ECONOMIC AND FINANCIAL ANALYSIS: SUBPROJECT 2

A. General

1. This document reappraises the proposed reconstruction and upgrade of an 87-kilometer (km) section of the A380 road from km 228 and km 315. The original appraisal was carried out in 2015; the estimated economic internal rate of return (EIRR) was 14.0%. Contract award under tranche 3 of the Second Central Asia Regional Economic Cooperation Corridor Road Investment Program.[1] was delayed and construction did not start until July 2020. Physical progress was 25% as of 31 October 2021. In view of the time that has elapsed since the original appraisal, the reappraisal considers the entire civil works project; disbursements since contract award in 2020 are not treated as sunk costs.

2. The section of the A380 road proposed for upgrade stretches northeast from the Bukhara ring road to Nukus, serving the small towns northwest of Bukhara for the first 25–30 km before entering an arid and sparsely populated area. The A380 is the main route between northwest and southeast Uzbekistan, serving transport demand in Central Asia Regional Economic Cooperation Corridor 2, which links Afghanistan, Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan, and the Russian Federation. Bukhara has a population of about 248,000 and lies at the junction of the A380 and the M37 east–west highway between Samarkand and the Turkmenistan border. The project road section, therefore, carries urban, suburban, long-distance, and international traffic.

3. The two-lane road is 11.6 meters (m) wide from km 228 to km 250 (the comparatively urban section near Bukhara city) and 7.9 m wide from km 250 to km 315.[2] No pavement condition data are available. A technical assistance consultant's report in 2010 refers to cracking, corrugation, ruts, and windblown sand on an adjacent section (km 315–km 322), and the 2015 appraisal refers to an international roughness index range of 4.6–6.6. Reappraisal conditions at the end of 2019 are assumed to be the same as the without-project conditions from km 964 to km 1,204 on the A380.[3] In the with-project scenario, the road will be replaced by a four-lane cement concrete pavement. Construction is expected to be complete by the end of 2024. In the without-project scenario, the road will continue to deteriorate.

B. Demand Estimate

4. Historic traffic estimates are taken from three sources: recent short-duration (1 day x 3 or 4 hours) classified counts undertaken by or on behalf of the Committee for Roads, estimate of 2013 traffic in the 2015 appraisal, and a 2017 estimate taken from the report and recommendation of the President for the A380 Karakalpakstan project (Table 1).

Table 1: Historic Motorized Traffic Estimates

Location	Date	Cars	Buses	LGVs	MGVs	HGVs	Truck-Trailers	AADT (vehicles/day)
Km 228–250	2013	4,273	1,167	539	1,298	1,215	578	9,070
Km 250–315	2013	1,784	469	269	967	984	718	5,191
Km 325	2017	1,542	67	86	220	459	329	2,703

[1] ADB. 2011. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility Republic of Uzbekistan: Second Central Asia Regional Economic Cooperation Corridor Road Investment Program.* Manila

[2] Kilometer 228 is just northwest of the Zakash river and the junction of the A380 and the Bukhara ring road.

[3] ADB. 2020. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Republic of Uzbekistan: Central Asia Regional Economic Cooperation Corridor 2 Karakalpakstan Road (A380 Kungrad to Daut-Ata Section) Project.* Manila.

Location	Date	Cars	Buses	LGVs	MGVs	HGVs	Truck-Trailers	AADT (vehicles/day)
Km 243	12.2020	15,216	1,204	988	1,235	533	39	19,215
Km 239	06.2021	10,202	1,023	1,947	4,775	3,977	443	22,367
Km 228–250	06.2021	14,664	289	285	1,001	985	423	17,648
Km 250–315	06.2021	10,902	269	182	573	1,276	495	13,697
Km 228–250	08.2021	15,999	267	358	1,026	918	543	19,111
Km 250–315	08.2021	11,453	248	338	963	910	534	14,446

AADT = annual average daily traffic, HGV = heavy goods vehicle (3-4 axle), km = kilometer, LGV = large goods vehicle, MGV = medium goods vehicle (2 axle).
Notes: 1. Motorcycle and nonmotorized traffic is excluded. 2. Agricultural tractors are included in the MGV totals.
Source: Asian Development Bank estimate based on Committee for Roads traffic counts.

