



Technical Assistance Consultant's Report

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Armenia: Preparing the North-South Road Corridor Development Project

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Asian Development Bank

**Asian Development Bank TA7208-ARM
Ministry of Transport and Communication
Republic of Armenia**

**Preparing the North-South Road Corridor
Development Project**

VOLUME I

MFF Framework

FINAL REPORT
May 2010



VOLUME I MFF FRAMEWORK

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ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
AC	Asphalt Concrete
ADB	Asian Development Bank
AGR	European Agreement on Main International Traffic Arteries
AMD	Armenian Dram
AP	Affected People
AR	Armenian Railways
ARD	Armenia Roads Directorate
ASIF	Armenia Social Investment Fund
BOQ	Bill of Quantities
DMS	Detailed Measurement Survey
EA	Executing Agency
EBRD	European Bank for Reconstruction and Development
ECRP	Emergency Contingency Response Plan
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EM	Environmental Manager
EMA	Emergency Management Agency
EMOP	Environmental Monitoring Plan
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
EO	Environmental Officer
ERT	Emergency Response Team
EU	European Union
GEF	Global Environment Facility
GDP	Gross Domestic Product
GoA	Government of Armenia
HDM	Highway Design Model
HH	Household
IDA	International Development Association
IDPR	Internally Displaced Persons and Refugees
IDPRDF	The Internally Displaced Persons and Refugees Development Framework
IDPRDP	Internally Displaced Persons and Refugees Development Plan
IDPRSA	Internally Displaced Persons and Refugees Specific Action
IEE	Initial Environmental Examination
IES	International Environmental Specialist
IFI	International Financial Institutions
IMF	International Monetary Fund
IRI	International Roughness Index
IRR	Internal Rate of Return
IT	Information Technology
IUCN	International Union for the Conservation of Nature
ILCS	Integrated Living Condition Survey
km	kilometer
kph	kilometer per hour
marz(es)	administrative region(s)
marzpet	Marz Governor
MCA	Millennium Challenge Account - Armenia
MCC	Millennium Challenge Corporation (USA)
MHPI	Modified Human Poverty Index
MDG	Millennium Development Goals

MFF	Multitranche Financing Facility
MM	Mitigation Measure
MNP	Ministry of Nature Protection
MOFE	Ministry of Finance and Economy
MOTC	Ministry of Transport and Communications
MTA	Ministry of Territorial Administration
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organization
NPE	Nature Protection Expertise
NRSC	National Road Safety Council
NSS RA	National Statistical Service of Republic of Armenia
OECD	Organization for Economic Co-operation and Development
PA	Protected Area
PIU	Project Implementation Unit
PMU	Project Management Unit
PPP	Public-Private Partnership
PPTA	Project Preparatory Technical Assistance
PRSP	Poverty Reduction Strategy Paper
RA	Armenian Government
RoA	Republic of Armenia
REC	Regional Environmental Centre (for Central and Eastern Europe)
ROW	Right-of-Way
RP	Resettlement Plans
RPF	Resettlement Policy Framework
RRC	Regional Resettlement Committee
RRSL	Rural Roads Sector Loan
RRSP	Rural Roads Sector Project
SE	Senior Engineer
SEEC	Department of State Environmental Expertise Commission
SEI	State Environmental Inspectorate
SIEE	Summary Initial Environmental Examination
SME	Small and Medium-sized Enterprise
SNCO	State Non-commercial Organization
SNP	Sevan National Park
SR	State Reservation
SSTA	Small Scale Technical Assistance
TA	Technical Assistance
TRACECA	Transport Corridor Europe Caucasus Asia
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCBD	United Nations Convention on Biological Diversity
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics (former)
WUA	Water Users' Association

EXECUTIVE SUMMARY

Study Background

1. The focus of the work under this Technical Assistance (TA) was: (i) to assist in preparing the Asian Development Bank (ADB) Multi-Tranche Financing Facility (MFF) for the development of the 556km North-South Road Corridor (NSRC), comprising the M-1 and M-2 from the Georgian border at Bavra to the Iranian border at Agarak; (ii) to undertake a feasibility study of MFF Tranche 1 project as per the RRP, September 2009; and (iii) to conduct a preliminary study of all other NSRC sections, in particular Ashtarak-Gyumri, which is expected to form the Tranche 2 project. Field work for the study was undertaken by the consultants from April–November 2009.

2. In addition to a road subsector roadmap, an investment plan, and draft framework documents for the MFF, the consultants work included cost estimates, contract packaging, an implementation schedule and arrangements, economic analysis, and social and environmental documents for the North-South Corridor projects. Annexes to the main report include survey data and the preliminary design for a possible 4-lane Tranche 2 improvement, including Drawings, Bill of Quantities, and Quantity of Work documents.

3. Overall guidance for TA implementation was provided by representatives of the Ministry of Economy (MOE) and the Ministry of Transport and Communication (MOTC). The consultants acknowledge the considerable support and assistance provided to them throughout their work by MOTC and ARD staff, and by the ADB Representative Office in Armenia.

Overview of the Road Sector

4. Day to day responsibility for interstate and republican roads is delegated by MOTC to ARD. The surface condition of the interstate network is reported as generally fair, with an average international roughness index (IRI) in 2008 of 4.9. An ARD sample survey of republican roads shows a worse picture, with an average IRI of 8.6 in 2008. This reflects the priority given in the allocation of rehabilitation and maintenance funding to the interstate network. Road safety is of serious and growing concern. There was a 57% increase in fatalities 2004–2008 and the death rate per 10,000 vehicles in 2008 was ten times as high as in the safest European countries.¹

The North-South Road Corridor (NSRC)

5. **Existing Situation:** The NSRC runs 556km from the border with Georgia at Bavra via Gyumri, Ashtarak, Yerevan, Goris, and Kapan, to the border with Iran at Meghri. It is 2-lane throughout, with the exception of an 18km length on the M-1 (Yerevan–Ashtarak) and the M-2 (Yerevan–Ararat section), which are dual 2-lane. In winter, snow disruption can occur at any time over the route passes and conditions are particularly severe in Shirak, north and south of Gyumri, where temperatures can be below –30C.

6. Internationally, the NSRC provides a transit corridor from Georgia to Iran. However, currently there is little transit traffic and potential is limited due to alternative routes through Azerbaijan and Turkey. The NSRC's strategic importance derives from Armenia's closed eastern and western borders as well as the Georgia–Russia border. In the south, the M-2 provides the only land connection with Iran (the rail link through Nakhichevan is closed). Most international freight transport is by rail and pipeline. Cross-border road freight traffic is relatively light and predominantly inbound. There is little long distance domestic road freight. Short haul freight is primarily of construction materials. Most international passenger traffic is by air. There are a few international bus services to Turkey, Iran and Georgia, and a rail link to Tbilisi. Most domestic public transport is by minibus and long distance taxi. There is little cross-border private transport, other than in summer to the Black Sea coast resorts.

7. Domestically, the NSRC serves multiple purposes: (i) providing two of the four main access routes to Yerevan, accommodating heavy local traffic for some 25km north and south of the city; (ii)

¹ The *National Road Safety Strategy for Armenia and Yerevan and Five Year Action Plan* was adopted by the Government in 2009.

the principal route between Yerevan and Gyumri; (iii) the main route for tourist traffic between Yerevan, Jermuk and Tatev; and (iv) for local traffic to Gyumri, Goris, Kapan and other towns en route. In terms of annual average daily traffic volume (AADT) on the NSRC, in 2005–2006 there was a growth of 12%, in 2006–2007 of 7%, but a decline of 5% 2007–2008.

8. **Improving the NSRC:** Under this TA, the consultants assessed several improvement options for road sections allocated under different tranches.

9. The figure opposite shows the sub project tranching, including Tranche 1 (as per ADB's Report and Recommendation of the President to the Board of Directors - Proposed Multi tranche Finance Facility and Administration of Cofinancing Republic of Armenia: North South Road Corridor Investment Program, ADB, September 2009) Yerevan – Ashtarak and Yerevan – Ararat; the candidate Tranche 2 Yerevan - Gyumri; in addition to candidate sub projects for further possible tranches.



Source: This Study, 2010

National Economy Considerations

NSRC development was proposed in the *Armenia Transport Sector Strategy 2020* (under TA4973-ARM, 2008). At the time of this study, it was envisaged that Armenia's economy would continue to grow strongly. Although the strategy's *Final Report, November 2008* did note that “contingency planning should start for a long and deep recession”, the depth of the depression during 2009 was not anticipated. Whilst the recorded growth in 2009 was -14.4%, the latest forecasts are more positive. In March 2010, IMF reviewed its growth forecast from 1.2% to 1.8% and the actual GDP growth for the first quarter accelerated to 5.5%. Since then due to high rates of economic growth over the first three months, the IMF has reviewed its forecasts and are predicting 4% GDP growth by end of 2010.

Feasibility of MFF Tranche 1

10. Tranche 1 project is defined as: (i) reconstruction to international standards of the existing 18.38 km dual two-lane Yerevan–Ashtarak section of the M-1, including improvement of the M-1/M-3 intersection; and (ii) improvement of traffic safety on the 37.97km Yerevan–Ararat section of the M-2.

11. **Traffic Analysis:** The consultants undertook classified traffic counts in May and July 2009 on the Tranche 1 section of the M-1 with a border crossing count at Bagratashen. The base year 2009 volume after seasonal adjustment and weighting of homogeneous sections (in addition to added traffic after repairs to the Bavra route) was calculated at 11,680 vehicles. The table below shows the traffic forecast for Tranche 1 taking into account traffic fleet growth and induced traffic.

Table 1: Tranche 1 Traffic Forecast

Section	2012	2015	2020	2025	2032
With project	13,060	17,110	24,490	36,660	65,605
Without project	13,060	15,550	22,270	33,330	59,641

Note: "With" case includes generated traffic.

Source: This Study, 2010

12. **Cost and Economic Analysis:** The consultants estimate the Tranche 1 construction cost to be US\$37.8m (excluding contingency and VAT). Economic benefits were calculated using the HDM4 model. The economic internal rate of return (EIRR) and the economic net present value (at a discount rate of 12%) were calculated by comparing the with-project and without-project scenarios for a 20-year period of project operation.² In the without-project case, surface condition is calculated within HDM4, based on typical maintenance of an interstate highway. Economic benefits accrue in the form of lower vehicle operating costs and road user time savings. The EIRR is 16.8%. The NPV for the Project is estimated at US\$12.4 million. The cost and benefit streams are shown in the Table below.

Table 2: Tranche 1 Construction Cost and EIRR

Location	Length (Km)	Economic Cost (\$ mil)	IRI	2009 AADT	EIRR	NPV (\$ mil)
Yerevan–Ashtarak	18.4	29.6	5.4	11,680	16.8	12.4

Source: This Study, 2010 and Asian Development Bank estimates

13. A sensitivity test of increasing cost by 20% would result in an EIRR of 14.9% and NPV of US\$8.9.

14. **Environmental and Resettlement Aspects:** The classification of the Tranche 1 Project for environmental impact is Category B and resettlement impact is Category C. All civil works will take place within the existing right-of-way or on unused state-owned land. No relocation of households or acquisition of productive land is expected, therefore, no Land Acquisition and Resettlement Plan for the Tranche 1 subproject is required. Also, the Tranche 1 project is classified for impact on indigenous people as Category C. While no LAR Impacts were observed, the consultants recommend that activity of fruit vendors along the highway should be considered for this subproject and others.

Feasibility of MFF Tranche 2

15. The candidate Tranche 2 M-1 Ashtarak–Gyumri (km29.9–118.3) is a continuation northwards from the end of Tranche 1 and is currently a single 2-lane carriageway. It runs through varied terrain: flat, rolling and mountainous. Steep gradients and sharp curves impede traffic flow on some sections.

16. **Improvement Options:** Based on engineering considerations the consultants considered five project options:

- Option 1: Widen to dual 2-lanes, construct new southbound carriageway and rehabilitate/reconstruct existing road as northbound carriageway.
- Option 2: Construct new 2-lane road, of design similar to southbound carriageway of Option 1. No upgrading of existing road. Both new and existing roads to operate with 2-way traffic. New road, access-controlled, for through traffic, existing road for local traffic.
- Option 3: Widen to dual 2-lanes through staged construction. In Stage 1, reconstruct existing road to the design of the northbound carriageway of a dual carriageway, providing advance earthworks etc. for the southbound carriageway. In Stage 2, when traffic growth necessitates, complete construction of southbound carriageway.
- Option 4: Rehabilitate/reconstruct existing road, with no provision for second carriageway.
- Option 5: Widen to dual 2-lanes on the Ashtarak–Talin Section and rehabilitate/reconstruct on the Talin–Gyumri section.

