	4	28	26	2	-	61
2. Construction supervision[c]							
Wastew ater collection and pumping	-	1	1	-	-	-	1
Lai Nghai upgrading	-	1	13	13	1	-	29
Subtotal	-	2	14	13	1	-	31
Subtotal	-	6	42	40	4	-	92
Total	342	785	2,821	2,514	1,447	-	7,909

[a] Excludes price contingencies

[b] Charged at 2.5% of investment cost

[c] Charged at 1.25% of investment cost

Source: Hoi An Government estimates.

Table 2: Financial Cost of Hoi An Urban Environment and Climate Change Adaptation Subproject by Year

($000s)

Item	Totals Including Contingencies[a] 2016	2017	2018	2019	2020	2021	Total
I. Investment Costs							
C. Flood Management							
1. Phap Bao Lake							
Stop-log gate	-	16	16	16	-	-	48
Park	-	429	442	429	-	-	1,299
Dredging	-	1,507	-	-	-	-	1,507
Subtotal	-	1,951	458	445	-	-	2,854
2. Non-structural Urban Flood Management							
a. Equipment							
Computer hardware and software	-	316	316	-	-	-	632
b. Consultants							
International Consultants	211	342	342	342	79	79	1,395
National Consultants	32	63	63	63	21	21	263
Subtotal	242	405	405	405	100	100	1,658
c. Consultant Support	5	5	5	5	5	5	32
d. Training/capacity building	-	63	63	63	63	63	316
e. Overheads	5	11	11	11	5	5	47
f. Surveys	53	53	53	53	53	53	316
Subtotal	305	853	853	537	226	226	3,000
Subtotal	305	2,804	1,311	981	226	226	5,854
D. Urban Area Development							
1. Urban Infrastructure							
a. Access road to Cua Dai Bridge							
Road	-	6,134	6,134	-	-	-	12,268
Bridges	-	6,296	6,296	-	-	-	12,593
Storm water system	-	273	273	-	-	-	546
Subtotal	-	12,704	12,704	-	-	-	25,407
2. Infrastructure for UDAs							
a. Infrastructure							
Co Co UDA	-	-	2,291	6,873	6,873	6,873	22,909
Subtotal	-	12,704	14,995	6,873	6,873	6,873	48,316
E. Provincial Road 608	-	-	5,065	5,065	-	-	10,131
F. Land Acquisition and Resettlement							
2. Climate Change Adaptation	8,201	8,201	-	-	-	-	16,401
Subtotal	8,201	8,201	-	-	-	-	16,401
G. Environmental Management							
1. Monitoring							
Water and air quality sampling	-	1	1	1	1	1	3
Water quality analysis	-	2	2	2	2	2	11
Air quality analysis	-	3	3	3	3	3	13
Subtotal	-	5	5	5	5	5	26
H. Engineering and Supervision							
1. Engineering and Management Overheads /a							
Phap Bao Lake	-	49	11	11	-	-	71
Urban Area Development	-	318	375	172	172	172	1,208
Provincial Road 608	-	-	127	127	-	-	253
Subtotal	-	366	513	310	172	172	1,533
2. Construction supervision /b							
Phap Bao Lake	-	24	6	6	-	-	36
Urban Area Development	-	159	187	86	86	86	604
Provincial Road 608	-	-	63	63	-	-	127
Subtotal	-	183	256	155	86	86	766
Subtotal	-	550	769	464	258	258	2,299
Total	8,506	24,263	22,145	13,389	7,362	7,362	83,028

[a] Excludes price contingencies

[b] Charged at 2.5% of investment cost

[c] Charged at 1.25% of investment cost

Source: Hoi An Government estimates.

Table 3: Financial Cost of Hoi An Project Management and Climate Change Support

($000s)

Item	Totals Including Contingencies[a] 2016	2017	2018	2019	2020	2021	Total
I. Investment Costs							
A. Overall Project Management - Hoi An							
1. International Consultants							
Team Leader/Civil Engineer /a	116	154	77	77	39	77	539
Climate Change/Urban Planner	19	58	19	19	19	-	135
Financial Management	19	19	19	19	19	-	96
Environment Monitoring Specialist	19	19	19	19	19	19	116
Resettlement Specialist	19	19	19	19	19	19	116
Gender specialist	19	19	19	19	19	19	116
Subtotal	212	289	173	173	135	135	1,117
2. Communications							
Environmental awareness campaigns	9	9	9	9	9	9	53
Subtotal	221	298	182	182	144	144	1,169
D. Project Management Unit: Hoi An							
1. National Consultants							
Deputy Team Leader	17	33	33	33	33	-	149
Contract Management Specialist	8	17	6	6	6	-	41
Climate Change/Urban Planner	3	8	3	3	3	-	19
Financial Management Specialist	6	17	17	6	6	-	50
Environment Monitoring Specialist	8	8	8	8	8	-	41
Resettlement Specialist	17	8	8	8	8	-	50
Gender Training Specialist	6	3	3	3	3	-	17
Subtotal	63	94	77	66	66	-	366
2. Consultant Support							
Office operation	66	66	66	66	66	-	330
Transportation	55	55	55	55	55	-	275
Training	110	-	-	-	-	-	110
Equipment (hardware & software)	28	-	-	-	-	-	28
Subtotal	259	121	121	121	121	-	743
3. Revolving funds							
Hoi An Women's Association	200	-	-	-	-	-	200
Subtotal	522	215	198	187	187	-	1,308
E. Detailed Engineering and Preparation							
2. Hoi An							
a. Co Co River UDA detailed planning	263	-	-	-	-	-	263
b. Detailed design and bid documents	788	-	-	-	-	-	788
Subtotal	1,050	-	-	-	-	-	1,050
Total	1,792	512	380	369	331	144	3,527