5. An origin–destination survey was undertaken as part of studies for the separate Karakalpakstan road project. Only 12% of movements were local or transit, and the rest were international trips between Uzbekistan and its trading partners. This pattern is likely to apply to movements at the northwestern end of the A380 project road, while local trips are likely to dominate demand closer to Bukhara. Transit traffic cost savings should not be counted as project benefits; 22 truck-trailers per day were, therefore, deducted from base-year project road traffic.

6. The road is split into two sections for analysis: km 228–km 250 and km 250–km 315. Adopted 2021 traffic in Table 2 is taken as the average of the June and August 2021 estimates in Table 1. Traffic in 2020 (the reappraisal start year) is taken as 2% below that for 2021, in line with recorded gross domestic product (GDP) growth for that year.

Table 2: Adopted Traffic Estimates for 2020–2021

Section	Year	Cars	Buses	LGVs	MGVs	HGVs	Truck-Trailers	AADT (vehicles/day)
Km 228–250	2020	15,025	273	315	993	932	467	18,005
	2021	15,331	278	321	1,014	951	477	18,373
Km 250–315	2020	10,954	253	255	752	1,071	467	13,753
	2021	11,178	259	260	768	1,093	477	14,034

AADT = annual average daily traffic, HGV = heavy goods vehicle (3-4 axle), km = kilometer, LGV = large goods vehicle, MGV = medium goods vehicle (2 axle).
Note: Transit traffic has been deducted from truck-trailer traffic.
Source: Asian Development Bank estimates and traffic count data adjusted as described in the text.

7. The implied compound annual traffic growth rate from 2013 to 2021 for km 228–250 is 9.2% (for AADT), compared with GDP growth of 5.9%, implying income elasticity of 1.6.

8. The Committee for Roads local agencies collect traffic data annually on the main road network. They indicated an annual growth rate of 2.1% on the A380 Karakalpakstan project road section from 2015 to 2018. GDP growth over that period was 5.9%, implying an elasticity of 0.4. GDP growth has been strong, averaging 6% per year from 2011 to 2020. The Asian Development Bank (ADB) and the International Monetary Fund forecast growth rising from 5.0% in 2021 to 5.5% in 2026.

9. The future traffic growth rates proposed in Table 3 reflect continuing growth of car use in the built-up area around Bukhara but much lower goods vehicle growth rates in line with established patterns of growth on the A380 in Karakalpakstan. Assumed elasticities are more conservative than historic values for km 228–250. Growth is capped when traffic on the km 228–250 section reaches 40,000 vehicles/day in 2042, when congestion would be serious and the without-project scenario would no longer be viable. Table 3 growth rates average 3.0% per annum

over the entire evaluation period, lower than the 4.0% assumed in the initial appraisal for the entire evaluation period and slightly lower than the 3.3% assumed for subproject 2.

Table 3: Forecast Traffic Growth Rates

Period (Gross domestic product growth)	Traffic Growth Rate (Elasticity) (%)[a]		
	Cars	Buses	Goods Vehicles
2022–2030 (5.2%)	5.2 (1.0)	3.1 (0.6)	2.1 (0.4)
2031–2042 (5%)	3.5 (0.7)	2.0 (0.4)	1.5 (0.3)
From 2042	0.0	0.0	0.0

[a] Assumed income elasticity in parentheses.
Source: Asian Development Bank estimates.

10. No diverted traffic is expected. The project will make small reductions to perceived costs; generated traffic is therefore expected to be minor and has been excluded from the analysis.

C. Economic Costs

11. Project costs are composed of (i) capital investment, including works, land acquisition and resettlement, consulting services, and social safeguard management; and (ii) road maintenance.