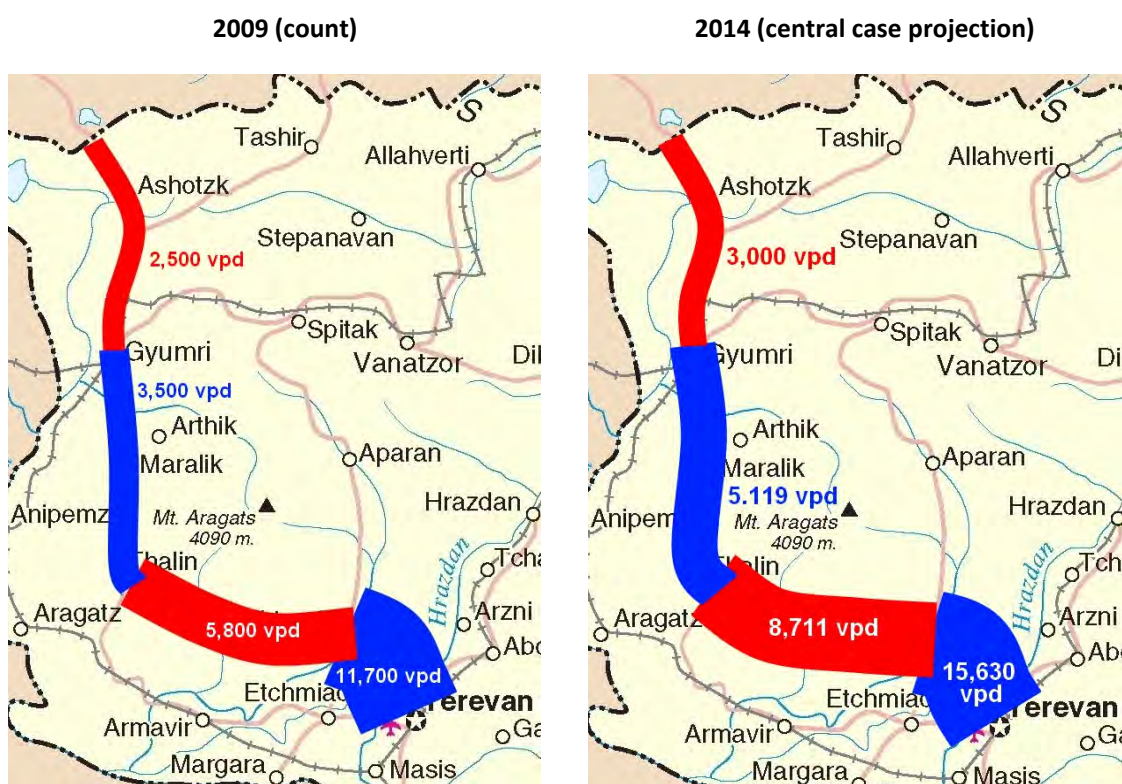
² Implementation was assumed to be in 2011-2012, with 40% of the cost incurred in 2011 and 60% in 2012.

17. **Traffic Analysis:** The consultants carried out classified traffic counts in May 2009. This was compared with ARD monthly counts. The base year 2009 volumes (including diverting traffic Bagratashen to Bavra) are: Ashtarak–Talin 5,820 and Talin–Gyumri 3,420. Annual traffic growth rates are assumed to be the same as for the adjoining Tranche 1 section assuming three scenarios of growth: low growth (6.6% 2009-2015 and 4.4% 2015+), central growth (8.4% 2009-2015 and 6.0% 2015+) and high growth (9.6% 2009-2015 and 7.2% 2015+). The resulting traffic volumes are shown in given in the Table and Figure below.

Table 3: Traffic Growth Forecasts (annual vehicles)

	Scenario 1 – Low				Scenario 2 – Central				Scenario 3 – High			
	2014	2020	2025	2032	2014	2020	2025	2032	2014	2020	2025	2032
Vehicles:												
Ashtarak–Talin	8,011	10,592	13,136	17,757	8,711	12,637	16,911	25,427	9,204	14,281	20,218	32,893
Talin–Gyumri	4,708	6,224	7,719	10,435	5,119	7,426	9,937	14,942	5,409	8,392	11,881	19,329

Source: This Study, 2010.



18. **Costs Estimate:** The table below compares the costs of the 5 options.³ The construction cost per km (including VAT but excluding land) ranges from US\$1.0 to US\$2.6 million.

³ Options 2-5 have been estimated by factoring of the Option 1 cost items.

Table 4: Tranche 2 Cost Comparison of Options

Item	Cost for Option (\$ million)				
	1	2	3	4	5
Earthworks	43.7	24.1	40.2	20.1	26.6
Road Pavement	83.6	66.5	0.0	0.0	27.4
Shoulder	10.4	7.5	7.5	7.5	8.7
Furniture	13.0	9.3	9.3	9.3	9.8
Drainage	12.5	8.3	8.3	8.3	8.6
Structures	5.5	3.9	5.2	3.9	4.1
Construction cost	167.6	120.6	85.7	63.4	97.7
Contingencies @10%	16.8	12.0	8.5	6.4	9.8
Design/Supervision @ 5%	8.4	6.1	4.3	3.1	4.9
Cost before VAT	192.8	138.6	98.4	73.0	112.4
VAT @ 20%	38.5	27.7	19.7	14.6	22.5
Construction Cost Incl. VAT	231.3	166.3	118.2	87.5	134.9
Land Cost	1.5	1.5	1.5	0	0.75
Total	232.8	167.8	119.7	87.5	135.7
Cost/Km	2.6	1.9	1.4	1.0	1.5
<i>Option 1: widen to dual 2-lanes; new southbound carriageway; existing road northbound.</i>					
<i>Option 2: new 2-lane road; new road (through traffic), old road (local traffic) are both 2-way.</i>					
<i>Option 3: Stage 1, reconstruct existing road northbound design, plus advance earthworks for southbound; Stage 2, complete construction of southbound according to traffic growth.</i>					
<i>Option 4: rehabilitate existing road.</i>					
<i>Option 5: Widen Ashtarak–Talin and rehabilitate Talin–Gyumri</i>					

Source: This Study, 2010

19. **Economic Analysis:** For each option, the Consultants tested three scenarios (Low, Central, and High cases), which uses traffic growth forecasts based on the growth assumptions presented in ADB's Report and Recommendation of the President to the Board of Directors – *Proposed Multitranchise Finance Facility and Administration of Cofinancing Republic of Armenia: North South Road Corridor Investment Program, ADB September 2009*⁴, which in turn uses forecasts in car ownership from a Millennium Challenge Corporation Study in 2007 as a proxy for growth.⁵ The aforementioned ADB Report includes economic analysis of the Tranche 1 Project. Traffic growth over the period to 2032 is based on the International Monetary Fund (IMF) June forecast for Armenia of 1.3% in 2010, 3.5% in 2011, and 4.5% per annum in 2012–2014. A GDP growth rate of 6.0% was assumed for 2014–2020 and 7.0% for 2020–2032. The average elasticity of traffic growth to GDP was taken as 1.2.

20. The table below summarizes the cash flows and EIRRs for each option under three economic growth scenarios.

Table 5: Tranche 2 EIRR Results by Option

Option	Cost (\$m)	EIRR		
		Low	Central	High
1	194.23	12.4%	15.5%	17.4%
2	140.11	13.2%	16.3%	18.3%
3	99.98	12.9%	15.5%	17.6%
4	72.96	5.6%	Negative	Negative
5	148.88	13.1%	15.0%	17.1%

Source: This Study, 2010

⁴ <http://www.adb.org/Documents/RRPs/ARM/42145-ARM-RRP.pdf>, p.26 in Appendix 2.

⁵ The MCC Study used gross domestic product (GDP) per capita and income elasticity of demand to forecast growth in car ownership. An elasticity of 1.1-1.2 was assumed and the car ownership of 80 per 1,000 population would increase to 344 by 2026.

21. For most options for each scenario, the figures for EIRR exceed 12%. Regarding Option 4, the EIRR is positive for lower traffic, however, negative figures were estimated for the higher scenarios as road deterioration progressed to a greater extent than the base case and travel speed and VOC became larger than the base case.

22. **Highway Design of Option 1:** At the request of ADB/MOTC in July 2009, the consultants prepared preliminary designs and a preliminary LARP for the Option 1 dual 2-lane option. The design follows the existing alignment except where necessary to accord with Category I geometric standard; improve the Mastara–Maralik alignment; and mitigate resettlement and environmental impact at Agarak–Ujan. In most sections, widening is to either side of the present road. The existing carriageway will require rehabilitation to replace failed surfacing and to protect the integrity of the pavement structure. The consultants fully prepared preliminary design drawings, the bill of quantities, and quantity of works for this Option.

23. **Environmental and Social Aspects:** The candidate Tranche 2 project between Ashtarak and Gyumri is classified as Category A with significant adverse environmental impact. Land acquisition for Option 1 assuming a 20m wide COI is estimated at 2,477,000 sqm, of which pasture land represents the largest area at 52% whilst 5% is residential. The land cost is estimated at US\$1.5m. A draft IEE was prepared by the consultants and submitted to ADB in July 2000. One of the main features was identification of archaeological and cultural heritage sites along the proposed alignment, though the exact locations and nature are not fully documented. Due to this issue in combination with the scale of providing a 4-lane project, a full EIA is required.⁶ Although the LARP for the candidate Tranche 2 will be finalized after detailed design, the consultants conducted a Detailed Measurement Survey (DMS), Socio-economic Survey (SES), and Valuation Survey and prepared a preliminary LARP based on the preliminary design for Option 1 between Ashtarak and Gyumri.

Feasibility of other MFF Tranches

24. Subsequent candidate MFF tranches were reviewed and briefly summarized in the table and paragraphs that follow.

Table 6: MFF Subsequent Tranches

Section	Standard	Length km	Preliminary Environmental and Resettlement Impacts	Cost (\$ million)			
				Const- ruction	VAT (20%)	Contin- gency	Total
M-1 Gyumri (Keti)– Bavra	Category I Case: 2-lane	38	Category: B, Proposed improvement of existing road, with lower impact of LARP, except at Ashotsk.	48	10	5	63
	Case: 2x2 lane			79	16	8	103
Gyumri Bypass	Category I* Case: 2-lane (embankment: for 2x2 lane)	19.5	Category: A Proposed alignment between M-2 and M-7 uses existing embankment, with lower impact of LARP. M-7 to Keti section needs land acquisition.	49	10	5	64
	Case: 2x2 lane			72	14	7	93
M-1 Ashtarak –Gyumri	Category I* 2x2 lane (without interchanges)	88	Category: B Initial survey indicates about 32,000 sqm. of land to be acquired, of which 75% is community land and pasture.	176	35	18	229
Yerevan Western Bypass	Category I* 2x2 lane	19.5	Category: A Proposed bypass passes through a thickly settled area and needs land acquisition and resettlement.	83	17	8	108
M-2 Ararat– Yerask	Category I* 2x2 lane	19.5	Category: B Proposed improvement is construction of bypass, with lower impact of LARP.	50	10	5	65
M-2 Goris– Kapan	Category II 2-lane	64	Category: A Bio-diverse and ecologically sensitive area,	164	33	16	213

⁶ ADB agreed to implement a full Environmental Impact Assessment (EIA).

Section	Standard	Length km	Preliminary Environmental and Resettlement Impacts	Cost (\$ million)			Total
				Const- ruction	VAT (20%)	Contin- gency	
(Alterna- tive to M-2)			Less Impacts of land and resettlement, most of the road alignment will pass through forest and mountain area.				
Total		248.5		570	115	57	742
				624	125	62	811

Source: This Study, 2010

25. **Bavra–Keti:** Future traffic volume of this section is uncertain. Currently there is little, mostly local area, cross-border traffic at Bavra and if the Turkish border were to open, most of this traffic would transfer to the border crossing at Gyumri. From a capacity standpoint, the existing road will provide for long term needs. The section could be improved on the existing alignment, with realignment where necessary.

