ECONOMIC ANALYSIS

A. Introduction

1. The Livable Cities Investment Project will focus on enhancing urban planning; building community resilience; and developing urban infrastructure (sanitation, solid waste management, and drainage) in the secondary cities of Bavet, Kampot and Poipet.

B. Demand Analysis

2. Urban services in Bavet, Kampot and Poipet no longer operate optimally and are unable to meet demand. Although 90%–93% of the total population has access to pour or flush toilets, the cities have no wastewater treatment plants (WWTPs) and 74%–91% of the excreta generated is unsafely managed. Only 14%–16% of the households have a solid waste collection service and 88%–90% of the solid waste generated is unsafely managed. Stormwater drainage systems are unable to cater to flows because of insufficient capacity and blockages caused by solid waste or building obstructions. Population growth in the targeted cities has highlighted the limited access to key public infrastructure and based on the average annual growth rate, for 2021–2040, the total population is estimated to increase by 82% to 226,118 in Poipet, 33% to 149,396 in Bavet, and 61% to 76,707 in Kampot.

3. Because rapid population growth and urbanization are expected to increase demand for urban infrastructure and services, the proposed WWTPs in Bavet and Poipet have been designed to 2030 capacity.[1] The sorting and composting plants will have a combined capacity of 56,420 tons per year (against a projected solid waste generation of 51,744 tons per year in 2025) in Bavet and 72,195 tons per year (against 67,513 tons per year in 2025) in Poipet. The design of the controlled landfills in Bavet and Poipet has been based on a 20-year design life, with a total design capacity of 1,032,609 cubic meters (m^3) in Bavet and 1,265,568 m^3 in Poipet.[2]

C. Least-Cost Analysis

4. A qualitative comparative analysis compared the cost effectiveness of the subproject design options, which were based on cost, technical and environmental performance, and the preference of the Cambodian government.[3] As part of the master planning process, a detailed scenario analysis was carried out based on different infrastructure layouts, sizing, and treatment options. For wastewater, the scenario analysis was based on the adoption of different pipe layouts, treatment plant size, and pump station requirements. For stormwater, the analysis looked at the use of different storm runoff rates and the implications this has on infrastructure sizing. For solid waste, different collection and treatment options—from using a controlled landfill only to including pre-sorting and composting facilities—were assessed. Capital and operational expenditures were estimated for different scenarios over the short term (up to 2025), medium

[1] The capacity of the proposed WWTP for Bavet is 3,930 cubic meters (m^3) per day and will be sufficient to treat a projected wastewater flow of 3,376 m^3 per day by 2030. The capacity of the proposed WWTP for Poipet is 9,576 m^3 per day, which will be sufficient to treat the projected wastewater flow of 9,576m^3 per day by 2030. The project will only service a priority catchment area in Poipet, and the projected flows are 2,037m^3 per day. For Kampot, no WWTP will be built under the project. A 3,300m^3 per day WWTP is being built under the Second Greater Mekong Subregion Corridor Towns Development Project and will be sufficient to service a projected flow of 1,303m^3 per day.

[2] The delivery of the landfill will be staged, and the project will deliver a capacity of 516,305 m^3 per day for Bavet and 632,784 m^3 per day for Poipet.

[3] A comparative analysis assessed the various technical options, including alternate treatment technologies, routing options, and estimated capital and operational expenditures. Findings of the assessment are documented in the sector master plans and feasibility studies, prepared under the TA for the Southeast Asia Urban Services Facility.

term (up to 2030), and long term (up to 2040). These options were presented to the Ministry of Public Works and Transport, the provincial governments, and the municipal administrations in April 2020. The discussions centered on the affordable balance between infrastructure costs, improved management of untreated sewage flows, reduced flood damage, and rate of diversion from landfilling.

D. Cost–Benefit Analysis

5. Economic analyses were conducted for each city and for the overall project following ADB's Guidelines for the Economic Analysis of Projects.[4] The analyses compared the projected conditions with and without the project to quantify the net incremental benefits. The $1 = KR4,074 exchange rate in July 2021 was used.

6. **Project costs.** Totaling $194.1 million, the project cost includes (i) civil works, mechanical and equipment, land acquisition and compensation, and consultancy and training; (ii) staff allowances, project management and project implementation unit operations, and financial auditing; and (iii) contingencies and financing charges during implementation (FCDI). Periodic capital expenditure in 2034 and 2035 allows for replacing vehicles and equipment with life spans shorter than 20 years. Project investment costs, including physical and price contingencies and FCDI, are in Table 1. Project financial costs, excluding price contingencies and FCDI, were converted to economic costs, resulting in an overall conversion factor of 0.84.[5]

Table 1: Summary of Investment Costs
($ million)

Outputs	Financial[a]	Economic[b]
Output 1: Policy and regulatory environment improved	2.1	1.6
Output 2: Urban infrastructure improved	189.3	147.48
Output 3: Institutional effectiveness and governance improved	2.7	2.12
Total project cost	**194.1**	**151.2**

[a] Includes price contingencies and financing charges during implementation.
[b] Excludes tax, price contingencies, and financing costs; allows for the shadow exchange rate factor and shadow wage rate factor.
Source: Asian Development Bank estimates.

