ECONOMIC AND FINANCIAL ANALYSIS

A. General

1. Tajikistan is a landlocked mountainous country in Central Asia bordered by Afghanistan, the People's Republic of China, the Kyrgyz Republic, and Uzbekistan. Despite its strategic location, as of 2017, the country had a gross domestic product (GDP) per capita of just $819,[1] with 32% of the population living below the poverty line.[2] Almost 70% of the population lives in rural areas, in a largely mountainous territory where only 10% of the land is suitable for cultivation.

2. Tajikistan's road network was largely constructed prior to its independence in 1991. Tajikistan depends heavily on transport corridors to support investment, job creation, trade, and ultimately economic growth and poverty reduction. Ailing transport infrastructure and low network connectivity, coupled with geographic isolation and mountainous terrain, pose significant barriers to the country's economic and social development. In light of this, the Government of Tajikistan has embarked on a long-term program of infrastructure rehabilitation and development.

3. The government has requested Asian Development Bank (ADB) assistance to progressively upgrade the 82-kilometer (km) Dushanbe–Kurgonteppa road, for which ADB has programmed two projects: one in 2016 (current project) and one in 2018 (proposed additional financing).[3] The road is a strategic north–south link, and one of the most heavily traveled roads in the country, as well as the confluence of Central Asia Regional Economic Cooperation (CAREC) corridors 2, 5, and 6. The project road passes through terrain that varies from flat to mountainous. A further 90 km beyond Kurgonteppa, connects Dushanbe to Afghanistan. The government has also requested ADB assistance through the project to improve several short sections of the national highway network that have substantial road safety-related deficiencies.

4. The road has large potential to support regional integration and inclusive economic growth, but this potential is limited by three factors: (i) road capacity, (ii) road condition, and (iii) road safety. The project will support the government's program to progressively improve the road by (i) expanding its width from two to four lanes to address the impending capacity constraints, (ii) improving its surface condition through structural overlays of the existing pavement and construction of new pavement, and (iii) providing well-designed safety facilities to address existing road safety deficiencies.

5. The current project is improving a 33 km road section from Dushanbe to Chashmasoron. The civil works on this section started in November 2017 and are expected to be completed by October 2020.[4] Additional financing is sought to scale up the project by improving a contiguous 40 km road section (Chashmasoron–Kurgonteppa) to the current 33 km project road. The additional financing will also support the program of the Ministry of Transport (MOT) to improve the road safety situation on selected priority sections of the national highway network. It is expected that the Japan International Cooperation Agency (JICA) will help finance, through collaborative parallel financing, the remaining 9 km section in Kurgonteppa to complete the project

[1] International Monetary Fund (IMF). IMF DataMapper. http://www.imf.org/external/datamapper/NGDPDPC@WEO/OEMDC/ADVEC/WEOWORLD (accessed 12 October 2017).
[2] ADB. 2017. *Basic 2017 Statistics*. Manila.
[3] ADB. 2017. *Country Operations Business Plan: Tajikistan, 2018–2020*. Manila.
[4] ADB. 2016. *Report and Recommendation of the President to the Board of Directors: Proposed Loan, Grant, and Administration of Grant to the Republic of Tajikistan for the CAREC Corridors 2, 5, and 6 (Dushanbe–Kurgonteppa) Road Project.* Manila.

road improvement. The JICA-financed section and the targeted priority safety improvements are not part of this economic and financial analysis.

Table 1: Road Sections and Expected Output

Section Identification	Section Name	Expected Output
7	Chashmasoron (km 33+475) to Obikiik (km 41+080)	Reconstruction of existing carriageway and widening from two to four lanes to an IRI of 2.0
8	Obikiik (km 41+080) to Kizilkala (km 71+300)	
9	Kizilkala (km 71+300) to Vakhsh bridge (km 73+050)	

IRI = international roughness index, km = kilometer.
Source: Asian Development Bank estimates.