26. **Gyumri Eastern Bypass:** Construction of an eastern bypass was abandoned in 1991. There are several development options with the key issue being the extent of diversion. A feasibility study should consider providing a dual 2-lane in the long term with initial operation as single 2-lane.

27. **Yerevan Western Bypasses:** The Western Outer Bypass is a high cost project, which is unlikely to be needed for many years, once the Western Inner Bypass is completed. Its development would also have a high social and resettlement impact. It is recommended that no immediate action is required, other than possibly protecting the alignment.

28. **Ararat–Yeraskhavan:** Widening of this section, which begins at the end of the dual carriageway, would complete a dual carriageway to within 1km of the Azerbaijan border. Of the 19.5km length, 15km is through the heavily built-up area of Surenavan and Armash, where widening is impractical, requiring a splitting a new northbound carriageway bypass. Widening is likely to be justified on capacity grounds at some stage during the 2020s.

29. **Yeraskhavan-H46 Goris Junction:** Some stretches are in poor condition and were identified for priority improvement under a proposed World Bank project. However, the World Bank project is unconfirmed and may also be considered for implementation under the MFF.

30. **H46 Goris-H46 Kapan Junction:** This section has a high landslide incidence. Accidents on the mountainous sections as well as winter storms can close the route. Provision of an alternative is desirable on strategic grounds: There are four development options: (i) improve the M-2 route, with H-46 rehabilitated primarily for tourist use, but also as an emergency alternative to M-2; (ii) upgrade H-46 to form the NSRC; (iii) as (ii) south of Tatev, with a new tunnel route Sisian–Tatev; and (iv) as (ii) south of Tatev, with a new non-tunnel route Sisian–Tatev.

31. **H46 Kapan Junction–Iran Border:** Having built this alternative route to the M-2, it is appropriate to make use of it. This can best be accomplished by routing northbound through traffic (the loaded direction for trucks) onto the new route, with southbound traffic remaining on the M-2.

Procurement Process

32. Under this TA, the consultants prepared the following documents for the project's procurement process: (i) Tranche 1: TOR for Detailed Design / TOR for Pavement Design Specialist / Invitation / Pre-Qualification Document for the Construction Works; (ii) Tranches 1,2,3: TOR for construction supervision of Tranche 1 and Detailed Design of Tranches 2 and 3.

Summary of Issues

33. **Economic Viability of Tranche 2:** It is strategically desirable to upgrade the NSRC to a uniform international standard, but due to adverse topography, economic depression, and low traffic volume (currently averaging 4,620 with 90% light vehicles), all of which impact on costs and economic

returns, improvements to the NSRC require careful decision.⁷ Options 2 and 5 show the highest EIRR values. Due to economic uncertainty, caution is advised over recommending options based on the higher growth scenarios. Option 4 (rehabilitation) is not a recommended solution for the long term road strategy as benefits are realized relatively quickly and then deteriorate.

34. **Land and Resettlement:** The Consultants produced a preliminary LARP for Tranche 2. The final LARP should be completed by the EA with full consultation, once a notification decree is passed. The Tranche 1 Supervising Consultants, who will, among other tasks outlined in an updated Tranche 2 LARF presently under Government review, carry out with the EA the legal DMS, based on the accepted DD.

35. **Environmental Concerns:** ADB classified the Tranche 2 alignment as Category A with significant adverse impacts based on the widening of the 2-lane road section to 4 lanes. Later, the consultants also found evidence of archaeological and cultural heritage sites along the 4-lane improvement alignment, which need to be further identified and located. The consultants recommended to ADB that supplementary in-depth assessment be undertaken.

36. **Utility Apparatus:** Although aboveground facilities were identified by the consultants' Detailed Measurement Survey (DMS), there are many underground utilities along the candidate Tranche 2 alignment. The consultants recommend that the Government provides appropriate information.

⁷ In 2008, when Armenia's transport sector strategy was prepared, it was envisaged that widening to dual 2-lanes would be feasible in the short to medium term, at least south of Talin.

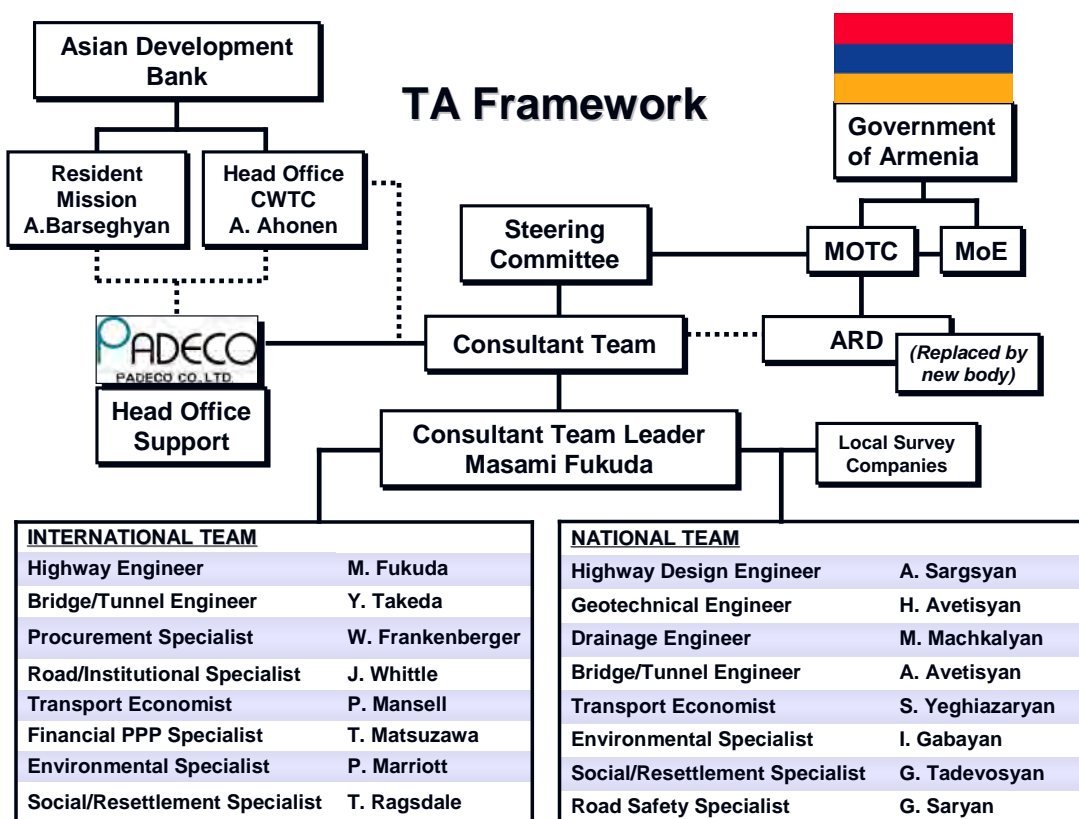
SECTION 1 INTRODUCTION

1.1 Study Background

1. This Technical Assistance included: (i) assistance with the preparation of the proposed Asian Development Bank (ADB) Multi-Tranche Financing Facility (MFF) for the improvement of the North–South Corridor; (ii) a feasibility study of the MFF Tranche 1 project¹; (iii) a pre-feasibility study of a candidate Tranche 2 Project; and (iii) a preliminary study of improvements to other sections of the North–South Corridor as candidate Tranche 3 Project.

2. The objective of the proposed MFF is to provide a high-quality North–South Road Corridor (NSRC) from the Georgian border to the Iranian border. The Bavra–Gyumri–Yerevan–Goris–Kapan–Agarak route will, after the improvement of adjoining sections in Georgia in 2010, provide the principal connection to the Black Sea ports of Poti and Batumi, and route for transit traffic to Turkey.

3. Figure 1-1 shows the organizational framework for this TA. The Consultant comprised both an international team and a national team of experts.²



Source: This Study, 2010

Figure 1-1 TA Organization

¹ As outlined in the Report and Recommendation of the President to the Board of Directors (RRP), September 2009.

² See Annex 1 Appendix 15 for a list of Project Stakeholders.

4. Overall guidance for TA implementation was provided representatives of the Ministry of Economy (MOE) and the Ministry of Transport and Communication (MOTC).

5. The Tranche 1 project was defined and approved by ADB and the Government of Armenia earlier this year. At the request of ADB/MOTC in July 2009, the consultants have prepared preliminary designs (see Annex 3 to this report) and are preparing a Land Acquisition and Resettlement Plan (LARP) for the candidate Tranche 2 road project from Ashtarak – Gyumri. Due to potential concerns regarding the economic feasibility of this proposed Tranche 2 project, this report also presents other options.

6. In addition to the road subsector roadmap, an investment plan, and draft framework documents for the MFF, this Report includes cost estimates, contract packaging, an implementation schedule and arrangements, economic analysis, and social and environmental documents for the North–South Corridor projects. The Appendices include survey and investigation material as well as all other data collected.

1.2 Report Structure

7. This Report consists of five (5) Volumes. The main volumes of the Report are structured to contain Section headings for the main topics of investigation. Introductions are provided to explain the approach to the tasks carried out under this project.

8. Volume 1: MFF Framework: This volume provides context to the N–S corridor by describing key and relevant features of Armenia. Following this Section 1 introduction, Section 2 provides an overview of the Armenian economy and main events that have shaped the country as well as socio economic indicators and trade flows. Section 3 provides the perspective of the N–S corridor in terms of sub regional transport including different modalities and their prospects, as well as the status of country borders, which are crucial to trade and transport patterns. Section 4 describes the Armenian road sector, at first generally, including institutional challenges, before focusing on the North–South Corridor itself. In this Section the concept of PPP is introduced and its potential for the N–S Corridor is assessed.

9. Volume 2: Tranche 1 Preparation: This volume focuses on Tranche 1 comprising two road sub projects: reconstructing the dual 2-lane section of the M-1 Yerevan–Ashtarak (18.38km) and improving the M-1/M-3 intersection to internationally acceptable standards; and (ii) improve traffic safety measures on the dual 2-lane M-2 section Yerevan–Ararat (37.97km). The Sections outline the Consultants approach to engineering considerations, traffic and economic analysis, in addition to the implementation schedule, arrangement and procurement plan (which also includes adjoining components for Tranche 2).

10. Volume 3: Tranche 2 Preparation: This volume describes the results of activities in preparation of the candidate Tranche 2. Section 1 introduces five possible options for an improvement to the Ashtarak–Gyumri road sub project. The options are assessed from engineering, technical, cost, and economic considerations. The preliminary design for the first option (widening to dual carriageway) is presented.

11. Volume 4: This volume describes the results of preliminary investigations of sub projects for further possible tranches on the N–S Corridor. Each sub project is presented with a general description, as well as the development strategy, and cost estimates.

12. Volume 5: Annexes: This volume comprises the annexes to the Report, which also included appendices within each annex. Annex 1 contains general appendices including traffic survey data, environmental/social documents and an overview of the 4-lane Tranche 2 design. Annex 2 includes documents related to procurement. Finally, Annex 3 is comprised of the preliminary design for the candidate 4-lane Tranche 2 improvement, including Drawings, Bill of Quantities, and Quantity of Work documents.

SECTION 2 NATIONAL ECONOMY

2.1 Introduction

13. This section describes the national economy of Armenia including major events in economic development, trade patterns, as well as comments on economic forecast, which impact on the evaluation of the major road corridor investment. High economic growth during the first part of the decade is noted, before more turbulent times and economic collapse, from which the country is only recently achieving positive growth. The vulnerability of the economy is highlighted, arising from factors such as reliance on remittances, trade imbalances, border closures and uncertainties, indicating the need for stability and an enabling environment for trade and economic growth. Whilst data on factors that shape economic development are made, the Consultants refrain from making national economic projections due to the uncertainty of the mentioned factors and the only recent emergence from economic crisis.

2.2 Economic Development

14. **Post-Independence recovery:** The break-up of the Soviet Union in 1991 and independence was a profound economic shock, while still recovering from the devastating Spitak/Gyumri earthquake of December 1988 (this killed 0.8% of the population and left 15% homeless). GDP declined by 65% 1989–1993. There was mass emigration (some 15% of the population 1992–1994) and runaway inflation. An impressive economic recovery began in 1993, with average annual GDP growth 1993–2000 of 5.4%. Double-digit GDP growth was achieved 2002–2007 (Table 2-1). GDP per capita in US dollars quintupled 2001–2008, a combination of Armenian Dram (AMD) appreciation and high economic growth.