12. There will be disruption during construction. The contractor proposes 12 detours around bridge and 24 km of temporary road widening. The cost of the disruption is based on changes in road user costs (RUCs). It is assumed that one-fifth of the total length is affected in every implementation year at an annual recurrent cost of $5m.

13. The amounts of existing contracts, signed in 2020, are indicative of financial costs at 2020 prices. They are converted to economic costs in line with ADB guidelines. All predicted project costs and benefits are measured in 2020 world economic prices, expressed in dollars. All non-traded costs and benefits are multiplied by the standard conversion factor, estimated at 0.99.[4] Traded items are multiplied by 1.0. A shadow wage rate factor of 0.8 was assumed and applied to unskilled labor.[5] Straight-line deprecation was used to estimate a residual value of 25%.

14. All land acquisition and compensation payments have been made and amount to a financial cost of $63,785 (less than 1% of project cost).

Table 4: Project Investment Costs

Intervention	Financial Cost, excluding Value-Added Tax ($ million)	Conversion Factor	Economic Cost ($ million)
Civil works	99.81[a]	0.99	99.18
Physical contingencies	9.98[a]	0.99	9.92
Consulting services	3.48	1.00	3.48
Project management unit	1.20	0.99	1.19
Land acquisition and resettlement	0.06	0.99	0.06
Totals	**114.53**		**113.83**
Total per kilometer of new road	**1.32**		**1.31**

[a] Treated as 32% non-tradable and allowing for 5% unskilled labor at a shadow wage rate factor of 0.8.
Source: Asian Development Bank estimates.

[4] Using the ADB simplified method, based on merchandise imports of $17.07 billion, exports of $12.17 billion, and taxes on trade of $419 million for 2017–2019 (World Bank Development Indicators). The local currency element of the works contract ($31.68 million) is treated as non-traded.

[5] An approximation based on the ratio of wages for agricultural workers and construction workers obtained through local enquiry.

15. Maintenance of the project concrete pavement is confined to routine maintenance at an economic cost of $2,000/km/year. The without-project scenario assumes initial remediation in the form of an overlay, followed by repairs (Table 5).

Table 5: Without-Project Maintenance Costs

Intervention	Economic Unit Cost	Intervention Criteria
Overlay (50 mm)	$20/m^2	Year = 2024 and then when IRI > 8
Pothole patching	$12/m^2	Potholes > 50/km, 80% patched, 6-month response
Crack sealing	$5/m^2	Every 2 years, 70% sealed
Off-carriageway maintenance	$2,000/km	Annually
Shoulder repairs	$12/m^2	Edge break > 1 m^2/km

IRI = international roughness index, km = kilometer, m = meter, mm = millimeter.
Source: Asian Development Bank estimates.

D. Economic Benefits

16. The main quantifiable economic benefits are vehicle operating cost (VOC) savings, savings in travel time, and reduced vehicle emissions. Road safety benefits have not been included for lack of data. Expected regional benefits include improved transport connectivity, increased trade, and increased investment opportunities resulting from improved road efficiency (reduced travel time and cost) in the project road sections.

17. **Vehicle operating cost savings.** To quantify savings, vehicle characteristics were estimated from available sources for 2020 and cross-checked against 2014 data.[6] Vehicle prices have risen in real terms since 2014, while wages have been reevaluated using recent statistical reports.

18. **Travel time cost savings** have been calculated based on values of time and HDM-4 vehicle speed relationships. Values of time for 2020 were assessed from Uzbekistan statistics for 2019, adjusted by the standard conversion factor and (for bus passengers) by the shadow wage rate factor (Table 6).[7] Nonworking time is valued at 30% of working time. Future values of time are assumed to grow at a real rate of 2.5% per year.[8] The shadow price of maintenance and crew labor is taken as lying midway between the values of car and bus working time, i.e., $1.40/hour.

Table 6: Adopted Values of Passenger Working and Nonworking Time

Vehicle Type	Value of Working Time ($/hour)	Value of Nonworking Time ($/hour)
Car and sport utility vehicle	1.60[a]	0.50
Bus	1.10[b]	0.30

[a] Based on the 2019 average monthly salary.
[b] Based on the occupational group with the lowest reported average salary (health-care workers).
Source: State Committee of the Republic of Uzbekistan on Statistics (2019).