6. **With-project scenario.** The with-project scenario involves the improvement of 39.6 km of road. The current two-lane road will be widened to four lanes and the existing carriageway will be reconstructed to achieve an international roughness index (IRI) value of 2.0. Construction works are expected to start in 2018 and end in 2021. The scheduled opening of the project road is 2022.

7. **Without-project scenario.** The without-project scenario involves (i) periodic maintenance of surface treatment when the IRI value exceeds 10; and (ii) routine maintenance of the existing road, including pothole patching, crack sealing, edge repairs, and summer and winter maintenance.

B. Traffic Studies

8. The project road was divided into three homogeneous sections in terms of traffic volume and composition between significant settlements, terrain type, and junctions. The results of traffic surveys conducted by JICA in 2015 were validated and updated in 2017 through further manual counting by ADB consultants (Table 2).[5]

Table 2: Baseline Traffic, 2017

Section Identification	Section Name	Length (km)	AADT
7	Chashmasoron (km 33+475) to Obikiik (km 41+080)	7.6	7,475
8	Obikiik (km 41+080) to Kizilkala (km 71+300)	30.2	10,627
9	Kizilkala (km 71+300) to Vakhsh bridge (km 73+050)	1.8	9,223
Total		**39.6**	

AADT = annual average daily traffic, km = kilometer.
Sources: Asian Development Bank consultants; and Japan International Cooperation Agency.

9. Traffic was projected for a 24-year period (2018–2041) as set out in Table 3. The growth rate for normal traffic was based on available GDP forecasts. For 2017–2021, forecasts from the International Monetary Fund (IMF) were used. Beginning in 2022, growth was assumed to drop to 3.5% per annum, declining further to 3.0% in 2026, to 2.5% in 2031, and to 2.0% in 2036. These adjustments reflect the uncertainty of the longer-term forecasts. Elasticity values were used to translate GDP growth forecasts into traffic growth rates. The elasticity values used for passenger vehicles were 1.20 for 2017–2025, 1.10 for 2026–2030, and 1.05 for 2031–2041. For goods vehicles, the elasticity values used are 1.10 for 2016–2025, 1.05 for 2026–2030, and 1.00 for 2031–2041.

[5] JICA. Data Collection Survey on a Road between Dushanbe and Kurgonteppa in Republic of Tajikistan (2015). Unpublished.

10. Generated traffic was conservatively estimated to add 1% to the estimated normal traffic, for a period of 10 years after the opening of the road in 2022. With regards to diverted traffic, the Dushanbe–Kurgonteppa road has no alternative routes that could result in diverted traffic using the newly reconstructed road. Therefore, diverted traffic was not included in the traffic forecasts.

Table 3: Forecast Annual Average Daily Traffic, 2021–2041

Section Identification	2021	2026	2031	2036	2041
7	9,208	11,297	13,192	14,919	16,531
8	12,950	15,766	18,296	20,588	22,816
9	10,235	13,658	15,846	17,827	19,753

Note: vehicle number estimates include generated traffic.
Sources: Asian Development Bank consultants; and Japan International Cooperation Agency.

C. Economic Costs

11. The economic costs considered for the analysis comprise (i) capital investment, which includes civil works, land acquisition and resettlement, consulting services, and physical contingencies; and (ii) road maintenance costs.[6] Costs related to taxes, duties, price contingencies, and financing charges during implementation were excluded. Table 4 gives a breakdown of the capital investment costs for each road section.

12. Financial costs were converted into economic costs in line with ADB guidelines.[7] The economic analysis was conducted based on the world price numeraire. A distinction was made between traded and nontraded goods for all cost items, and a standard conversion factor of 0.942 was applied to nontraded goods. Shadow wage rate factors of 0.8 for unskilled labor and 1.0 for skilled labor were estimated and applied.