15. Real pre-independence GDP was surpassed in 2004, but the economy remained vulnerable and this vulnerability has been seen in the 2009 recession: (i) all fuel is imported; (ii) remittances from the diaspora, largely based in the Russian Federation and in the US, and external assistance are essential to finance the large trade imbalance; and (iii) investment in the 2001–2008 boom focused largely on a single sector, property, which is suffering severely from lower private sector inflows. The world recession began to impact in the second half of 2008, reducing GDP growth to 6.8%.

Table 2-1: GDP 2001–2008

Item	2001	2002	2003	2004	2005	2006	2007	2008
GDP growth rate %	9.6	13.2	14.0	10.5	13.9	13.2	13.7	6.8
GDP/Capita \$	659	740	874	1,112	1,523	1,982	2,853	3,684
GDP/Capita AMD '000	366	424	506	594	697	827	976	1,127
Exchange rate AMD/\$	555	573	579	533	458	416	342	306
CPI %		1.1	4.7	7.0	0.6	2.9	4.4	9.0

AMD = Armenian Dram, CPI = consumer price index, GDP = Gross Domestic Product, Sources: Asian Development Outlook 2009 and IMF.

Source: This Study, 2010

16. **Turbulent 2008:** The year 2008 was a time of geopolitical disturbance in the Caucasus and the start of extreme financial and economic turbulence worldwide. Events included: (i) the Georgia–Russia war, resulting in the *de facto* independence of South Ossetia and Abkhazia, temporary closure of the railway to the key Black Sea ports of Poti and Batumi, disrupting Armenia’s international trade; (ii) oil price variability, from near \$150/barrel in June to under \$45/barrel in November; (iii) the first visit of a Turkish president to Armenia (football diplomacy); (iv) Armenian Railways operating concession to a subsidiary of Russian Railways; (v) the seizing up of international credit markets and the world banking system; (vi) the collapse, merger and bailout of major banks, investment banks and

insurance companies; (vii) until that point, the biggest ever one-day point decline in the Dow Jones Industrial Index (28 September) and in the FTSE100 (6 October); (viii) near bankruptcy of Iceland with knock-on doubts about the financial strength of many other countries; and (ix) the start of a worldwide recession. Armenia's major trading partner Russia was particularly affected by the fluctuations in energy prices.

17. **Economic troubles in 2009:** Armenia has been affected by the international economic recession, which impacted it through: (i) a decline in remittance income from Russia and the US; (ii) a fall in property prices and a collapse of sector investment; and (iii) a fall in exports. In the *ADB Asian Development Outlook 2009* (based on data available in March 2009) Armenia's GDP was forecast to increase by 0.5% in 2009. The deviation from the forecast GDP, within the year of the forecast, is unprecedented and illustrates both the sudden onset and unexpected depth of the depression.

18. **Budget impact:** The Medium Term Expenditure Framework 2009–2011 planned for an increase in budgetary support for roads (Table 2-2). As a result of the economic depression, the MTEF has been scrapped and budgets are being set on a short timeframe. As in many countries, the 2009 budget is under strain, with a budget deficit of 7.5% of GDP expected, financed through ADB, IMF and World Bank special provisions and a loan from the Russian Federation. Clearly, providing an adequate budget for roads in the short to medium term will be a challenge. The draft 2010 budget cuts MOTC expenditure for capital repair by 89% compared with that planned in the MTEF and by 85% compared with expected outturn spending in 2009. Budget expenditure in 2010 is expected to be AMD8.79 billion, a reduction of 56% on that in 2008. In dollar terms, the decline is 66%, with the added factor of depreciation. Foreign funding will need to be used effectively to compensate for the decline in domestic funding.

Table 2-2: MOTC Road Budget 2006–2010
(AMD billion)

Item	2006	2007	2008	2009 Expected	2010 MTEF	2010 Draft
Capital repair of roads	11.93	13.60	12.66	13.27	17.95	2.00
Operation and maintenance	5.02	5.99	6.19	6.30	7.36	6.29
Capital repair of structures	0.55	0.45	1.10	0.50	0.50	0.50
Total AMD billion	17.50	20.04	19.95	20.07	25.81	8.79
Total \$ million	42.1	56.1	66.1	55.0	66.2	22.5

Source: MOTC/MOF

2.3 Economic Forecast

19. Whilst the recorded GDP growth in 2009 was -14.4%, the latest forecasts are more positive. In March, IMF reviewed its growth forecast from 1.2% to 1.8% and the actual GDP growth for the first quarter accelerated to 5.5%. Since then due to high rates of economic growth over the first three months, the IMF has reviewed its forecasts and are predicting 4% GDP growth by end of 2010. The following paragraphs provide comment on medium and long term economic forecasts, which help substantiate future traffic growth provide later in this report.

20. **Medium term forecast:** The IMF forecast is for a gradual recovery in GDP 2010–2014 (Table 2-3). However, Dram GDP in 2014 is still expected to be 1% below that of 2008. Dollar per capita income in 2014 is forecast to be 13% lower than in 2008, as a result of the devaluation of the Dram and the slow recovery.

21. The cumulative impact of the recession compared with the PRSP-2 forecast, the basis for the development of the *Armenia Transport Sector Strategy 2020*, is illustrated in Table 2-3. In 2014, Dram GDP is forecast to be 37% of that in the PRSP-2 scenario. The

impact on road transport use may be even greater, as demand elasticity to GDP is generally greater than 1. Assuming an overall elasticity of 1.2, road transport volume in 2014 would be 44% less than if PRSP-2 had been realized. There will be a lag in the impact on traffic volume: it does not fall directly in line with GDP, the impact is realized over time. Comparing 2008 with 2009 is affected by the large change in fuel prices. The initial impact of the depression, however, is apparent in vehicle imports, which for January–September 2009 declined by 58% over the same period of 2008 (Table 2-4). A low import volume is likely to persist for some time and the vehicle fleet will show both accelerated aging and an actual decline, as scrapped vehicles are not replaced.

22. **Long term prospects:** No economic forecasts beyond 2014 have been made since the start of the depression. Whilst short to medium growth is highly dependent on the level of remittances, long term prospects depend on future international circumstances. There is potential for the agricultural sector to grow particularly following the recent opening of the Russia–Georgia border, which had resulted in a reduction in export of agricultural produce as traders were forced to re-route supplies to relatively expensive rail-ferry services. A World Bank study published in 2001 found that opening of borders with both Turkey and Azerbaijan could lead to a reduction in Armenia’s trade deficit by a third to half and increase in GDP by 30 percent (Evgeny Polyakov, World Bank, “Changing Trade Patterns after Conflict Resolution in the South Caucasus”, *World Bank Policy Research Working Paper No. 2593*, April 2001). It is generally recognised that oligopolistic and monopolistic practices are constraining economic development, so that political will for reform in the long term is a feasible prospect.

23. For developing traffic growth rates, an average annual GDP growth of 5.0% 2014–2020 and 6.0% from 2020 is assumed. Significantly higher growth rates are unlikely unless there is border opening (section 2.3). Clearly, growth would be much slower in adverse circumstances.

Table 2-3: Impact of Recession 2008–2014

Item	2008	2009	2010	2011	2012	2013	2014	2015
GDP change in %:								
PRSP-2 2008	10.0	9.5	8.5	7.5	6.0	6.0	6.0	--
IMF in AMD	6.8	-14.4	1.8	3.0	3.5	4.0	4.5	4.5
Per capita GDP, current \$	3,685	2,668	2,506	2,492	2,555	2,663	2,818	2,981
GDP Index 2007 = 100:								
PRSP-2	110.0	120.5	130.7	140.5	148.9	157.9	167.3	--
IMF	106.8	91.4	93.1	95.9	99.2	103.2	107.8	112.7
IMF/PRSP-2 % change	-2.9	-24.1	-28.8	-31.8	-33.4	-34.6	-35.6	--
GDP Elasticity 1.2 in %	-3.5	-28.9	-34.5	-38.1	-40.1	-41.6	-42.7	--

Sources: IMF, World Economic Outlook Database and the Consultants.

Table 2-4: Vehicle Imports 2008–2009

	January–Sept. 2008		Total 2008		January–Sept. 2009	
	No.	Duty paid*	No.	Duty paid*	No.	Duty paid*
Total	30,641	34,056	41,926	46,723	12,868	15,384
Price (\$'000)						
0 – 5			10,314		4,037	
5 – 10			16,428		4,630	
10 – 15			5,746		1,612	
15 – 30			6,773		1,808	
30+			2,665		781	

Note: * AMD million

Source: This Study, 2010

2.4 Population

24. **Static population:** Population changes have a long term impact on traffic volume, as older people tend to make less trips. The population saw little change 2002–2008, within the range 3.21–3.23 million (see Table 2-5). Almost two-thirds live in urban areas. The birth rate is currently below replacement level and the below working age cohort is gradually declining. A slow decline in population is expected over the next few years, with a more marked decline in the 2020s, if the low birth rate persists. The recession has, however, resulted in the return of many migrant workers in 2009, increasing the resident population, although perhaps temporarily. The economically active share of the population is relatively low, 36% in 2007, and declining. Most activity is in agriculture.

Table 2-5: Population 2002–2008

Item	2002	2003	2004	2005	2006	2007	2008
Total ('000)	3,210	3,212	3,216	3,220	3,223	3,230	3,238
Of which: Urban (%)	64.2	64.2	64.1	64.1	64.1	64.1	64.0
Rural (%)	35.8	35.8	35.9	35.9	35.9	35.9	36.0
Below working age (%)	25.4	24.5	23.6	22.7	21.7	–	20.2
Economically active (%)	38.6	38.4	37.2	37.1	37.3	36.2	–
Of which: in farming (%)	39.7	40.9	41.9	42.0	41.8	–	–

Source: Statistical Yearbook of Armenia 2009.

2.5 Trade and Exchange Rates

25. **Fluctuating exchange rate:** The Dram was introduced in November 1993. Consumer prices rose by 1884% in 1994, before stabilizing in 1995. The AMD was one of the world's strongest currencies 2003–2008, rising to 307 to the dollar, from 579 in 2003. The Government pursued a strong Dram policy to contain inflation. This ended with the Dram float on 3 March 2009. As of end-November 2009, the Dram was 388 to the dollar, a devaluation of 26%.

26. **Trade imbalance:** The value of merchandise exports increased by 49% 2004–2008 and imports by 214%. For January–September 2009, the value of imports was 468% that of exports, compared with 162% of exports in 2004. Both imports and exports have fallen sharply in 2009 (Table 2-6). Exports are predominantly of four product groups: precious stones (principally diamonds), ferrous metals, ores and drinks, which accounted for over 60% by value in 2008 (Table 2-7). Imports are less specialized, with fuel, bitumen, precious stones and vehicles accounting for one third. In 2008, nearly 60% of exports and 35% of imports were with the five principal trading partners (Table 2-8). The Russian Federation is the most important trading partner for both exports and imports.

27. Trade with neighbors Turkey, Iran and Georgia is a small proportion of the total, accounting for 10% of exports by value in 2008 and for 14% of imports. Trade with Turkey is restricted by the border closure, which severed the rail link, necessitating a long and expensive detour through Georgia, but imports doubled in value 2007–2008. The direct road and rail routes to Iran were also cut by the border closures, obligating the use of the M-2, which crosses high passes in the south.