[a] Excludes price contingencies

Source: Hoi An Government estimates

Table 4: Summary of Financial Costs by Component and Subproject

Component/Subproject	Total Financial Costs Including Physical Contingencies($000s) 2016	2017	2018	2019	2020	2021	Total
A. Hoi An Urban Environment and Climate Change Adaptation	8,848	25,048	24,966	15,903	8,809	7,362	90,937
1. Water Resources Subproject	342	785	2,821	2,514	1,447	0	7,909
2. Urban Environment and Climate Change Adaptation Subproject	8,506	24,263	22,145	13,389	7,362	7,362	83,028
B. Project Management and Climate Change Support	1,792	512	380	369	331	144	3,527
1. Water Resources Subproject	69	16	43	58	54	0	307
2. Urban Environment and Climate Change Adaptation Subproject	1,723	496	337	311	276	144	3,220
Total PROJECT COSTS	10,640	25,560	25,346	16,272	9,140	7,506	94,464

Source: Hoi An Government estimates.

7. Subproject economic costs were derived from the financial costs by eliminating taxes and duties, and adjusting the local currency cost by the SCF. The economic costs by year for each of the subprojects and by component are shown in Table 5. The total economic cost for Hoi An is estimated at $85.45 million of which $82.28 million is for component investments and $3.17 million for project management and climate change support. By subproject the total economic investment cost is $7.29 million for the water resources subproject and $78.16 million for the urban environment and climate change adaptation subproject.

Table 5: Summary of Economic Costs by Component and Subproject

	Total Economic Costs Including Physical Contingencies ($000s)						
Component/Subproject	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
A. Hoi An Urban Environment and Climate Change Adaptation	**8,817**	**23,103**	**22,024**	**14,049**	**7,776**	**6,507**	**82,276**
1. Water Resources Subproject	342	723	2,471	2,212	1,269	0	7,016
2. Urban Environment and Climate Change Adaptation Subproject	8,475	22,380	19,553	11,837	6,507	6,507	75,260
B. Project Management and Climate Change Support	**1,632**	**456**	**337**	**327**	**293**	**129**	**3,175**
1. Water Resources Subproject	63	14	38	52	48	0	271
2. Urban Environment and Climate Change Adaptation Subproject	1,569	442	300	276	245	129	2,904
Total PROJECT COSTS	**10,449**	**23,559**	**22,361**	**14,376**	**8,069**	**6,636**	**85,451**

Source: Consultant's estimates based on Financial Costs

2. Operation and Maintenance Costs

8. Operation and maintenance (O&M) costs for the water resources subproject were determined as the difference between O&M costs without- and with-project as used for the least cost analysis, resulting in a net reduction in O&M costs. Similarly the net saving in investment costs were estimated based on the additional investment that would be required without- and with-project as reported for the least cost analysis, resulting in a further cost savings with-project. The economic cost for reduced O&M costs and capital savings were estimated using the same methodology as for the overall subproject investment costs.

9. O&M costs for the climate change adaptation subproject were estimated based on Circular 11/2012/TT-BXD, dated 25 December 2012, relating to the allocation of funds for O&M by type of construction work. With respect to urban development, the circular indicates that industrial works should be allocated 0.6-0.1% of investment costs, civil construction works 0.08-0.1% and urban infrastructure works 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 construction works are completed. Since most of the investments included in this subproject are classified urban infrastructure works, the suggested O&M costs are a maximum of 0.25% of the investment cost every 5 years, equivalent to 0.05% annually. The consultant considers that such a small allocation to O&M will not maintain the infrastructure at the level required to achieve the proposed project life. Unless more is spent the infrastructure will rapidly deteriorate and the benefits will be lost. An allocation of 1% of the investment cost has therefore been used for the financial and economic analyses.

3. Benefits

a. Water Resources Subproject

10. Subproject benefits were assessed based on the estimated of willingness-to-pay (WTP) identified through the focus group meetings undertaken as part of the social study. These values were adjusted to reflect the difference in composition of the overall Hoi An community and the members of the focus groups, which concentrated on the poorer sectors of the

community. Based on experience in similar situations and additional general discussions in the project area, it was assessed that the average incremental WTP for improved water supply by domestic and tourist consumers, the latter who particularly value high quality water was about 30% of the currently low water price of VND5,500/m^3. This value appears reasonably consistent with recent agreements with the World Bank for price increases.