19. Emissions are estimated from fuel consumption and valued using the recommended ADB unit carbon price of $43.20 per ton in 2020, increased thereafter by a real 2% per annum.

[6] PADECO. 2014. *Strategic Network Level Assessment Volume 2: HDM-4 Calibration. Prepared for Republican Road Fund under Loan No. 2635-UZB CAREC Corridor 2 Road Investment Program Project 1*. Tokyo.
[7] In constant dollar terms, wages have barely changed since 2019.
[8] The value of journey time savings is linked to wages. Wages may become decoupled from productivity. Future time values should be linked to expected growth in GDP per head with caution. The adopted rate of 2.5% is well below the historic growth rate of GDP per head, which averaged 4.2% from 2011 to 2020.

20. Observed vehicle operating speeds are not available. For the without-project scenario, HDM-4 predicts initial speeds of 60–65 km per hour (km/h), dropping to about 35–45 km/h at the end of the evaluation period. In the with-project case, speeds rise to 70–75 km/h and remain at that level. The expected journey time saving after the upgrade is about 12 minutes. VOC and journey time savings across the fleet over the evaluation period are summarized in Table 7.

Table 7: Vehicle Operating Cost and Journey Time Savings

	Without Project		With Project		Saving
Item	**IRI**	**$/vehicle-km**	**IRI**	**$/vehicle-km**	**$/vehicle-km**
Vehicle operating cost	5.4[a]	0.25	2.7[a]	0.21	0.04
Journey time cost		0.07		0.04	0.03

IRI = international roughness index.
[a] Average during 2025–2048.
Source: Asian Development Bank estimates.

E. Results of Economic Analysis

21. An economic analysis of the project was carried out according to ADB guidelines.[9] The analysis compared the benefits of reduced VOCs, travel times, and vehicle emissions with the initial investment costs and changes in operation and maintenance costs over a 29-year appraisal period (5 years of implementation and 24 years of operation).[10] Principal assumptions are summarized in Table 8.

Table 8: Principal Assumptions

Assumption	**Value**
Price base year	2020
Discount year	2020
Currency of analysis	US dollar
Construction start year	2020
Construction end year	2024
First year of benefits	2025
Appraisal period	23 years (operation) plus implementation period
Numeraire used	World price numeraire
Income elasticity of demand	Cars: 1.1 (2018)–0.8 (from 2029) Buses: 0.7 (2018)–0.4 (from 2029) Goods: 0.7 (2018)–0.6 (from 2029)
Value of time (working, 2020)	$1.60/hour (car passengers)–$1.10/hour (bus passengers)
Value of time (nonworking, 2020)	$0.50/hour (car)–$0.30/hour (bus passengers)
GDP growth assumption	2021 and 2022: 5.0% and 5.3% (ADO 2021) 2026: 5.5% (IMF, WEO 2021)
Shadow wage rate factor	0.8 (unskilled)
Standard conversion factor	0.99
Conversion factor applied to construction	0.99
Conversion factor applied to supervision	1.0
Conversion factor applied to taxes, duties, profits, transfers	0.0

ADO = Asian Development Outlook, GDP = gross domestic product, IMF = International Monetary Fund, WEO = World Economic Outlook (IMF publication).
Source: Asian Development Bank estimates.

22. The results of the economic analysis are summarized in Table 9. The project has an EIRR of 18.0% and is, therefore, economically viable. It is considerably higher than the EIRR at initial appraisal (14.0%) and arises from (i) lower initial costs ($114 million at 2020 prices compared

[9] ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.
[10] The operational period was chosen for consistency with the period adopted for the Surkhandarya Regional Road project.

with $204 million at 2014 prices) and (ii) higher transport demand (18,400 vehicles/day forecast in 2025 in this reappraisal compared with 12,700 vehicles/day).