Table 2-6: International Trade 2004–2009
(\$ million)

Item	2004	2005	2006	2007	2008	2009*
Merchandise exports	738	1,005	1,025	1,197	1,100	–41%
Merchandise imports	1,196	1,593	1,921	2,797	3,753	–28%
Of which with neighboring countries:						
Exports						
Turkey	2	2	2	3	2	
Iran	31	29	30	39	25	
Georgia	29	47	55	88	82	
Imports						
Turkey	45	67	95	131	268	
Iran	62	89	114	142	203	
Georgia	13	19	35	46	49	

Source: World Bank estimate. Note: * January–September with same period of 2008

Table 2-7: Principal Traded Goods
(% by value)

Item	2003	2004	2005	2006	2007	2008
Exports:						
Precious stones, etc.	51.2	41.4	34.5	30.0	18.1	16.4
Ferrous metals	2.6	9.8	25.0	17.0	21.1	20.3
Ores	5.6	10.1	5.3	9.5	10.9	11.9
Drinks	8.8	7.9	8.7	8.0	11.0	13.8
Others	31.8	30.8	26.5	35.5	38.9	37.6
Imports:						
Fuel, bitumen etc.	14.0	15.3	14.7	16.0	14.8	14.6
Precious stones etc.	26.0	21.6	19.3	14.3	9.1	6.9
Vehicles	5.9	6.7	8.1	8.9	11.5	12.4
Machinery, appliances	6.3	5.1	8.7	7.7	7.4	8.9
Electrical machinery	4.2	4.9	4.2	6.2	5.7	6.4
Others	43.6	46.4	45.0	46.9	51.5	51.5

Source: Statistical Yearbook of Armenia 2009.

Table 2-8: Principal Trading Partners
(% by value)

Country	2003	2004	2005	2006	2007	2008
Exports:						
Germany	6.5	11.5	15.6	15.0	14.7	17.4
Netherlands	3.2	3.6	13.7	12.9	13.5	12.4
Russian Federation	13.8	10.8	12.2	12.3	17.5	19.7
Belgium	18.1	14.9	12.8	11.0	8.7	8.5
Israel	13.6	11.5	12.0	8.9	2.3	0.5
Others	44.8	47.7	33.7	39.9	43.3	41.5
Imports:						
Russian Federation	13.7	11.8	13.5	13.9	22.0	19.2
Ukraine	4.3	6.0	7.0	7.4	7.7	7.1
Kazakhstan	0.6	0.9	0.1	7.3	0.5	0.4
Germany	4.6	5.9	7.8	6.6	6.8	5.8
Belgium	9.8	7.6	8.0	5.5	3.6	2.1
Others	67.0	67.8	63.6	59.3	59.4	65.4

Source: Statistical Yearbook of Armenia 2009.

2.6 Volume of Output

28. The output of major agricultural and industrial products 2003–2007 is given in Table 2-9. The combined output of the top seven agricultural products (including milk) in 2007 was 3.2 million tons. Cement and building materials production in 2006 was 1.08 million tons. Cement production benefitted from the construction boom, which ended in 2008. Use of

concrete pavement for road construction would capitalize on surplus local cement capacity, reducing dependence on imported bitumen. Under a World Bank project, concrete pavement is being tested on a rural road.

Table 2-9: Agricultural and Industrial Output 2003–2007
(‘000 tons)

Item	2003	2004	2005	2006	2007	2008
Grain	310	457	396	213	453	415
Potatoes	507	576	564	540	584	649
Vegetables	569	601	664	780	845	825
Melons	115	113	118	135	206	182
Fruit/Berries	103	114	316	286	260	318
Grapes	82	149	164	201	219	186
Milk	514	555	595	620	642	662
Cement	384	501	605	625	722	770
Building materials (non-metal)	336	459	402	452	na	749
Copper concentrate	67	65	63	68	67	71

Source: Statistical Yearbook of Armenia 2009

2.7 Fuel Consumption

29. Transport sector fuel consumption increased by 74% 2001–2007, an average annual growth rate of 9.7% (Table 2-10). There was a major switch in fuel use, with CNG becoming the main fuel, due to its relatively low price. It accounted for 42% of consumption by weight in 2007.

Table 2-10: Transport Fuel Use by Type
(%)

Type	2001	2002	2003	2004	2005	2006	2007
Petrol	66	57	52	54	47	39	34
Diesel	24	28	30	26	29	26	24
CNG	10	15	17	20	24	35	42
Total	100	100	100	100	100	100	100
Total ‘000 Tons	285	312	366	401	391	442	496

Source: Sustainable Urban Transport in Yerevan

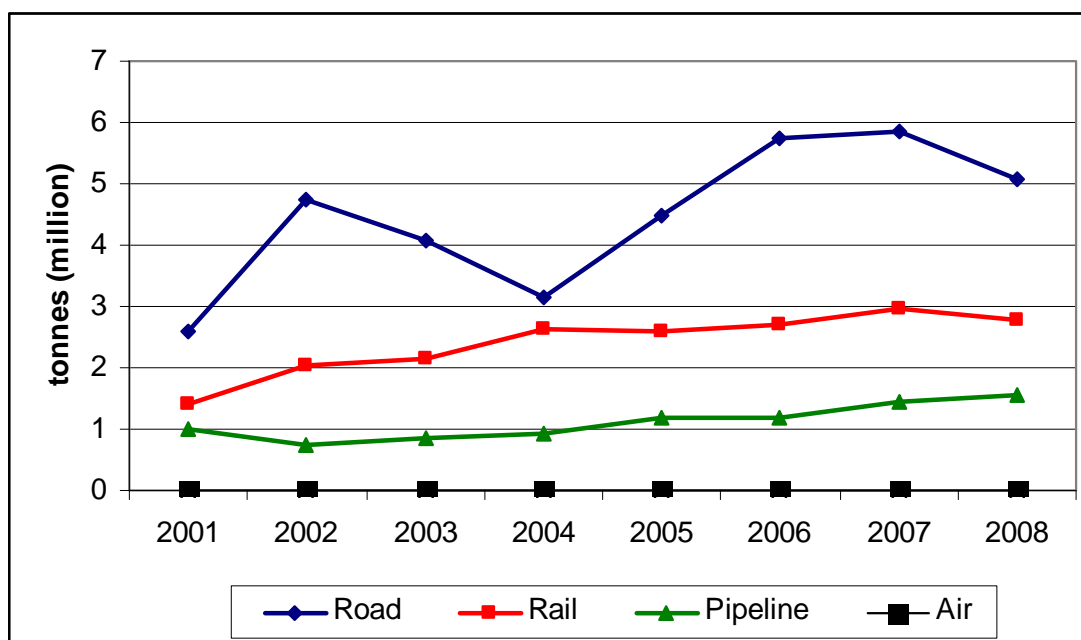
SECTION 3 SUB REGIONAL TRADE AND TRANSPORT

3.1 Regional Context

30. Armenia is not only landlocked, but for most of the period since independence has had to contend with closed borders to the west (with Turkey and Azerbaijan) and to the east (with Azerbaijan). North–south routes currently provide the only option for international trade. Development of the North–South Corridor (Turkey/Georgia–Bavra–Gyumri–Yerevan–Kapan–Agarak–Iran) is the main focus of the MFF and is strategically important to transport in the region. In the south, the M-2 highway provides the only land connection with Iran (the rail link through Nakhichevan is closed). During the Russia–Georgia war of August 2008, when both rail and road links through Georgia were cut, the country was for a short period totally dependent on the M-2. Dependence on Georgia and Iran for transit has resulted in high transport costs and insecure access, the effects of which were seen during the Georgia–Russia war of 2008. Figure 3-1 shows the context of transport in the region, with the Armenian N–S Corridor providing a route linking Georgia and Iran. Key border crossings are identified.

3.2 Freight Transport

31. There has not been a survey of road freight operators since 1999 that identifies freight by commodity, but statistics for total tonnage and ton km are developed annually. Figure 3-1 shows the volume (tons million) of cargo transportation by mode from 2001 to 2008 and Table 3-1 provides supporting data to show the share by ton-km and haul km. In terms of tonnage, road is the main mode taking 54% of the market share.



Source: Statistical Yearbook of Armenia 2009.

Figure 3-1: Cargo Transportation in Armenia by Mode of Transport

Table 3-1: Freight by Mode 2001–2008

Item	1990	2001	2002	2003	2004	2005	2006	2007	2008	% share
Tons million:										
Road	96.9	2.61	4.75	4.09	3.15	4.48	5.73	5.87	5.07	54.0
Rail	37.6	1.40	2.02	2.13	2.63	2.61	2.72	2.98	2.76	29.4
Pipeline		0.99	0.75	0.84	0.94	1.18	1.20	1.44	1.56	16.6
Air	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1
Total		5.01	7.53	7.06	6.73	8.28	9.66	10.30	9.39	100.0
Index 2001=100		100.0	150.4	141.1	134.6	165.4	192.8	205.6	187.4	
Ton km million:										
Road	1,533	43	68	79	55	56	91	133	179	5.9
Rail	4,884	344	452	529	678	654	668	771	705	23.4
Pipeline		1,327	1,010	1,127	1,264	1,580	1,574	1,958	2,118	70.2
Air	50	9	6	6	10	11	12	13	13	0.4
Total		1,722	1,536	1,741	2,007	2,301	2,346	2,875	3,015	100.0
Index 2001=100		100.0	89.2	101.1	116.6	133.6	136.2	167.0	175.1	
Haul km:										
Road	16	16	14	19	18	12	16	23	35	
Rail	130	246	224	249	258	250	246	259	255	
Pipeline		1,345	1,346	1,340	1,340	1,340	1,312	1,360	1,358	
Air	2,778	798	655	632	1,087	1,151	1,200	1,300	1,300	
All		344	204	246	298	278	243	279	321	

Source: Statistical Yearbook of Armenia 2009.

Note: Air and pipeline figures include international components.

3.3 Domestic Context

32. The NSRC serves multiple domestic purposes: (i) heavy local traffic for some 25km north and south of Yerevan, it provides two of the four main access routes to the city; (ii) the principal route between Yerevan and Gyumri; (iii) the main route for tourist traffic between Yerevan, Jermuk and Tatev; and (iv) for local traffic to Gyumri, Goris, Kapan and other towns en route.

3.4 Road Transport

33. Almost the whole country lies at an altitude above 1,000m. The NSRC crosses four passes of 1,800–2,500m: (i) Bavra–Gyumri; (ii) Gyumri–Yerevan; (iii) Goris–Kapan; and (iv) Kapan–Meghri. The highest point is the Kajaran Pass, 2,489m at km340. In winter (November–April), snow disruption can occur at any time over the passes. Conditions are particularly severe in Shirak, north and south of Gyumri, where temperatures can be below –30°C.

34. The M-2 highway route to Iran crosses high passes and can be closed for short periods in winter. The northern route for trucks to the key Black Sea ports of Poti and Batumi is circuitous, via Bagratashen, Tbilisi and the East–West Highway through Georgia.

35. The much shorter route via Bavra is currently unsuitable, with the section immediately north of the border in Georgia in poor condition. Rehabilitation of this road is in progress, for completion late-2010. This and a planned new Georgia–Turkey border crossing will considerably reduce the distance for Armenia–Poti/Batumi and Armenia–Turkey traffic.

3.5 Rail Transport

36. Rail transport has an impact on the road sector in terms of either competition or complementarity, therefore it needs to be considered. Like the road sector, rail in the Caucasus is in a state of change, which combined with border closures/openings, is causing uncertainty in its future. The Armenia Railways (AR) were concessioned, on June

1st 2008, to a subsidiary of Russian Railways, and renamed South Caucasus Railway (SCR). Existing routes in adjacent countries, such as Iran, Georgia, and Turkey, are being upgraded and extended the results of which could have a positive or negative impact on the SCR. Also, the port of Poti, key to the railway's traffic has been concessioned and a duty free zone is being constructed adjacent to the port.

37. In terms of rail demand, following the country's independence, annual rail traffic of around 30 million tonnes and 5 million passengers had collapsed by 1999 to just 1.5 million tonnes and 1.3 million passengers. By 2007 freight traffic had recovered to 3.0 million tonnes, but passenger traffic continued to decline, to 0.7 million. The fall in rail traffic primarily reflects the decline of rail-based industries, the improving road network, and better service from road hauliers, bus companies, and increase in ownership of private cars.

38. In 2006 the World Bank commissioned a report on future options for the railway, titled *Restructuring Project Final Report* (Harral, Winner, Thompson, Sharp and Klein, October 2006). The Report indicated only a modest recovery in rail freight traffic, to around 4 million tonnes by 2020. With reopening of the Turkish border, that could increase to 9 million tonnes. Passenger services will need to be subsidized indefinitely. Annual renewal of existing assets is estimated to cost AMD4 billion (\$13 million), with outstanding deferred investment of AMD55 billion (\$182 million). In addition, investment for traffic growth and asset replacement is necessary, including AMD11 billion (\$36 million) for new electric multiple units. This with current annual revenue of about \$25 million.