11. For industrial users the incremental WTP was estimated at a much lower amount of only 5%, reflecting their expressed intention and capacity to switch to using groundwater if the price increases too much.

12. Total WTP was estimated by year for each consumer group—domestic consumers, tourists, and industries—taking into account the expected increases in consumption due to population growth, tourist numbers and industrial production. In the case of domestic consumption the WTP was further adjusted to reflect the expected increase in household incomes, which were assumed to increase by 3% per annum in real terms over the project life and the income elasticity of WTP, which was taken as 0.5. The results of the analysis were examined to determine the impact of alternative assumptions on the estimated economic viability. No adjustments were made for tourists, other than their number, since there was no indication of any planned change in the tourist mix. The financial WTP was converted to its economic equivalent by adjusting by the SCF, implying that WTP is a non-tradable commodity.

b. Climate Change Adaptation Subproject

13. The benefits from the subproject are expected to derive from (i) reduced flooding due to improved flood management in Phap Bao Lake and implementation of non-structural flood management measures; (ii) increased economic activity due to urban development in the Co Co UDA; (iii) improved traffic flow following construction of the access road to Cua Dai Bridge; and (iv) improved flood protection and reduced travel costs, particularly during flood periods, from raising of a section of Provincial Road 608.

14. **Improved flood management in Phap Bao Lake and non-structural flood management measures.** The limited available data and the nature of the annual damage prevents reasonable estimate of expected damage from flood events with specific return periods. However, the regular pattern of flood damage suggests it will be sufficient to base the analysis on annual average losses rather than annualized damages. Available data for flood damage over the past 10 years indicates that the annual average value of flood losses was about $2 million in nominal values. For the purpose of this analysis an annual stream of $2 million was converted to its average value in constant 2013 dollars and this was assessed as the average value of damage in 2012, the latest year for which information was available. This base value for damage was assessed at $3 million, which was assumed to increase without-project in proportion with population growth. This represents a conservative estimate of future damage since no account was taken of increased economic activity.

15. **Increased Economic Activity in Co Co Urban Development Area.** Development of the Co Co UDA will convert an area of currently predominantly agricultural land into a new urban area with completed basic infrastructure including the road system, domestic and commercial water supply, wastewater collection, drainage, power transmission, communication lines, etc. The main benefits from the project will come from (i) improved welfare of families that move to the new residential areas, including access to a reliable water supply and wastewater collection and treatment facilities, which will have a beneficial impact on health; (ii) improved facilities for tourists and workers in industrial areas within the new UDA; (iii) improved and lower

cost transportation both through and within the UDA; (iv) incremental economic activity; (v) aesthetic value of living and working in the new UDA with its network of parks and cycle ways; and (vi) reduced flood damage in terms of both erosion and land loss due to the buffer zones created along the river. Quantification of these benefits is complex since the new UDA is only in the planning stage. Conducting a contingent valuation survey to assess beneficiaries' willingness-to-pay (WTP) for the benefits from the infrastructure to be developed was considered not practical due to the problems with defining an appropriate sample population. The alternative—to estimate where possible the economic value of the improved services to be offered in the UDA, particularly water supply, wastewater treatment, solid waste collection and disposal, improved road access, improved flood protection, and quality of life—was therefore preferred and the estimates were based on the projected population of 8,910 persons as indicated in the masterplan. Household size was assumed to be about 4 persons, indicating a total of about 2,225 households. Since no tourist numbers were available, the benefits to tourists of the water supply were assumed to be the same as for the main part of Hoi An where an average water consumption of 140 liters per capita per day (lcpd) was estimated to cover both residents and tourists. No estimates were possible for non-resident employees of industrial enterprises and these were treated as non-quantifiable.

16. The benefits from improved water supply were treated in the same way as for the water supply subproject. Beneficiaries in their current location were assumed to be currently consuming 140 lcpd at a cost of VND5,500/m^3 and the economic benefit in the new UDA was limited to the average incremental WTP: that is 30% of the current price. WTP was adjusted annually to take into account the expected increase in consumers (beneficiaries), annual increase in real incomes (assumed to be 3%) and the assumed income elasticity of WTP of 0.5. The total financial WTP for each year was converted to its economic value by applying the SCF. Since no information was available on the likely benefits from improved wastewater collection and treatment, which are predominantly in the form of reduced incidence of waterborne diseases, the basic data on treatment costs, work days lost, and disease incidence obtained for the Dong Hoi component were applied to the expected population of Co Co UDA. Given the similarities of the two areas, this was considered reasonable.

17. Of the two main roads associate with the Co Co UDA, the north-south road is part of the access road to Cua Dai Bridge so that the benefits for that are already accounted for. No data were available for either the east-west road linking Hoi An to the coast or any of the internal roads. However, the benefits are expected to be substantial since the roads will be used by tourists and local residents and it did not seem appropriate to consider them as non-quantifiable. The only option for quantification was to adopt a benefit transfer approach using the available data for the Bao Ninh urban development area in Dong Hoi with suitable adjustments to reflect the different expected populations of the two areas. Other assumptions relating to travel distances and time savings were maintained at the same level. All other identified benefits, particularly from flood protection measures, were also treated as not-quantifiable although their value is expected to be substantial.