Table 4: Financial Cost Estimate
($ million, 2017 prices)

	Road Section Identification			
Cost	**7**	**8**	**9**	**Total**
Land acquisition and resettlement	0.23	0.92	0.05	**1.20**
Civil works	14.57	48.75	9.28	**72.60**
Consulting services	1.08	4.29	0.28	**5.65**
Taxes and duties	3.10	10.39	1.95	**15.44**
Physical contingencies	1.53	5.24	0.94	**7.71**
Price contingencies	0.92	2.95	0.57	**4.44**
Incremental administrative expenses			0.50	**0.50**
Total	**21.43**	**72.54**	**13.57**	**107.54**

Source: Asian Development Bank estimates.

13. Long-term maintenance costs have been estimated at $1,500 per km for general summer routine maintenance, $465 per km for winter maintenance, $4.76 per square meter for patching potholes and edge breaks, $8.32 per square meter for surface treatment, and $12.62 per square meter for periodic asphalt overlays. These levels of expenditure are compatible with the current budget allocations for maintenance of a road of this category.

[6] The opportunity cost of land was computed based on net agricultural output foregone.
[7] ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

14. A residual value equivalent to 30% of the investment cost has been included in the economic analysis, estimated by applying the straight-line depreciation method to individual project items based on assumed life spans.

D. Economic Benefits

15. The economic benefits that will accompany the project are (i) vehicle operating cost (VOC) savings and (ii) time cost savings. Benefits were calculated separately for normal and generated traffic. For generated traffic, the "rule of half" was applied as per standard practice. Standard conversion factors were applied to the benefit streams applied the to allow for comparison with costs using the world price numeraire.

16. Differences in carbon dioxide emissions between the with- and without-project scenarios were calculated and added to the economic benefits. At the 2016 price level, 1 ton of carbon dioxide emissions cost $36.20, with a 2% annual increase (footnote 7).

17. **Vehicle operating cost savings.** Savings in VOCs accrue from better traffic conditions and a higher level of service on the improved road. Unit rates for VOCs per km by IRI value were calculated using the Highway Development and Management Model. The IRI values for the upgraded road are forecast to start at 2.0, increasing to an average of 5.0 in 2041, at the end of the analysis period. VOCs were estimated from data collected from various sources for each representative vehicle in each vehicle class at the end of 2016. Data included the price of new vehicles, tires, petrol, lubricating oil, crew wages, annual overhead, cargo, and maintenance costs.

18. **Time cost savings.** Savings in travel time costs will result from higher permissible vehicle speeds, better alignment, smoother pavement, and easier overtaking conditions. Average speeds were calculated using a traffic model by applying a speed-flow formula that links average speeds to road type and traffic volumes. Values of working time were calculated based on existing data on salaries and wages. According to official data, the average monthly salary in Tajikistan during January 2015–February 2016 was TJS910.31 or $104.75 equivalent, which equates to $0.60 per hour based on 22 days worked per month and 8 hours worked per day. It was assumed that the annual increase in average salary is 5%, increasing it to $0.66 per hour in 2017. An income adjustment factor of 1.45 was applied to car passengers to allow for their higher incomes. Conversely, a factor of 0.50 was applied to bus passengers. The value of non-working time was taken as 20% of the value of working time.

19. Average vehicle occupancy was derived from JICA's study (footnote 5), with 3.16 persons per car or light vehicle, 6.41 persons per small bus, 49.33 persons per large bus, and 1.5 persons per truck (including the truck driver). As the VOC unit rates include a crew cost component, the time savings calculation did not include those for goods vehicle crews, as this would represent double counting. Of all vehicle occupants (including crew), 33% of car occupants, 100% of heavy vehicle occupants, and 70% of bus occupants were assumed to be traveling for work. Other occupants were assumed to be traveling for non-work purposes, which included those not active in the labor force.

E. Results of Economic Analysis

20. An economic assessment of the project was carried out using the standard appraisal methodology that compares the incremental benefits derived from reductions in VOCs and travel

time costs resulting from the project, against the initial investment costs and incremental changes in operation and maintenance costs over the 24-year appraisal period, including a 20-year period when the road is open to traffic. The results of the economic analysis are shown in Table 5, expressed as the key economic indicators of (i) economic internal rate of return (EIRR) and (ii) net present value (NPV) at a 12% discount rate. The results indicate that the project is economically viable for each road section and for the project as a whole. The EIRR for the project is 15.4% and the NPV is $20.13 million. The economic indicators are considered to be conservative estimates, as the impact on road safety has not been monetized owing to lack of data. Table 6 shows the stream of costs and benefits during 2018–2041 for the project.