39. Under the concession agreement the concessionaire has agreed to invest \$528 million over the period of the 30 year concession, 2.8 times the amount recommended by the World Bank study. It is questionable whether the traffic will ever be there to justify this level of investment.

40. The railways in the region were constructed in an era of central planning, and unrestricted access between countries of the USSR. Freight shipment distances of greater than 200 km were if at all possible, required to go by rail. Trucking was state controlled and private ownership of cars was restricted. In addition, central planning designated location of manufacturing facilities and their respective markets with little consideration to transportation costs. The technical quality and work ethic of the labor force resulted in many high tech strategic industries being located in Armenia.

41. The situation has changed dramatically, a free market economy, an aggressive trucking industry and national border restrictions or closures. In addition, most of the Armenian industries for various reasons have either disappeared or are a fraction of their former selves. Of the few that still exist, few have appropriate rail connections. In addition the railway does not have the domestic distances usually required to offset the lack of door to door service and slower transit times. Currently, because of borders being closed, other than a circuitous route through Georgia to the ports of Poti and Batumi, there is no international rail traffic.

42. There are a number of rail route investments currently under construction or under consideration in the region some of which will have most likely a negative effect on future SCR traffic. In addition, the reopening of various borders could have an impact on rail traffic. Other than the Gyumri border crossing it is difficult to see how any of these investments would have any significant effect on the Gyumri to Ashtarak highway.

43. There is a possibility of the Armenia-Turkey border being reopened in the foreseeable future. The potential of the reopening of the rail crossing will be hampered by the difference in track gauges (1520 and 1435 mm). It is possible to partially overcome this problem by changing wagon bogies, but this is an expensive and time consuming process that can only be justified if the savings from long distance movements are possible. The

most likely use of this connection will be for transporting containers between Armenia and the Mediterranean ports and thus bypassing the high cost Black Sea shipping. The gauge change and lack of domestic rail distances will cause Gyumri to become an intermodal terminal and logistics center for Armenia with all distribution and collection being by road. This will have the effect of increasing highway traffic on the Gyumri to Ashtarak highway.



Source: This Study, 2010

Figure 3-2: Armenia—Regional Transport

44. South Caucasus Railway identifies 58 commodities, plus “others” that it transports. Table 3-2 shows 2007 traffic classified into imports, local/domestic, and exports. In terms of tonnage, imports are by far the largest category. By examining this traffic it is possible to develop some indication of the traffic that is containerizable and may be easily diverted to road. It should be noted that Armenian exports are primarily fresh fruit, vegetables, fish and precious stones and they are almost all transported by air.

Table 3-2: Rail Freight by Commodity

Commodity	Imports	Domestic	Exports	Total
Mineral ore (clay)	10,884	520,839	21,850	553,573
Grain	480,881	4,995		485,876
Cement	188	50,053	331,216	381,458
Oil (light)	354,932	1,628		356,561
Raw material mineral (stone)	18,098	68,283	116,468	202,849
Semi-processed copper, molybdenum, gold	2,786	32,909	76,156	111,851
31 Products of less than 10,000 tonnes	65,269	28,238		93,507
Sugar	85,945	–		85,945
Ferrous metal coils	76,141	431	803	77,374
Non-ferrous metal alloy	52,961	7	21,256	74,223
Wall material	57,403	–	5,735	63,138
Ferrous metal	1,381	279	47,000	48,661
Alcohol, drinks	20,398	1,878	26,173	48,449
Pit-granulated slag		29,255	13,914	43,169
Fruit	29,531	4	10,189	39,725
Metal products	37,855	1,133	342	39,331
Sawn products	33,904	488		34,392
Flour-grinding industry product	16,376	17,441		33,817
Dairy products	26,703			26,703
Combined feed product	26,474			26,474
Mineral fertilizer	24,722	125		24,846
Food industry product	20,760		405	21,164
Transport, military	1,896	9,504	7,632	19,032
Inorganic chemicals	11,429	1,627	4,584	17,641
Paper	15,387		37	15,425
Timber goods	14,946	67	56	15,069
Timber	14,494		110	14,604
Meat products	13,864			13,864
Other freight	9,938	2,320	1,006	13,264
Natural resin	11,477		4	11,481
Total	1,537,021	771,505	684,938	2,993,465

Source: Armenian Railways, 2007.

45. The potential for developing freight traffic considering the primary types of cargo and relative merits of competing transport modes is considered in the paragraphs below.

46. **Grain:** Currently almost all grain is imported in bulk through the port of Batumi, and an increasing proportion of the grain is coming from Canada and Europe. Almost all of it is transported to Armenia in railway covered hopper wagons. In addition, there is an increasing variety of grains being imported. Internationally grain is an accelerating trend for shipping grain in containers¹. While 2007 railway data shows only 2% is in containers, it can be assumed that this global trend will have an impact on the transportation of grain for Armenia. While it is not yet as prevalent as grain, sugar (the other bulk import product) is starting to be also shipped in containers. With the reopening of the Turkish border there is likely to be a significant increase of grain and sugar being shipped in containers. Road will

¹ Using containers improves grain quality as it is handled twice compared to up to eight times if shipped in bulk. It also more easily enables shipment of smaller quantities of specialized grain.

be used for distribution. If this trend continues then with the opening of the border it has been assumed that 20% of grain will be shipped in containers.

47. **Cement:** The railway is currently transporting cement both domestically and for export. There are two cement plants. One is in Ararat and the other in Hrazdan. Both are close to the primary domestic market of Yerevan. There is some domestic transportation of cement and the clinker needed for cement production, but it is limited. The finished product is subject to increasing highway competition. This can be expected to increase with an improved highway, given the total shipped by rail is only about 50,000 tons a reasonable assumption is possible a 10% shift or about 2 trucks a day. The export quantities will be subject to increasingly stronger domestic Georgian competition and, possibly, highway competition which would be from the Hrazdan plant which is significantly closer. It is assumed there will be little shift to the road.

48. **Agriculture Products:** With the dissolution of the collective farms, individuals were given small sections of land and possibly a few animals. Individually the farmers have had little success and have either sold the land (Armenia has one of the most liberal land sales policy) to companies that are assembling the necessary acreage to have economical production or have started to see the necessity to cooperate with other farmers. Either way there is increasing production in exportable agriculture products. However, to fully take advantage of this export potential, specialized wagons, particularly refrigerated and those suitable for boxed products, would be required. The majority of this produce is for CIS countries and will be continued to be transported to road.

49. **Bottled and Frozen Food Products:** There are currently bottled products that are exported include brandy, wine, beer, mineral water, and various fruit and food products. Most of these products going to CIS countries are shipped in conventional closed wagons. As a result there is a need for extra packaging to prevent damage. Unless refrigerated wagons are available, these products cannot be shipped during the winter. It also takes several days longer by rail than road. One of the larger shippers stated that as soon as the road connection is reopened, the company will no longer use the railway because of service quality and lack of suitable freight wagons. The Lars Pass has recently been reopened and so it can be expected that this traffic will switch to road. Even if the rail connection through Abkhazia is reopened it is reasonable that most will still be transported by road because of the much lower transit time.

50. **Copper Concentrate:** There is a copper mine in Alaverdi close to the Georgian border. The entire mine's production is exported in containers. The weight per container is such that it is shipped by rail. Currently it only goes a short distance to the border on SCR. When the border with Turkey is reopened, it is expected that it will be transported to Gyumri for export through the Mediterranean ports. The mining company has plans for increasing its production to about 150,000 tons per year. Given that they are making use of the marine container capacity this will remain on rail.

51. **Semi Processed Ore:** Potentially there could be substantial rail movement of gold and molybdenum ore but because of the low value and the weight it is inconceivable that any quantity will be moved by truck, should do so it will not be on the Gyumri to Ashtarak road.

52. **Construction Materials:** Export of cut and polished stone and marble is expected to continue and expand. Conversely, import of construction materials, such as reinforcing steel, may return to the 2007 levels for about 5 years after the current recession., and then it is expected to decline as the market for new houses declines. The ability of the railway to handle containers that are too heavy for road will ensure the majority of the traffic continuing on the railway unless an exemption is given for marine limit weight containers.

However with a central logistics center at Gyumri, it can be expected that these products will be distributed from there increasing road traffic at the expense of SCR.

53. Other Products:

There are numerous other products shipped by rail, but all in small volumes that could in most cases be easily shipped in containers, by either road or rail.

54. Container Transportation: Almost all containerized goods are currently being imported or exported through the port of Poti. The rail transit time between Yerevan and Poti is 6-10 days, but by road the current transit time is 1 day. According to freight forwarders, when all the handling and transportation charges are considered, it costs less to transport the containers by road.

55. Based on 2007 data, which is thought to reflect current traffic, approximately 30,000 containers (about 70% are 40ft) were imported through Poti, and of these about 2,000 were from Russia. Approximately 25% or 7,000 containers were transported by rail. These containers account for about 170,000 tons of the total imported rail freight traffic, or about 11% of the total rail handled import traffic of about 1.5 million tons. With the reopening of the Turkish border, the existing container traffic, including a substantial proportion of the 7,000 is likely to be diverted to the Gyumri border crossing. In addition, some of the existing bulk and other freight will be containerized and also diverted to Gyumri crossing.

56. Data is not available to determine, by tons, the origin of Armenian imports. However, according to Armenian 2008 Statistics, approximately 25% by value (excluding fuel) of Armenian imports are from CIS countries and about 5% by value are imported through Iran. Allowing for about 15% of imports to be from or through Black Sea counties and Georgia, this leaves about 55% of imports that could be imported through the Mediterranean and Turkey. Of these imports, a percentage will continue to be imported in bulk and be transferred to railway in Poti or Batumi.

57. The reopening of the Armenian Turkish border and access to the Mediterranean ports will encourage the use of containerization. A review of the various types and tonnages of imported products, currently being transported by the railway, indicates that the number of containers could increase by 300% (assuming same market share) to about 23,200 containers a year² as shown in the table below. This will have the effect of significantly reducing the bulk and box car traffic handled by the railway. Approximately 55% of the imports could switch to being imported through the Mediterranean ports and the planned logistics and distribution center at Gyumri. In numerical terms this would be about 12,800 containers, imported through Gyumri, at the 2009 traffic levels. The SCR would continue to handle the Black Sea and CIS containers between Poti and Armenian destinations.

Table 3-3: Calculations for Determining Potential Containerization

Product	Import of freight (tonnes net)	Imports		Estimated			Current	Future	2007
		Number of		Percent in	Tons in	Tons in	No.	Tons in	Tons in
		wagon	Cont.	Cont.	Wagon	Cont.	Cont.	Cont.	Cont.
Grain	480,880.6	7,265	410	20	65	24	4,007	96,176	9,840
Seeds	1,076.3	19	10	100	50	14	77	1,076	140
Vegetables, potato	4,280.4	53	43	100	60	20	214	4,280	860
Fruit, berries, nuts	6,748.6	186	42	100	40	18	375	6,749	756
Animals, poultry				100				-	-
Other agric. products	35.4	2	1	90	20	10	3	32	10
Timber	14,493.6	270		60	55	20	435	8,696	-
Sawing production	33,904.0	623	23	80	55	20	1,356	27,123	460

² Armenian Railway's (prior to SCR) traffic data lists import tons, by product, and number of wagon and container loads. With knowledge of the weight of the product it is possible to estimate the tons per container. By examination of international shipping practice it is possible to estimate the total percentage of a specific product that could be containerized.