Table 9: Results of Economic Analysis

Project Road	EIRR (%)	NPV ($ million)	Benefit–Cost Ratio
A380 (km 228–km 315)	18.0	245	3.4

EIRR = economic internal rate of return, km = kilometer, NPV = net present value.
Note: The NPV uses a 9% discount rate.
Source: Asian Development Bank estimates.

23. The results of a sensitivity analysis are in Table 10, and streams of costs and benefits are shown in Table 11. Base-year traffic is uncertain; the value tested as part of the sensitivity analysis assumes 2% annual growth from 2013 traffic in Table 1. However, even this particularly severe test delivered an EIRR slightly above 9%. In summary, project returns exceed the 9% threshold and the project remains economically viable.

Table 10: Sensitivity Analysis

Item	Change (%)	EIRR (%)	NPV ($ million)	Switching Value[a]
Base case		18.0	245	
VOC benefits	(20)	17.1	209	(100)
Journey time benefits	(20)	17.2	212	N/A[b]
VOC and journey time benefits[c]	(20)	16.2	177	(55)
Traffic growth rate	(20)	15.4	136	(60)
Base-year traffic	(40)	9.3	5.4	(42)

( ) = negative, EIRR = economic internal rate of return, N/A = not applicable, NPV = net present value, VOC = vehicle operation cost.
[a] The percentage by which costs or benefits need to change to give an EIRR of 9%.
[b] No positive value of benefits that will generate an EIRR of 9%.
[c] Both the change and the switching value apply equally to each parameter.
Source: Asian Development Bank estimates.

Table 11: Cost and Benefit Streams, 2020 World Prices
($ million, undiscounted)

	Costs		Benefits				
Year	Capital Works	Recurrent Works	VOC Savings	Journey Time Savings	Emission Reductions	Total Benefits	Net Benefits
2020	26.21[a]	5.00	0.00	0.00	0.00	0.00	(31.21)
2021	13.68[a]	5.00	0.00	0.00	0.00	0.00	(18.68)
2022	25.07[a]	5.00	0.00	0.00	0.00	0.00	(30.07)
2023	25.07[a]	5.00	0.00	0.00	0.00	0.00	(30.07)
2024	8.56[a]	5.00	0.00	0.00	0.00	0.00	(13.55)
2025	0.00	0.00	5.95	4.90	0.08	10.93	10.93
2030	0.00	0.00	14.05	9.99	0.29	24.33	24.33
2035	0.00	(0.34)	28.94	20.74	0.88	50.56	50.90
2040	0.00	(0.00)	60.72	55.13	2.68	118.53	118.53
2045	0.00	0.00	40.55	64.59	3.69	108.83	108.83
2048	(28.49)	0.00	44.10	70.27	3.98	118.34	146.83
					EIRR		**18.00%**
					NPV, 9%		**245.00**
					BCR		**3.40**

( ) = negative, BCR = benefit–cost ratio, EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost.
[a] Costs of disruption during construction are included.
Source: Asian Development Bank estimates.

FINANCIAL ANALYSIS

F. Scope

24. The project is nonrevenue generating. The objective of the analysis is to assess the Committee for Roads' capacity to meet the recurrent costs of operating and maintaining its network of 42,965 km of roads, of which 3,993 km (including the A380) are international, 14,203 km national, and 24,614 km local.

G. Unconstrained Operation and Maintenance Costs

25. Recent technical assistance estimated the unconstrained periodic and routine maintenance requirement for the entire Committee for Roads network at $366 million (at 2020 prices),[11] equivalent to SUM3,741 billion at 1 July 2020 exchange rates.[12] This is an estimate of the long-term requirement and excludes backlog. The unconstrained O&M cost per kilometer of international road ($20,100) is higher than the $16,000/km estimated for the project road under the without-project scenario, arising from differences in the timing of periodic maintenance.