7. **Project benefits.** Because the project adds new, improved services, all project benefits are considered incremental. The economic analyses considered the following benefits:

(i) **Improved wastewater management systems.** By connecting to a new sewerage system and improving the collection and treatment of wastewater and septage, the project will
   (a) save costs of installing new septic tanks; and maintaining, periodically desludging, and cleaning existing septic tanks;
   (b) save costs of alternative wastewater collection and treatment for commercial and institutional connections;
   (c) save health care costs for households; and

[4] ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.
[5] The conversion factor using the domestic price numeraire was based on a shadow wage rate factor of 0.60 and an ADB shadow exchange rate factor of 1.00 for traded goods because of the high dollarization of the economy (J. Menon. 2008. Cambodia's Persistent Dollarization: Causes and Policy Options. *Working Paper Series on Regional Economic Integration*. No. 19. Manila: ADB; and S. Samreth, M. Sanchez-Martin, and S. Ly. 2019. Dollarization Dilemma: Price Stability at the Cost of External Competitiveness in Cambodia. *Policy Research Working Paper*. No. 8893. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/31906).

(d) improve the natural environment, rivers, and wetlands through a net reduction in undesirable pollutants from unsafely managed excreta.[6]

(ii) **Improved drainage systems.** Through this project, flooding will no longer damage residential and commercial properties, prevent economic activity and cause productivity loss, and increase travel time or costs.

(iii) **Improved solid waste management systems.** The project will
(a) save costs on alternative trash collection and disposal methods;
(b) reduce the environmental impact from alternative disposal methods and greenhouse gases through a new controlled landfill;
(c) reduce greenhouse gases valued at the social cost of carbon;[7]
(d) increased value of reclaimed and recycled material, and compost;
(e) save cost of expenditure on health, travel expenses, and lost productivity by reducing sick days for the resident population, special economic zone workers, and tourists.[8]

(iv) **Increase in international tourists.** This project will raise the marginal income from international tourism estimated using historical tourist visits and expenditure.[9]

8. **Salvage value.** The economic life is only 20 years and is limited by a population projection only up to 2040. Because of this, a salvage value is included to allow for the remaining value of the assets created by the project. The salvage value is 51%–59% depending on the asset type.

9. **Economic rates of return.** The net present values and economic internal rates of return (EIRR) were calculated for each city. Table 2 provides a summary of results. All EIRR values exceed 9.00%. The overall EIRR for the combined project is 12.1%, indicating that the overall project is economically viable. Table 3 provides the base case cash flows for the overall project.

Table 2: Summary of the Economic Evaluation

Output	**EIRR** (%)	**NPV** ($ million)
Bavet	15.5	18.65
Poipet	9.7	3.40
Kampot	15.2	2.05
Overall project	12.1	24.10

ADB = Asian Development Bank, EIRR = economic internal rate of return; NPV = net present value.
Source: ADB. 2021. *Feasibility Study Report for Cambodia: The Livable Cities Investment Project*. Manila.

10. **Sensitivity analysis.** Sensitivity analysis was undertaken to test the sensitivity of the estimated EIRRs of the proposed outputs to adverse changes in key variables. Four risks are considered: (i) a 20% increase in capital cost, (ii) a 20% increase in operation and maintenance costs, (iii) a 20% decrease in benefits, and (iv) a 1-year project delay. Table 4 provides a summary

[6] The net reduction in undesirable pollutants—biological oxygen demand, chemical oxygen demand, suspended solids, nitrogen, and phosphorus—were valued at the estimated shadow for undesirable outputs from sewage and contaminated water and is based on United Nations methodology (United Nations Environment Programme, 2015. *Economic Valuation of Wastewater: The Cost of Action and the Cost of No Action*. Nairobi).

[7] The valuation of greenhouse gases used a value of $43.20 per ton of carbon dioxide equivalent in 2020 prices, inflating at 2% per year in real terms over the life of the project, following ADB guidelines.

[8] Health benefits for special economic zone workers and tourists have a separate population projection, are excluded in the health benefits for the general resident population, and has a small contribution to total project benefits.

[9] No tourism benefits have been estimated for Kampot. As with tourist health benefits, international tourism benefits make a small contribution to total benefits but were included for completeness. The recorded additional daily expenditure for international tourists in Bavet and Poipet is $33 and only 13% and 15% of this was used as the marginal economic benefit. The average length of stay is 2 day.

of sensitivity tests for the overall project 4. EIRR exceeds 9% for all tests except the reduction in the benefits.