Product	Import of freight (tonnes net)	Imports		Estimated			Current	Future	2007
		Number of		Percent in	Tons in	Tons in	No.	Tons in	Tons in
		wagon	Cont.	Cont.	Wagon	Cont.	Cont.	Cont.	Cont.
Timber goods	14,946.0	281	65	80	50	18	664	11,957	1,170
Paper	15,387.2	308	259	90	40	16	866	13,848	4,144
Iron ore	1,507.0	22		-				-	-
Raw material of non-ferrous metal	2,786.0	4	95	95	56	27	98	2,647	2,565
Mineral fuel	6,155.0	96		-				-	-
Turf and turf product	27.2		1	100		27	1	27	27
Oil (light)	354,932.4	5,513	16	10	65	27	1,315	35,493	432
Oil(dark)	8,597.8	152		-				-	-
Mineral ore (clay)	10,883.8	149	62	40	61	26	167	4,354	1,612
Raw material mineral	18,097.7	304		-				-	-
Wall material	57,402.9	75	2,007	100	60	27	2,126	57,403	54,189
Building material	3,092.7	30	46	90	60	25	111	2,783	1,150
Pit-granulated slag				-				-	-
Cement	188.3	3		-				-	-
Flux metal	2,596.5	48	8	80	50	20	104	2,077	160
Fireproof, asbestos	3,651.9	59		20	60	26	28	730	-
Ferrous metal	1,381.3	20	3	20	62	28	10	276	84
Ferrous metal hiring	76,140.8	2,118	50	20	35	15	1,015	15,228	750
Non-ferrous metal alloy	52,960.8	581	484	60	65	28	1,135	31,776	13,552
Vehs and equipment	7,581.0	335	73	25	20	5	379	1,895	365
Agricultural machinery	2,199.1	85	12	25	25	10	55	550	120
Metal construction	290.5	6		-				-	-
Cars	1,374.7	64	2	10	20	5	27	137	10
Transport, Military	1,896.0	118	25	30	15	5	114	569	125
Apparatus, devices	186.9	18	3	50	10	5	19	93	15
Metal products	37,855.2	630	13	20	60	20	379	7,571	260
Rails(cranes)		131	1	-				-	-
Mineral fertilizer	4,721.5	386	1	20	64	27	183	4,944	27
Chemical products	1,656.2	36	13	50	35	15	55	828	195
Rubber	477.3	27		10	18	10	5	48	-
Natural resin	11,476.8	59	352	95	58	23	474	10,903	8,096
Chemical recovery product	227.3		10	100		23	10	227	230
Inorganic chemistry product	11,429.3	193	5	25	60	25	114	2,857	125
Flour-grinding industry product	16,376.1	269	17	50	60	25	328	8,188	425
Food industry product	20,759.6	193	592	90	52	18	1,038	18,684	10,656
Salt	3,184.0	47		60	66	26	73	1,910	-
Combined feed product	26,474.2	445	178	50	50	23	576	13,237	4,094
Dairy products	26,703.1	399	187	80	55	25	854	21,362	4,675
Meat product	13,863.8	36	379	100	60	28	495	13,864	10,612
Fish and fish product	94.5	-	3	100		30	3	95	90
Fruit	29,530.8	353	458	90	50	25	1,063	26,578	11,450
Alcohol, drinks	20,397.5	196	402	95	50	26	745	19,378	10,452
Water, ice, distillery		-		-				-	-
Fabric, apparel	266.4	5	4	100	40	20	13	266	80
Shoes, leather, fur		-		-				-	-
Glass product	1,509.9	47		100	36	15	101	1,510	-
Other products of light industry	48.3	1		100	48	15	3	48	-
Other freight	9,937.8	106	284	80	45	18	442	7,950	5,112
Containing oxygen	762.7	14		-				-	-
Chemicals	7,641.3	120	37	80	55	22	278	6,113	814
Sugar	85,945.1	1,218	255	40	65	27	1,273	34,378	6,885
Totals tons, wagons or containers	1,537,021	23,718	6,931				23,207	526,918	166,814

Source: The Consultants

58. Import containers on arriving at Gyumri will either be transferred directly to truck or into the logistics and distribution center. Given the limited delivery distances and it being considerably faster to deliver by road, this will undoubtedly result in containers and or the contents being transferred to their destination by truck. Based on the fact a percentage of the containers will weigh a 'marine' maximum and will be too heavy for road, some of the

containers will be partially unloaded. In addition, as a result of the distribution aspect of the logistics center, the center will generate more truck loads than import containers (an additional 10% is assumed). Given the Armenian population and geographical distribution, it is estimated that about 80% of the trucks will make use of the M-2 (southbound) road.

59. If cement exports and other construction exports to Georgia are excluded then currently containerizable imports exceed exports by a multiple of 4. As empty shipping containers must be returned, exports would have to essentially quadruple before it would have an impact on the total number of containers being handled. Therefore it can be assumed that the additional truck traffic generated by the transfer of freight from rail to road, will be approximately double that generated by import traffic alone.

60. Globally 90% of non-bulk freight traffic is shipped in containers. Only about 4% of Armenian import traffic handled by the railway is bulk and could be considered non-containerizable. The overall assumption used in this analysis is that only a 34% of the current SCR import traffic will in the future will be containerized and could be subject to being imported through Gyumri.

61. Based on this logic it has been determined that within a year or so of the Turkish Armenian border reopening there would be a significant transfer of traffic from the railway to the M-2 highway. Using the assumption that import tonnage is directly proportion to GDP growth³ Table 3-4 shows freight traffic that could be transferred from rail to road. In 2020, assuming the border has been reopened; there would be the equivalent of a minimum of 138 additional 18 wheel trucks using the highway. This amount could be higher if import/export traffic grows faster than the GDP.

Table 3-4 With-Project Additional Road Freight Forecast

	2009	2014	2020	2025	2032	Comments
% /yr increase in containers		3.45	6	7	7	IMF GDP growth estimates
Imported containers -Gyumri	12,800	15,689	23,590	37,881	60,828	
Impact of lighter trucks	14,080	17,258	25,949	41,669	66,911	Assumed 10% increase
'Import' truck/yr using highway	11,264	13,806	20,759	33,335	53,529	80% traffic using M-2 road
'Import' trucks/day using M-2	38	46	69	111	178	Average based on 300 days.
Total additional trucks trips/day	75	92	138	222	357	Assumes 100% container return

Source: The Consultants

62. Given the location of the upgraded road it is difficult to envision a scenario where the railway benefits. There is a possibility with the improved quality of the road, railway or marine maximum loaded containers would be allow for trucks to use the highway to travel to Gyumri logistics center. This would then primarily benefit the Turkish railway. However it would lower transportation costs and so promote Armenian exports.

3.6 Rail Passenger Services

63. Prior to 1990 private car ownership was limited and intercity bus services were only available where there was no railway service. Today, cars are available with few restrictions

³ Import growth has been assumed to being similar to the growth of the GDP. However a review of the import products indicates that only 25%, at the most, of the import tonnage are directly proportional to population. According to the World Bank data while Armenia has gone through a period of negative growth, since 2008 population has become stable. The assumption of only 34% of the traffic being containerized allows for possible errors introduced by assuming an overall traffic growth rate of GDP growth.

on ownership. In addition intercity bus services are privatized and are, and will be, much cheaper than the train unless the train is heavily subsidized. Based on international experience for a developed country, it is unlikely that the railway will have a passenger market share of more than 3 or 4%.

64. The Yerevan area has 43% of the national population or about 1.3 million, and may be able to justify an improved urban rail system. The other major centers of population are Gyumri (146,000) and Vanadzor (105,000). These cities are large enough to warrant connection by quality public transportation. However, the road network is such that the distance between these cities and metro Yerevan is much shorter than by rail and especially after the upgrading of the M-2 highway, road will be much faster. Given the terrain, and the likely ridership it is unlikely that a rail service to compete with the road will ever be justified.

65. The primary passenger route in Armenia, is Yerevan–Gyumri. The current travel time by road is 2.25 hours and by train it is 3.5 hours. The rail route also has about a 25% distance disadvantage and does not pass through any sizable towns. Upgrading the road to a 4-lane highway (see Volume III of this report) would reduce the travel time by intercity bus to about 1.25 hours. For the railway to compete on this distance will require very large investments that will not be required for freight trains.

66. The current train passenger ridership has already been reduced to rural people taking produce to market, people taking advantage of the availability of a low cost service for short distance travel, a very few long distance passengers, and those riding on free or reduced rate passes⁴.

67. Daily there are over 50 minibuses, 20 taxis, 3 buses and one/two trains carry passengers between Gyumri to Yerevan. Clearly the majority of the passengers are travelling by road. These facts indicate that as car ownership continues to increase the majority of passenger travel will shift from public road transport, where most already is, to private cars.

68. The future level of passenger train subsidy is not defined, so it is not possible to determine exactly what percentage of the remaining rail passengers may eventually use the road. The option does exist for the rail service to be reduced or discontinued but the concession agreement would make this very difficult. Given the travel time difference, the investment required to make a time competitive rail service and a lack of a rational subsidy funding mechanism, it is reasonable to assume that there will be little shift from rail to road, other than for local travel.

3.7 Impact of Border Openings

69. Figure 3-1 showed the main borders between Armenia and neighboring countries.

Russia–Georgia Border:

70. The recent reopening of the Upper Lars main land border crossing between Russia and Georgia on 1 March 2010 will assist Armenia in its international trade. The border, which was closed in 2006, once served as Armenia's only overland commercial conduit to Russia and Europe. The closure particularly resulted in a reduction in export of agricultural produce as traders were forced to re-route supplies to relatively expensive rail-ferry services.

71. The reopening will have a positive effect on Armenia, whose economy has also been constrained by the closed borders at Turkey and Azerbaijan. Considering the uncertainties

⁴ Consultant observation

and doubtful prospect of opening the Turkey–Armenia border, Armenia will continue to regard Georgia and to a lesser extent Iran as its most reliable supply line, hence the strategic importance of the N–S corridor.

Armenia–Turkey Border:

72. Opening of the Turkish border, which has been closed since 1993, will have an impact on Armenia, on the economy and, most immediately, on the transport sector. A Protocol on the Establishment of Diplomatic Relations and a Protocol on the Development of Bilateral Relations were signed by Armenia and Turkey in Zurich on 10 October 2009. Following these protocols, the border was to open in the first half of 2010. Still, many technical issues need to be resolved to facilitate cross-border movement. Turkey and Armenia do not have any bilateral transport agreements. Further, border control facilities are not in place and access routes are in poor condition. It could take up to a year for all such issues to be resolved.

73. To some extent, Turkish border opening may reduce the strategic importance of the north–south corridor, by providing alternative routes. However, the impact on traffic is complex: (i) if the rail route is opened, rail transport will become even more competitive for international traffic, but with a distribution center at Gyumri, possibly less competitive for internal distribution; and (ii) international road transport may switch from Bagratashen/Bavra to Gyumri/Markara. Road transport operators suggested that even for remaining traffic to Batumi/Poti, transit through Turkey may be preferred to the Bavra route; (iii) some Iranian traffic may also switch to transit through Turkey, particularly in winter; (iv) lower transport costs and new border crossings will dramatically increase the volume of cross-border movement; (v) faster economic growth will increase domestic transport volume; and (vi) Gyumri will become a logistics center increasing its economic importance.

74. With all borders open, the southern sections of the north–south corridor may be of less importance. Some international traffic will switch to the route through Nakhichevan and there will be a rail links to Iran through Azerbaijan.

75. **Economic impact:** The impact of border opening has not been officially assessed. A World Bank study published in 2001 found that opening of borders with both Turkey and Azerbaijan could lead to a reduction in Armenia's trade deficit by a third to half and increase in GDP by 30 percent (Evgeny Polyakov, World Bank, "Changing Trade Patterns after Conflict Resolution in the South Caucasus", *World Bank Policy Research Working Paper No. 2593*, April 2001). An Armenian International Policy Research Group (AIPRG) paper *Economic and Social Impacts of Opening the Border: Summary of Conference Research Findings* (Dr. Bryan Roberts, 2007) concludes that trade and FDI benefits would provide at least a 10–17% increase in GDP over the medium to long term, but that there would be both losing and gaining sectors. However, a 2005 study supported by the Armenian–European Policy and Legal Advice Center (AEPLAC) found a much more modest annual increase of 0.67%, although with an additional 2.7% increase over five years ("Study of the Economic Impact on the Armenian Economy from Re-Opening of the Turkish–Armenian Borders", 2005).

76. **Traffic pattern:** The principal border crossing for heavy vehicles is expected to be near Gyumri. There would also be a crossing at Markara on the M-3. The border bridge here was constructed in the 1960s, but only used for a short period in 1993, for delivery of humanitarian supplies. There may also be a third crossing at the end of the M-5. The average distance to a border, particularly from the Yerevan area, will be much reduced. Yerevan–Bagratashen is 210km and Yerevan–Bavra 170km, while it is 125km to the border at Gyumri, 63km to an M-5 border and only 45km to Markara. Thus, while cross-border tonnage would increase sharply, due to trade impacts, tonne km would decline.