18. **Improved Traffic Flow Following Construction of the Access Road to Cua Dai Bridge.** The traffic flow benefits following construction of the access road to Cua Dai Bridge were estimated based on traffic volumes measured by the Quang Nam Department of Transportation in 2013 (Table 6). These vehicles currently move along relatively low quality roads into different parts of Hoi An and further up the cost. Once the access road has been completed, traffic will move faster with reduction in both vehicle operating costs (VOCs) and time. For this analysis VOCs for 2009 were obtained from the review of the Da Nang – Quang

Ngai Expressway Project,[7] and updated to reflect the situation in 2013 (Table 7). The results obtained from these data were compared to those from an alternative set derived from the 2012 survey report for the Da Nang Sustainable City Development Project. These data relate to both Da Nang and surrounding areas, including some districts of Quang Nam Province on the border with Da Nang City. They are therefore considered appropriate for the current analysis. The conclusion was that the former set were more appropriate for the current analysis although they resulted in lower estimates of cost savings.

Table 6: Traffic Volume of LacLongQuan Street, 2013

Type of vehicles	Traffic volume in 2013 (vehicle/day)		Traffic volume (vehicle/day)
	March	June	Average
Bicycles	565	412	489
Motorbikes/lamboro	1,829	1755	1,792
Tractors	-		-
Cars	137	149	143
Small buses	247	287	267
Large buses	162	137	150
Light trucks ≤ 2,5 tons	154	76	115
Medium trucks ≤10 tons	124	80	102
Heavy trucks (03 axles)	61	75	68
Heavy trucks (≥4 axles)	6	8	7
Total	3285	2979	3132

Source: Quang Nam Department of Transportation, 2013.

Table 7: Estimated Vehicle Operating Costs

Speed (kph)	Car	Mini Bus	Large Bus	LGV	Truck 2 Axles	Truck 3 Axles	Truck >3 Axles
20	2,941	4,180	4,180	7,904	7,904	7,904	7,904
25	2,673	3,732	3,732	6,949	6,949	6,949	6,949
30	2,406	3,284	3,284	5,992	5,992	5,992	5,992
35	2,251	3,057	3,057	5,544	5,544	5,544	5,544
40	2,097	2,828	2,828	5,094	5,094	5,094	5,094
45	2,035	2,762	2,762	4,919	4,919	4,919	4,919
50	1,972	2,694	2,694	4,744	4,744	4,744	4,744
55	1,937	2,690	2,690	4,555	4,555	4,555	4,555
60	1,903	2,684	2,684	4,366	4,366	4,366	4,366
65	1,948	2,712	2,712	4,515	4,515	4,515	4,515
70	1,992	2,739	2,739	4,663	4,663	4,663	4,663
75	2,069	2,910	2,910	4,865	4,865	4,865	4,865
80	2,147	3,080	3,080	5,067	5,067	5,067	5,067
85	2,218	3,219	3,219	5,293	5,293	5,293	5,293
90	2,289	3,357	3,357	5,519	5,519	5,519	5,519
95	2,461	3,694	3,694	6,070	6,070	6,070	6,070
100	2,881	4,029	4,029	6,623	6,623	6,623	6,623

Source: Adapted from CPCS Transcom Limited. 2010.

[7] CPCS Transcom Limited. 2010. *Review of the Feasibility Study For Da Nang – Quang Ngai Expressway Project (DQE)*, prepared for the World Bank and Australian Government (AusAID).

19. With the road length of approximately 4.86 km, the average length of a trip was assumed to be 3.65 km, or 75%, of the length of the road for bicycles and 4.86 km for all other vehicles. For bicycles the average speed was assumed to increase from 10 kmph to 15 kmph, while for all other vehicles it was assumed to increase from 20 kmph to 30 kmph. This increase seems to be realistic given conditions in Viet Nam. The annual financial savings under 2013 conditions were estimated at $0.95 million with an economic value of $0.86 million in constant 2013 values. The value of time, assessed at VND250,000/person-day in 2013, was then adjusted to reflect the expected increase in labor productivity of 3% per annum.

20. **Reduced Vehicle Operation Costs and Time Saved in Traveling on Road 608.** The same approach was used for estimating reduced VOCs and time saving for Road 608. Actual traffic volumes for 2012 and projections for 2030 were obtained from the Quang Nam Provincial Department of Transportation, and extrapolated for the intervening years. No further growth was assumed after 2030, when the road will likely need further upgrading to accommodate traffic. The length of road to be upgraded is 5.2 km but the average trip cars and motorcycles was assumed to be 75% of the upgraded length. Average vehicle speed was assumed to increase from 10kmph to 15 kmph for bicycles and from 20 kmpk to 30 kmph for all other vehicles. Average VOC reduction was estimated following Table 13.4. total annual financial cost savings per year under 2013 conditions were estimated at about $0.52 million, with an economic value of about $0.47 million in constant 2013 values. As with the access road to Cua Dai Bridge, the value of time was adjusted to reflect the expected increase in labor productivity.

c. Non-quantifiable Benefits

21. There are significant non-quantifiable benefits associated with the climate change adaptation subproject including (i) flood protection for the Co Co UDA; (ii) improved quality of life in the Co Co UDA; (iii) increased economic activity along the access road to Cua Dai Bridge; and (iv) reduced flood damage due to the raising of Road 608, which will allow residents greater protection from floods and easier travel during flood events. Quantification of these benefits would have a significant positive impact on the economic viability of the subproject.