Table 3: Economic Internal Rate of Return and Switching Value

Sensitivity Test	EIRR (%)	ENPV ($ million)	Sensitivity Indicator	Switching Value (%)[a]
Base case	12.1	24.10		
20% increase in investment cost	9.6	5.54	4.0	25
20% increase in O&M costs	11.4	18.84	1.1	94
20% reduction in benefits	8.4	(4.54)	6.0	(17)
1-year project delay	9.9	7.62	7.4	14

( ) = negative, ADB = Asian Development Bank, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance.

[a] The percentage increase or decrease in costs and benefits to maintain an EIRR equal to 9%.

Source: ADB. 2021. *Feasibility Study Report for Cambodia: The Livable Cities Investment Project*. Manila.

Table 4: Economic Internal Rate of Return Analysis for the Overall Project

($ '000)

Year	Capex $'000	Economic Cost		Net Benefit (Cost)	Sensitivity				
		Opex $'000	Total Costs $'000	Benefits $'000	Base Case $'000	Invest-ment 20% $'000	O&M 20% $'000	Benefit -20% $'000	1-yr Delay in Benefit $'000
2021	-	-	-	-	-	-	-	-	-
2022	2,258	-	2,258	-	(2,258)	(2,710)	(2,258)	(2,258)	(2,258)
2023	32,250	-	32,250	-	(32,250)	(38,700)	(32,250)	(32,250)	(32,250)
2024	47,631	-	47,631	-	(47,631)	(57,157)	(47,631)	(47,631)	(47,631)
2025	58,668	1,240	59,908	12,584	(47,324)	(59,058)	(47,572)	(49,841)	(59,908)
2026	7,638	4,636	12,274	23,940	11,666	10,139	10,739	6,878	310
2027	847	4,685	5,532	24,427	18,895	18,726	17,958	14,010	18,408
2028	-	4,735	4,735	24,929	20,194	20,194	19,247	15,208	19,692
2029	-	4,786	4,786	25,448	20,662	20,662	19,705	15,572	20,143
2030	-	4,839	4,839	25,989	21,150	21,150	20,182	15,952	20,610
2031	-	4,871	4,871	25,333	20,463	20,463	19,488	15,396	21,118
2032	-	4,903	4,903	25,660	20,756	20,756	19,776	15,624	20,430
2033	-	4,936	4,936	25,991	21,055	21,055	20,067	15,856	20,723
2034	4,725	4,969	9,695	26,327	16,633	15,687	15,639	11,367	16,296
2035	-	5,003	5,003	26,669	21,666	21,666	20,666	16,332	21,325
2036	-	5,036	5,036	27,015	21,978	21,978	20,971	16,575	21,632
2037	-	5,070	5,070	27,366	22,295	22,295	21,281	16,822	21,944
2038	-	5,105	5,105	27,723	22,618	22,618	21,597	17,073	22,261
2039	-	5,139	5,139	28,085	22,946	22,946	21,918	17,329	22,583
2040	69,095	5,174	(63,921)	28,453	92,373	106,192	91,339	86,683	92,005
1	84,925	75,128	160,052	405,938	245,886	228,901	230,860	164,698	217,433
			Discount Rate @ 9%	**EIRR**	12.1%	9.6%	11.4%	8.4%	9.9%
				ENPV 9%	24,100	5,544	18,839	-4,537	7,620
			Sensitivity Indicator	**EIRR**		4.0	1.1	6.0	7.4
				ENPV		3.8	1.1	5.9	7.1
			Switching Value	**EIRR**		25%	94%	17%	14%
				ENPV		26%	92%	17%	14%

( ) = negative, ADB = Asian Development Bank, CAPEX = capital expenditure, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance, OPEX = operating expenditure.

Source: ADB. 2021. *Feasibility Study Report for Cambodia: The Livable Cities Investment Project*. Manila.

11. **Benefit distribution and poverty impact analysis.** The analysis was prepared for each city. The economic benefits generated from the project will be allocated to stakeholders—the government, consumers, and the public—and the distribution of costs and benefits among stakeholders relies on estimates of the net incremental benefits and costs generated by the main project outputs. All financial and economic benefits and costs are expressed in present value terms (9% discount rate). The difference in the present values of the capital and operating expenditures between economic and financial prices relate to the tax and the shadow value of unskilled labor. The higher future present value for unskilled labor is a gain to unskilled labor employed during construction because the shadow wage rate factor is 0.6. The tax element in the capital and operating expenditures is a gain to the government.

12. ADB's poverty assessment for Cambodia was 12.9% in 2018, down from 47.8% in 2007 and 13.5% in 2014, although the coronavirus disease (COVID-19) pandemic is expected to reverse this downward trend. Poverty incidence in cities is assumed to be similar to the national average and has been showing a progressive decline in tune with the rest of the country. Overall, the distribution impact will largely benefit residents and local communities, including workers in special economic zones.