Table 5: Results of the Economic Analysis

NPV ($ million)	**EIRR** (%)
20.13	15.4

EIRR = economic internal rate of return, NPV = net present value.
Source: Asian Development Bank estimates.

Table 6: Benefit and Cost Streams
($ million)

Year	Capital Costs	Maintenance Costs			VOT Savings	VOC Savings	Carbon Dioxide Savings
		Without Project	With Project	Incremental Change			
2018	12.25	0.06	0.06	0.00	0.00	0.00	0.00
2019	24.50	0.06	0.06	0.00	0.01	0.15	0.00
2020	24.50	0.07	0.06	0.02	0.03	0.53	(0.01)
2021	20.42	0.06	0.06	0.00	0.07	1.31	(0.02)
2022	0.00	0.08	0.06	0.02	0.71	6.17	(0.33)
2023	0.00	0.06	0.06	0.00	1.02	8.85	(0.43)
2024	0.00	0.08	0.06	0.02	1.49	12.73	(0.53)
2025	0.00	0.06	0.06	0.00	2.00	17.01	(0.60)
2026	0.00	2.37	0.06	2.31	2.56	21.86	(0.64)
2027	0.00	0.61	0.06	0.55	1.66	14.14	(0.62)
2028	0.00	0.06	0.06	0.00	1.69	14.29	(0.66)
2029	0.00	0.06	0.06	0.00	1.88	15.75	(0.72)
2030	0.00	0.06	0.06	0.00	2.06	17.21	(0.77)
2031	0.00	0.06	0.06	0.00	2.26	18.72	(0.82)
2032	0.00	0.06	0.06	0.00	2.48	20.28	(0.86)
2033	0.00	0.06	0.06	0.00	2.72	22.00	(0.91)
2034	0.00	0.07	0.06	0.01	3.00	23.91	(0.95)
2035	0.00	2.36	0.06	2.30	3.26	25.68	(0.97)
2036	0.00	0.61	0.09	0.51	2.14	15.74	(0.89)
2037	0.00	0.06	0.06	0.00	2.00	14.18	(0.82)
2038	0.00	0.06	7.05	(6.99)	1.80	12.78	(0.59)
2039	0.00	0.06	0.06	0.00	2.73	22.81	(1.13)
2040	0.00	0.06	0.06	0.00	2.99	24.91	(1.19)
2041	(24.50)	0.06	0.06	0.00	3.27	27.24	(1.25)
	57.17	**7.21**	**8.46**	**(1.25)**	**43.83**	**358.25**	**(15.71)**
					EIRR	**15.4%**	
					NPV	**20.13**	

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost, VOT = value of time.
Source: Asian Development Bank estimates.

21. Sensitivity tests and calculations of switching values were carried out to determine the effect of variations in key input parameters on the key economic indicators (Table 7). Overall, the economic viability of the project was found to be robust against cost increases of up to 34% and decreases in VOC savings of up to 27%. One scenario considered the lack of timely provision of

maintenance funds (no preventive periodic maintenance), which would result in more rapid deterioration of the road surface quality and a lower residual value, thus tapering off benefits.

Table 7: Results of the Sensitivity Analysis

Scenario	NPV ($ million)	EIRR (%)	Switching Value (%)
Base case	20.13	15.4	
Construction cost: 10% increase	14.21	14.2	34
VOC savings: 10% reduction	12.69	14.2	(27)
VOT savings: 10% reduction	19.25	15.3	(225)
No preventive periodic maintenance	12.91	14.4	

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost, VOT = value of time.
Source: Asian Development Bank estimates.

F. Financial Analysis

22. The project is nonrevenue generating. Therefore, aspects of financial sustainability have been assessed from the viewpoint of the ability to ensure the upkeep of the assets created and improved under the project.