Table 12: Estimates of Unconstrained Operation and Maintenance Costs
($ million)

	Network			Total
	International	National	Local	
Current repair (periodic maintenance)	66.9	113.7	97.7	278.3
Routine maintenance	5.0	12.2	17.0	34.2
Off-carriageway maintenance	4.0	10.6	12.3	26.9
Winter maintenance	4.0	10.6	12.3	26.9
Total	**79.9**	**147.1**	**139.3**	**366.3**
Network (km)	3,981	14,100	24,614	42,695
$/km	20,100	10,400	5,700	8,600

km = kilometer.
Source: Asian Development Bank estimates.

H. Execution and Shortfall

26. Committee for Roads historic executed budgets are shown in Table 13. In current terms, expenditure was close to being constant from 2016 to 2018 but has since fallen by about 35%.

Table 13: Actual Roads Expenditure, 2016–2020
(SUM billion)

Expenditure (Actual)	2016	2017	2018	2019	2020
Current repair (periodic maintenance)	403	560	1,062	748	676
Routine maintenance	182	223	390	355	486
Off-carriageway maintenance	7	10	109	85	99
Winter maintenance	24	38	34	39	64
Total (SUM billion)	616	831	1,595	1,227	1,326
Total ($ million)[a]	210	210	203	144	130
As $/kilometer	4,900	4,900	4,700	3,400	3,000

[a] At prevailing exchange rates on 1 July in each year.
Source: ADB. 2020. *Road Subsector Development Strategy and Action Plan: Technical Assistance Report*. Manila (TA-9987 UZB).

[11] Figures in this section are taken from ADB. 2021. *Technical Assistance to Uzbekistan for Road Finance and Asset Management. Draft Report*. Manila (TA-9987 UZB).
[12] The TA report converts the sum to dollar using 1 July exchange rates. The same approach is adopted here.

27. A comparison of Table 12 requirements with Table 13 expenditure gives an estimate of the shortfall in Table 14, which has risen from 43% in 2016 to 65% in 2020.

Table 14: Shortfall, 2016–2020

	2016	2017	2018	2019	2020
Unconstrained requirement (SUM billion)[a]	1,077	1,449	2,883	3,130	3,741
Expenditure (SUM billion)	616	831	1,595	1,227	1,326
Shortfall as % requirement	43%	43%	45%	61%	65%

[a] $366 million at prevailing exchange rate.
Source: ADB. 2020. *Road Subsector Development Strategy and Action Plan: Technical Assistance Report*. Manila (TA 9987-UZB).

I. Financial Sustainability

28. The project is expected to be completed in 2024. Comparisons of HDM-4 projections of with- and without-project maintenance expenditure show that the project road is expected to save about $1.1 million per year (or SUM15 billion at 2025 exchange rates), resulting in a modest reduction in total maintenance claims on the Committee for Roads budget (Table 15).

Table 15: Financial Sustainability with Project
(SUM billion)

Item	2020	2024	2025
	Without Project	Without Project	With Project
Actual and projected road maintenance expenditure	1,326	1,922	2,095
Unconstrained O&M requirement	3,741	5,424	5,897
O&M shortfall (to unconstrained O&M requirement)	65%	65%	64%
Inflation-linked increase in expenditure		596	173
Inflation-linked increase in O&M requirement		1,683	473
Incremental O&M requirement for project			(15)
Total increase in O&M requirement with project			458

O&M = operation and maintenance.
Assumptions: (i) Maintenance expenditure and O&M requirement increase from 2020 in line with inflation assumptions as follows: 12.9% (2020), 10% (2021), and 9% (2022–2025). (ii) The exchange rate moves to offset relative Uzbekistan–US inflation as follows: 10,600 (2021), 12,747 (2024), and 13,595 (2025).
Source: Asian Development Bank estimates.

29. To ensure project road financial sustainability, the Committee for Roads should obtain additional maintenance funding. The government's National Development Strategy 2017–2021 recognizes the importance of road infrastructure for developing economic competitiveness. Given the projected financing gap in road maintenance, the government should commit to increasing road maintenance expenditure expressed through a road policy directive.[13]

[13] Additional funding may be secured through either budgetary allocations or a dedicated road maintenance fund that will receive road user charges such as a fuel tax, fines, or tolls.