E. Financial Analysis of the Climate Change Adaptation Subproject

1. Base Case

22. Since the government is both the owner of the land and the investor, and will benefit from the revenue to be generated by the climate change adaptation subproject, it was considered appropriate to estimate the financial internal rate of return (FIRR). The results of the base financial analysis are shown in Table 8. The FIRR is estimated at 13.2% with a financial net present value (FNPV) of $314.3 million when discounted at the WACC of about 1%. Using a discount rate of 12% reduces the EIRR to $8.1 million.

Table 8: Financial Evaluation of Hoi An Urban Environment and Climate Change Adaptation Subproject

($000)

Year	Investment Costs	O&M Costs	Total Cost	Co Co UDA	Flood Manage-ment	Traffic Benefits Cua Dai Rd	Traffic benefits Road 608	Total Benefits	Net Benefits
2016	10,229	-	10,229	-	-	-	-	-	(10,229)
2017	24,759	-	24,759	-	-	-	-	-	(24,759)
2018	22,482	-	22,482	-	-	-	-	-	(22,482)
2019	13,700	-	13,700	-	-	1,652	-	1,652	(12,048)
2020	7,638	712	8,501	436	3,391	1,864	-	5,691	(2,810)
2021	7,506	788	8,294	1,145	3,451	2,103	1,222	7,921	(373)
2022		863	863	2,340	3,489	2,374	1,368	9,571	8,707
2023		863	863	3,611	3,526	2,680	1,534	11,351	10,488
2024		863	863	4,458	3,565	3,025	1,723	12,771	11,908
2025		863	863	5,054	3,603	3,415	1,938	14,011	13,148
2026		863	863	5,173	3,642	3,856	2,183	14,855	13,992
2027		863	863	5,250	3,681	4,354	2,462	15,747	14,884
2028		863	863	5,329	3,721	4,918	2,778	16,746	15,883
2029		863	863	5,410	3,761	5,554	3,139	17,864	17,001
2030		863	863	5,494	3,801	6,273	3,550	19,118	18,255
2031		863	863	5,581	3,842	7,086	4,017	20,526	19,662
2032		863	863	5,669	3,884	7,277	4,124	20,954	20,091
2033		863	863	5,761	3,927	7,474	4,234	21,395	20,532
2034		863	863	5,855	3,970	7,676	4,347	21,848	20,985
2035		863	863	5,952	4,013	7,885	4,463	22,314	21,451
2036		863	863	6,052	4,057	8,100	4,583	22,793	21,930
2037		863	863	6,155	4,101	8,322	4,707	23,285	22,422
2038		863	863	6,261	4,146	8,550	4,834	23,791	22,928
2039		863	863	6,370	4,191	8,785	4,965	24,311	23,448
2040		863	863	6,482	4,236	9,027	5,100	24,845	23,982
2041		863	863	6,597	4,282	9,277	5,239	25,395	24,532
2042		863	863	6,716	4,329	9,533	5,383	25,961	25,098
2043		863	863	6,839	4,376	9,798	5,530	26,542	25,679
2044		863	863	6,965	4,423	10,070	5,682	27,140	26,277
2045		863	863	7,094	4,471	10,351	5,839	27,755	26,892
FNPV (12%)	61,717	4,207	66,010	20,304	18,481	23,296	12,027	74,109	8,099
FIRR									13.2%
FIRR @ WACC	83,724	17,874	100,911	107,618	81,187	131,135	72,361	392,301	314,256

FIRR = financial internal rate of return; FNPV = financial net present value; WACC = weighted average cost of capital.
Note: Values in parentheses are negative.
Source: Asian Development Bank estimates.

2. Sensitivity Analysis

23. Sensitivity analyses were conducted including (i) a 10% cost increase; (ii) a 10% benefit decrease; (iii) a 10% cost increase combined with a 10% benefit decrease; (iv) a 1-year lag in benefits, and (v) a 50% increase in O&M costs. Switching values and sensitivity indexes were only estimated for the cost increase and benefit decrease analyses since the financial viability of the subproject is clearly not affected by an increase in O&M costs. The results of the sensitivity analyses are summarized in Table 9. They indicate that a 10% cost increase will reduce the FIRR to 12.2%, a 10% benefit decrease reduce it to 12.1% and these two changes combined decrease it to 11.1%. These values are all well in excess of the WACC. A 50% increase in O&M costs would only reduce the FIRR to 12.9%, indicating that the subproject is not sensitive to

increased O&M costs. A 1-year benefit lag would reduce the FIRR to 12.9%, well above the cut-off point for financial viability.