23. **Condition of the road network.** The road network under the MOT's jurisdiction (13,968 km) comprises 3,178 km of international roads (23%), 2,120 km of national roads (15%), and 8,670 km of local roads (62%). It is estimated that approximately 10%–15% of the road network (i.e., 1,500–2,000 km) connects the main cities and border crossing points and carries most of the road traffic. This portion forms the core highway network—critical to ensuring minimum accessibility and transit functions across the country—which has been substantially improved since 2000 with the financial support of various development partners.[8] However, the maintenance backlog in other parts of the road network remains acute.

24. **Road maintenance budget.** The nominal allocation for road maintenance nearly doubled from TJS30.3 million in 2009 to TJS60.2 million in 2017 (Table 8); this allocation covers routine and periodic maintenance of roads and structures under the MOT's jurisdiction. During 2009–2017, the compounded annual growth rate of the road maintenance budget was 9.2%, while the average annual inflation rate was 6.9%. It is estimated that about TJS20,000 per year per km is needed to cater for routine maintenance for a typical two-lane highway in Tajikistan. The annual routine maintenance requirements for international roads, like the project road, are therefore estimated at TJS64 million, which is close to the road maintenance budget allocated in 2017.

Table 8: Budgetary Allocation to the Road Sector, 2009–2017

Year	MOT Budget Share of the National Budget (%)	Road Maintenance Funding Share of MOT Budget (%)	Funds Allocated to Road Maintenance (TJS million)
2009	10.3	4.9	30.3
2010	9.8	5.3	34.0
2011	11.1	4.2	39.0
2012	8.6	5.0	46.8
2013	8.6	5.3	54.7

[8] Development Coordination (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).

2014	9.4	4.4	57.2
2015	6.2	6.2	59.6
2016	4.6	7.0	60.5
2017	7.2	4.3	60.2

MOT = Ministry of Transport.
Sources: Ministry of Finance; and MOT.

25. **Improving the overall road maintenance situation.** The MOT has initiated, with the World Bank's support, the development of a road asset management system (RAMS), which will help compare expenditures on road maintenance against the unconstrained requirements at the network level.[9] The proposed additional financing will support these efforts by building up the bridge module of the RAMS that will include a geo-referenced inventory of the main bridges of the highway network. Once the RAMS will be functional, the MOT will be in a better position to optimize the level and allocation of road maintenance funding in relation to medium- and long-term results on road conditions and road user costs. The RAMS will introduce a significant change from repairing as much damages as possible within an available yearly budget to maintaining a specified service level at the lowest cost based on roads' needs and functions. In addition, the proposed additional financing will help support the dialogue with MOT on expanding the revenue base for maintenance (e.g., through tolling of selected road sections).

26. **The project road.** The Dushanbe–Kurgonteppa road has been explicitly tagged as a priority investment in both the National Development Strategy and the CAREC Transport and Trade Facilitation Strategy 2020.[10] The project road is an important international highway that is amongst the 2-3 most travelled road countrywide (about 10,000 vehicles per day). The MOT has been maintaining the project road regularly to keep it in acceptable condition (IRI of about 4-5) as compared to the rest of the road network.

27. The government is committed to maintaining the project road and facilities at the required standard, as reflected in a specific covenant in the grant agreement.[11] The annual average incremental recurrent costs associated with the project are estimated to be about 0.8% of the overall road maintenance budget in 2017. It is therefore expected that adequate funding, ultimately based on the RAMS developed in conjunction with the project, will be allocated to the MOT to cover recurrent project costs.

[9] World Bank. 2015. *Project Appraisal Document for the Second Phase of the Central Asia Roads Links Program*. Washington, DC.

[10] Government of Tajikistan. 2017. *National Development Strategy of the Republic of Tajikistan for the Period up to 2030.* Dushanbe; and ADB. 2014. *CAREC Transport and Trade Facilitation Strategy 2020*. Manila.

[11] *Grant Agreement (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).*