Table 9: Summary of Financial Indicators

Scenario	FIRR (%)	FNPV @ 12% discount ($ million)	FNPV @ WACC ($ million)
Base case	13.2	8.01	314.26
10% cost increase	12.2	1.49	304.00
10% benefit decrease	12.1	0.69	272.57
10% cost increase + 10% benefit decrease	11.1	(5.91)	262.32
1-year benefit lag	11.9	(0.9)	289.74
50% increase in O&M Costs	12.9	5.90	304.73

FIRR = financial internal rate of return; FNPV = financial net present value; O&M = operation and maintenance; WACC = weighted average cost of capital.
Note: Values in parentheses are negative.
Source: Asian Development Bank estimates.

F. Economic Analysis

1. Water Resources Subproject

a. Base Case

24. The results of the base economic analysis of the water resources subproject are shown in Table 10. The EIRR of the subproject is estimated at 13.0% and the ENPV at $0.31 million, indicating the subproject is economically viable.

Table 10: Economic Evaluation of Hoi An Water Resources Subproject
($000s)

	Economic Costs				Economic benefits		
Year	Investment	Incremental Investment Costs	Incremental Recurrent Costs	Total cost	WTP	Total	Net Benefits
2016	405	-	(52)	353	342	342	-11
2017	737	-	(71)	666	362	362	-304
2018	2,509	-	(89)	2,419	383	383	-2,036
2019	2,263	-	(107)	2,157	406	406	-1,750
2020	1,316	-	(123)	1,194	431	431	-763
2021		-	(138)	(138)	457	457	595
2022		-	(143)	(143)	480	480	623
2023		-	(148)	(148)	504	504	653
2024		-	(153)	(153)	530	530	684
2025		-	(158)	(158)	558	558	716
2026		(2,958)	(163)	(163)	588	588	751
2027		-	(163)	(163)	604	604	767
2028		-	(162)	(162)	622	622	784
2029		-	(161)	(161)	639	639	801
2030		-	(161)	(161)	658	658	819
2031		1,468	(204)	(204)	677	677	881
2032		-	(323)	(323)	692	692	1,015
2033		-	(324)	(324)	707	707	1,031
2034		-	(324)	(324)	722	722	1,047
2035		-	(325)	(325)	738	738	1,063
2036		(463)	(326)	(326)	755	755	1,080
2037		-	(327)	(327)	772	772	1,098
2038		-	(328)	(328)	789	789	1,117
2039		-	(330)	(330)	806	806	1,136
2040		-	(331)	(331)	825	825	1,156
2041		-	(332)	(332)	843	843	1,175
2042		-	(332)	(332)	862	862	1,194
2043		-	(332)	(332)	882	882	1,214
2044		-	(332)	(332)	901	901	1,234
2045		-	(332)	(332)	922	922	1,254
ENPV	4,920	(654)	(1,181)	3,740	4,053	4,053	313
EIRR							13.0%

EIRR = economic internal rate of return; ENPV = economic net present value.
Note: Values in parentheses are negative,
Source: Asian Development Bank estimates.

b. Sensitivity Analysis

25. Sensitivity analyses were conducted including (i) a 10% cost increase; (ii) a 10% benefit decrease; (iii) a 10% cost increase combined with a 10% benefit decrease; and (iv) a 1-year lag in benefits. Switching values and sensitivity indexes were estimated for the cost increase and benefit decrease analyses. The results of the sensitivity analyses are summarized in Table 11. A 10% cost increase will reduce the EIRR to 11.8%, a 10% benefit decrease will reduce it to 11.7%, and combined 10% cost increase and 10% benefit decrease will reduce it to 10.7%, and a 1-year benefit lag will reduce it to 11.6%. The switching values indicate that it would take a

8.4% cost increase or a 7.7% benefit decrease to render the subproject economically non-viable, which indicates that it is sensitive to changes in both costs and benefits.

Table 11: Summary of Economic Indicators and Sensitivity Analysis

Scenario	EIRR (%)	ENPV ($ million)	Switching Value (%)	Sensitivity Index
Base case	13.0	0.31	11.8	11.9
10% cost increase	11.8	(0.06)	7.7	12.9
10% benefit decrease	11.7	(0.09)		
10% cost increase + 10% benefit decrease	10.7	(0.47)		
1-year benefit lag	11.6	(0.15)		

EIRR = economic internal rate of return; ENPV = economic net present value.
Note: Values in parentheses are negative.
Source: Asian Development Bank estimates.

2. Climate Change Adaptation Subproject

a. Base case

26. The results of the base economic analysis of the climate change adaptation subproject are shown in Table 12. The EIRR of the subproject is estimated at 13.1% and the ENPV at $6.83 million, indicating that the subproject is economically viable.

Table 12: Economic Evaluation of Hoi An Urban Environment and Climate Change Adaptation Subproject

Year	Investment Costs	O&M Costs	Total Cost	Co Co UDA	Flood Manage-ment	Traffic Benefits Cua Dai Rd	Traffic benefits Road 608	Total Benefits	Net Benefits
2016	10,044	-	10,044	-	-	-	-	-	(10,044)
2017	22,822	-	22,822	-	-	-	-	-	(22,822)
2018	19,852	-	19,852	-	-	-	-	-	(19,852)
2019	12,113	-	12,113	-	-	1,486	-	1,486	(10,626)
2020	6,752	648	7,401	393	3,052	1,677	-	5,122	(2,279)
2021	6,636	716	7,352	1,033	3,106	1,893	1,099	7,132	(220)
2022		782	782	2,114	3,140	2,137	1,231	8,621	7,839
2023		782	782	3,266	3,174	2,412	1,381	10,232	9,450
2024		782	782	4,038	3,208	2,723	1,551	11,520	10,738
2025		782	782	4,580	3,243	3,074	1,745	12,641	11,859
2026		782	782	4,692	3,278	3,471	1,965	13,405	12,623
2027		782	782	4,762	3,313	3,919	2,215	14,210	13,427
2028		782	782	4,834	3,349	4,426	2,501	15,109	14,327
2029		782	782	4,909	3,385	4,998	2,825	16,117	15,335
2030		782	782	4,985	3,421	5,646	3,195	17,247	16,464
2031		782	782	5,064	3,458	6,377	3,616	18,515	17,732
2032		782	782	5,146	3,495	6,549	3,712	18,902	18,120
2033		782	782	5,229	3,534	6,726	3,810	19,300	18,518
2034		782	782	5,315	3,573	6,909	3,912	19,709	18,927
2035		782	782	5,404	3,612	7,097	4,017	20,130	19,347
2036		782	782	5,495	3,652	7,290	4,125	20,562	19,780
2037		782	782	5,589	3,691	7,490	4,236	21,006	20,224
2038		782	782	5,686	3,731	7,695	4,351	21,463	20,681
2039		782	782	5,785	3,772	7,907	4,469	21,932	21,150
2040		782	782	5,888	3,813	8,125	4,590	22,415	21,633
2041		782	782	5,994	3,854	8,349	4,715	22,912	22,130
2042		782	782	6,102	3,896	8,580	4,844	23,422	22,640
2043		782	782	6,214	3,938	8,818	4,977	23,947	23,165
2044		782	782	6,329	3,981	9,063	5,114	24,487	23,705
2045		782	782	6,448	4,024	9,316	5,255	25,043	24,260
ENPV (12%)	56,184	3,815	59,999	18,410	16,632	20,967	10,825	66,833	6,834
EIRR									13.1%

EIRR = economic internal rate of return; ENPV = economic net present value.
Note: Values in parentheses are negative.
Source: Asian Development Bank estimates.

b. Sensitivity Analysis

27. Sensitivity analyses were conducted including (i) a 10% cost increase; (ii) a 10% benefit decrease; (iii) a 10% cost increase combined with a 10% benefit decrease; (iv) a 1-year lag in benefits, and (v) a 50% increase in O&M costs. Switching values and sensitivity indexes were estimated for the cost increase and benefit decrease analyses. The results of the sensitivity analyses are summarized in Table 13. These indicate that a 10% cost increase would reduce the EIRR to 12.1% and a 10% benefit decrease would reduce it to 12.0%, both marginally economically viable. A combined 10% cost increase and 10% benefit decrease would reduce the EIRR to 11.1% and render it economically non-viable. A 1-year benefit lag would reduce the EIRR to 11.8%, also marginally economically non-viable. A 50% increase in O&M costs would only reduce the EIRR by 0.3 percentage points. The switching values indicate that the subproject would require an 11.4% cost increase or a 10.2% benefit decrease to affect its

economic viability. The subproject is thus considered to be sensitive to changes in costs and benefits.

Table 13: Summary of Economic Indicators and Sensitivity Analysis

Scenario	EIRR (%)	ENPV ($ million)	Switching Value (%)	Sensitivity Index
Base case	13.1	6.83		
10% cost increase	12.1	0.83	11.4	8.8
10% benefit decrease	12.0	0.15	10.2	9.8
10% cost increase + 10% benefit decrease	11.1	(5.85)		
1-year benefit lag	11.8	(1.07)		
50% increase in Operation and Maintenance Cost	12.8	4.93		

EIRR = economic internal rate of return; ENPV = economic net present value.
Note: Values in parentheses are negative.
Source: Asian Development Bank estimates.

3. Overall Economic Analysis of the Hoi An Component

a. Base Case

28. In this section, the economic analyses for the two subprojects are combined to generate an overall economic analysis of the Hoi An Component. The results of the overall economic analysis are shown in Table 14. The EIRR of the subproject is estimated at 13.2% and the ENPV at $7.80 million, indicating the component is economically viable.

Table 14: Economic Evaluation of Overall Hoi An Urban Environment and Climate Change Adaptation Component

	Investment Costs			Recurrent Costs				Benefits			
Year	Lai Nghi	Urban Develop-ment	Total	Lai Nghi	Urban Develop-ment	Total	Total Cost	Lai Nghi	Urban Develop-ment	Total	Net Benefits
2016	405	10,044	10,449	(52)	-	(52)	10,397	342	-	342	(10,055)
2017	737	22,822	23,559	(71)	-	(71)	23,488	362	-	362	(23,126)
2018	2,509	19,852	22,361	(89)	-	(89)	22,272	383	-	383	(21,888)
2019	2,263	12,113	14,376	(107)	-	(107)	14,269	406	1,486	1,893	(12,377)
2020	1,316	6,752	8,069	(123)	648	526	8,594	431	5,122	5,553	(3,041)
2021	-	6,636	6,636	(138)	716	578	7,214	457	7,132	7,589	375
2022	-	-	-	(143)	782	639	639	480	8,621	9,102	8,463
2023	-	-	-	(148)	782	634	634	504	10,232	10,737	10,103
2024	-	-	-	(153)	782	629	629	530	11,520	12,050	11,421
2025	-	-	-	(158)	782	624	624	558	12,641	13,199	12,575
2026	(2,958)	-	(2,958)	(163)	782	619	(2,339)	588	13,405	13,993	16,332
2027	-	-	-	(163)	782	620	620	604	14,210	14,814	14,194
2028	-	-	-	(162)	782	620	620	622	15,109	15,731	15,111
2029	-	-	-	(161)	782	621	621	639	16,117	16,756	16,136
2030	-	-	-	(161)	782	621	621	658	17,247	17,904	17,283
2031	1,468	-	1,468	(204)	782	578	2,046	677	18,515	19,192	17,146
2032	-	-	-	(323)	782	459	459	692	18,902	19,594	19,134
2033	-	-	-	(324)	782	459	459	707	19,300	20,007	19,548
2034	-	-	-	(324)	782	458	458	722	19,709	20,431	19,974
2035	-	-	-	(325)	782	457	457	738	20,130	20,868	20,411
2036	(463)	-	(463)	(326)	782	457	(7)	755	20,562	21,317	21,323
2037	-	-	-	(327)	782	455	455	772	21,006	21,778	21,323
2038	-	-	-	(328)	782	454	454	789	21,463	22,252	21,798
2039	-	-	-	(330)	782	453	453	806	21,932	22,739	22,286
2040	-	-	-	(331)	782	451	451	825	22,415	23,240	22,789
2041	-	-	-	(332)	782	450	450	843	22,912	23,755	23,305
2042	-	-	-	(332)	782	450	450	862	23,422	24,284	23,835
2043	-	-	-	(332)	782	450	450	882	23,947	24,829	24,379
2044	-	-	-	(332)	782	450	450	901	24,487	25,389	24,939
2045	-	-	-	(332)	782	450	450	922	25,043	25,965	25,515
ENPV (12%)	4,267	56,184	60,450	(1,181)	3,815	2,635	63,085	4,053	66,833	70,887	7,802
EIRR											13.2%

EIRR = economic internal rate of return; ENPV = economic net present value.
Note: Values in parentheses are negative.
Source: Asian Development Bank estimates.

b. Sensitivity Tests

29. Sensitivity analyses were conducted including (i) a 10% cost increase; (ii) a 10% benefit decrease; (iii) a 10% cost increase combined with a 10% benefit decrease; (iv) a 1-year lag in benefits, and (v) a 50% increase in O&M costs. Switching values and sensitivity indexes were estimated for the cost increase and benefit decrease analyses. The results (Table 15) indicate that a 10% cost increase would reduce the EIRR to 12.1% and a 10% benefit decrease would reduce it to 12.0%, both marginally economically viable. A combined 10% cost increase and 10% benefit decrease would reduce the EIRR to 11.0%, which would render the overall subproject economically non-viable. A 1-year benefit lag would reduce the EIRR to 11.8%, and a 50% increase in O&M costs would reduce it to 12.9%, a 0.4 percentage point reduction. Therefore the subproject is concluded to be not sensitive to increased O&M costs. The switching values indicate that the subproject would require a 12.4% cost increase or an 11.0%

benefit decrease to affect its economic viability, which confirms that the subproject is sensitive to cost increases or benefit decreases.

Table 15: Summary of Economic Indicators and Sensitivity Analysis for Overall Hoi An Component

Scenario	EIRR (%)	ENPV ($ million)	Switching Value (%)	Sensitivity Index
Base case	13.2	7.80		
10% cost increase	12.1	1.49	12.4	8.1
10% benefit decrease	12.0	0.71	11.0	9.1
10% cost increase + 10% benefit decrease	11.0	(5.60)		
1-year benefit lag	11.8	(0.58)		
50% increase in Operation and Maintenance Cost	12.9	6.48		

EIRR = economic internal rate of return; ENPV = economic net present value.
Note: Values in parentheses are negative.
Source: Asian Development Bank estimates.

G. Distribution and Poverty Impact Analysis

30. Given the relatively low reported incidence of poverty in the subproject area, it was not considered appropriate to estimate a formal poverty impact ratio. However, it is clear that the project will have significant impacts on the poorer sectors of the community since these will benefit the most from improved flood protection as they tend to live in those areas with the greatest flooding problems. They are also expected to benefit from job creation during construction of the new urban area and in the increased employment following establishment of commercial enterprises in this area.