77. The extent of the impact is illustrated by the Yerevan–Istanbul international coach service. Via Bagratashen the journey takes 36 hours. Operators estimate that via Markara it will take 25 hours, 30% less.

78. **Trade:** While imports from Turkey are substantial, exports are minimal. A European Union study concluded that an opening of the border would favor Armenian exports to Turkey more than Turkish exports to Armenia (Directorate General External Policies of the Union, The Closed Armenia–Turkey Border: Economic and Social Effects. Including Those on People; and Implications for the Overall Situation in the Region, August 2007). However, another 2006 study found that border opening would increase exports to Turkey by 38% and imports from Turkey by 50% (Karine Toroysan, Avanti Gangidze, and Richard Beilock, A Phased Strategy for Opening Armenia's Western Border, 2006). In any case, the size of the Turkish market provides many opportunities and trade is likely to both expand substantially and become more balanced. Yerevan is the largest city in the area and well placed to become a service center for eastern Turkey. Imports of agricultural products will provide increased competition for Armenian producers. The move from what is in effect a protected market to an open market will spur productivity gains and help eliminate the many rigidities in the economy. The World Bank and the IMF have recently noted that oligarchic/monopolistic practices are severely constraining economic development. Turkey's efficient trucking and logistics industry will spur development.

79. **Rail:** Border opening could ultimately restore a rail link. SCR have indicated that the rail connection, close to Gyumri, could be in operation quickly. The change of gauge from European (1,435mm) to CIS (1,520mm) would take place on the Armenian side. Rail access to Mediterranean ports, principally Mersin and Latakia, and a direct connection to the European network through the Bosphorus tunnel will divert traffic from Poti and Batumi and strengthen rail's competitive position. Intermodal facilities will be developed at Gyumri. The gauge change there will provide an opportunity for road hauliers to capture some of the domestic distribution of containers.

80. If and when the Turkish border opens, a major share of the international traffic will make use of the Mediterranean ports. Given the problem of the track gauge change, it is almost certain that container's traffic will make use of an intermodal terminal at the border with little, if any, of the Armenian containers going by rail to this terminal. Even with the opening of the borders, there will be little traffic that will be in train load volumes. As illustration, grain used to be imported in train load volumes from the Ukraine. Today much of the grain comes from Canada in a diversity of types, thus promoting the use of containers.

81. **Tourism:** In 2008, Turkey was the world's third most popular tourist destination, with 26 million visitors. The number of visitors to Armenia was 558,000. If just 1% of visitors to Turkey also visited Armenia, tourism would increase by 47%. "Western Armenia" in eastern Turkey has many historic sites, in addition to Mt. Ararat and Lake Van. An open border will have the following impacts: (i) Armenian tourism will diversify from Lake Sevan and the Georgian Black Sea coast, with many holidays switching to Turkish destinations; (ii) diaspora visitors to Armenia will also visit adjacent areas of Turkey; and (iii) visitors to Turkey will also visit Armenia. The potential for tourism development is high.

Armenia–Azerbaijan Borders:

82. A successful opening of the Turkish border would provide an impetus for resolving Azerbaijan border issues. Opening of all borders would transform the economy, allowing it to reclaim its historic role on east–west Euro–Asia transit routes.

SECTION 4 ROAD SUB SECTOR

4.1 Introduction

83. The Consultants carried out an overall review of the existing road sector including the condition of the road network, transport demand, challenges within the sub sector, institutional capacity, and potential for public-private participation. Considering the issues arising within this review, the Consultants then focused on assessing the N–S Corridor and appropriate tranching as a pre-cursor to feasibility and pre-feasibility studies of candidate tranches.

4.2 Road Network and Condition

84. Day to day responsibility for interstate and republican roads is delegated by MOTC to ARD. In March 2008, 2,224 km of local roads were reclassified as republican roads and transferred to ARD. Road length by province and category, including urban roads, is given in Table 4-1. The network is estimated at 10,819 km, with 7,704 km non-urban. There are in addition an estimated 2,500km of unadopted roads and tracks.

85. The surface condition of the interstate network is generally fair, with an average international roughness index (IRI) in 2008 of 4.9 (Table 4-2). An ARD sample survey of republican roads shows a worse picture, with an average IRI of 8.6 in 2008. This reflects the priority given in the allocation of rehabilitation and maintenance funding to the interstate network.

Table 4-1: Road Length by Marz 2008

Marz	Road Length km				Area sq.km	Density km/ '000sq km
	Interstate	Republican	Local	Total		
Aragatsotn	178.2	427.0	150.0	755.2	2,753	274
Ararat	103.6	294.3	238.1	636.0	2,096	303
Armavir	167.3	274.7	209.4	651.4	1,242	525
Gegharkunik	224.5	350.3	211.8	786.6	3,300	238
Lori	213.4	471.4	223.1	907.9	3,789	240
Kotayk	49.0	442.8	118.8	610.6	2,089	292
Shirak	112.9	469.9	283.4	866.2	2,681	323
Syunik	373.0	470.7	220.4	1,064.1	4,506	236
Vayots Dzor	113.3	394.3	116.2	723.8	2,308	314
Tavush	150.8	460.9	190.8	802.5	2,704	297
Total Above	1,686.0	4,056.3	1,962.0	7,704.3	27,468	280
Yerevan				725.0		
Gyumri				265.0		
Vanadzor				162.0		
Other towns				1,962.7		
Total				10,818.8		

Sources: Government Decree 1 March 2008, Consultants' estimates.

Table 4-2: IRIs 2005–2008

Road Category	2005		2006		2007		2008	
	Km Survey	IRI	Km Survey	IRI	Km Survey	IRI	Km Survey	IRI
Interstate	1,228	5.42	1,364	5.32	1,568	4.28	1,577	4.91
Republican	505	10.58	562	12.11	387	8.01	281	8.56

Source: ARD

4.3 Road Safety

86. **Deteriorating situation:** Road safety is of serious and growing concern. A World Bank workshop in September 2008 developed strategies for interventions at national level and for Yerevan in the *National Road Safety Strategy for Armenia and Yerevan and Five Year Action Plan*, issued in October 2008 and adopted by the Government in 2009.

87. There was a 9% increase in fatalities 2001–2004 and a 57% increase 2004–2008 (Table 4-3). Serious injuries increased by 148% 2001–2008. The fatality rate per 10,000 vehicles in 2007 was 10.1, and was ten times higher than the safest European countries in 2008.¹ Of particular concern is the large number of pedestrian fatalities.

88. **National Road Safety Council (NRSC):** This was established in 2005 as a nongovernmental organization (NGO). It has sponsored a number of campaigns including *Think Before You Drive* in 2006 and was largely responsible for the introduction of the mandatory seatbelt law in 2007. A permanent working group of concerned agencies has been established, including the traffic police and other NGOs. A program of school visits is in progress. A road safety program, which identifies accident black spots, has been initiated. NRSC and others note that traffic accident rates are very much under-reported. Accidents involving the many uninsured vehicles are generally not reported to police. Fatalities include deaths within 7 days of an accident, while the international norm is within 30 days. Self-financing of the traffic police has led to an improvement in enforcement, in particular concerning wearing of seatbelts and drink-driving.

89. The MFF targets road safety through a safety audit of all road designs and specific measures in each investment tranche. Under Tranche 1, safety measures on the M-1 and M-2 existing dual carriageway sections include: enhanced provision of road lighting, renewal/extension of safety barriers, elimination/improvement at U-turns, improved signage and redesign of the M-1/M-3 intersection at Ashtarak to improve safety.

Table 4-3: Road Accidents 2001–2008

Item	2001	2002	2003	2004	2005	2006	2007	2008
No. of accidents	1,021	1,002	1,025	1,164	1,312	1,574	1,943	2,202
Deaths	237	235	252	259	310	332	371	407
Injuries	1,258	1,213	1,294	1,492	1,774	2,089	2,720	3,125

Source: Statistical Yearbook of Armenia 2009.

4.4 Transport Demand

90. **Vehicle Fleet:** Vehicle registration data is not readily available. The figures by province as of end-2006 are given in Table 4-4. Nearly 80% of the fleet was made up of cars/light passenger vehicles. There is little difference in car ownership between provinces, ranging from 45 per 1,000 population in Gegharkunik to 79 in Vayots Dzor. Yerevan is an exception, with 120 vehicles per 1,000, reflecting its higher income level. The fleet is currently estimated to have an average age approaching 15 years.

¹ Data from Global Safety Status Report on Road Safety, WHO.

Table 4-4: Vehicle Fleet End-2006

Province	Cars	Buses	Light Truck	Medium Truck	Heavy Truck	Total	% of Total	Cars /'000
Yerevan	132,668	8,458	9,641	8,326	412	159,505	48.4	120
Aragatsotn	8,478	395	663	1,800	62	11,398	3.5	61
Ararat	16,726	746	1,526	2,555	601	22,154	6.7	61
Armavir	21,981	720	1,327	2,039	100	26,167	7.9	78
Gegharkunik	10,869	492	1,282	3,005	59	15,707	4.8	45
Lori	15,244	926	863	3,135	354	20,522	6.2	54
Kotayk	16,852	1,479	1,648	3,707	197	23,883	7.2	61
Shirak	16,538	867	786	2,924	421	21,536	6.5	59
Syunik	8,165	373	599	3,037	73	12,247	3.7	53
Vayots Dzor	4,400	129	370	1,113	71	6,083	1.8	79
Tavush	7,319	345	752	2,209	28	10,653	3.2	55
(Non-Yerevan)	(126,572)	(6,472)	(9,816)	(25,524)	(1,966)	(179,350)	(51.6)	(59)
Total	259,240	14,930	19,457	33,850	2,378	329,855	100.0	80
% of Total	78.6	4.5	5.9	10.3	0.7	100.0		

Source: Ministry of Interior

91. **Post-independence collapse in demand:** In the former Soviet Union, the economy and transport use was centrally planned: production was highly integrated, non-competitive and regionally specialized. This resulted in a very high transport-intensity, a dominance of rail and specialized location of production facilities, requiring large-scale movement of intermediate goods. Rapid de-industrialization occurred after independence and the volume of transport fell sharply from its 1988 peak of 320 million tons and 401 million passengers. The transformation from an industrial into (for a short time) a quasi-subsistence economy, reduced the economic importance of the transport sector.

92. There was a complete reorientation to cater primarily for domestic demand, with new trade patterns and trading partners and a rapid change from a heavy industrial to an agriculture/light industry/service economy: recorded passenger volume fell by 79% and freight volume by about 94% 1988–1995. Infrastructure maintenance virtually ceased for some years. The newer industries, such as diamond processing, have very high unit value but low transport volume intensity.

93. **Road Transport:** Road is the dominant mode for public transport with a share in 2008 of over 90% of journeys and over 70% of passenger km. In terms of tonnage, road is the main mode, but its share of ton km is quite small due to the much longer haulage distance of rail and pipeline transport. Road tonnage nearly doubled 2001–2008, while ton km quadrupled, with the average haul doubling.

94. **Passenger Transport:** Table 4-5 summarizes passenger transport by mode from 2001 to 2008.

Table 4-5: Passengers by Mode 2001–2008

Item	1990*	2001	2002	2003	2004	2005	2006	2007	2008	% share 2008
Passengers million:										
Bus/Minibus	377.4	121.9	128.9	147.5	158.6	174.0	198.9	216.0	207.7	83.9
Taxi	0.0	0.0	0.7	1.2	2.8	7.8	10.0	12.5	14.9	6.0
Rail	3.5	1.2	1.3	1.1	0.8	0.7	0.7	0.6	0.7	0.3
Air	1.8	0.8	0.9	0.9	1.1	1.2	1.2	1.4	1.5	0.6
Metro	49.2	15.3	15.1	16.2	16.6	15.8	15.4	17.3	18.9	7.6
Trolleybus	39.0	7.4	5.7	4.1	5.1	4.8	4.1	3.6	3.4	1.4
Tram/Cable car (In above)		5.3	4.2	3.0	0.6	0.5	0.4	–	–	0.0
Total	470.9	151.9	156.8	174.0	185.6	204.8	230.7	251.8	247.5	100.0
Index 2001=100	310.0	100.0	103.2	114.5	122.2	134.9	151.9	165.8	162.9	
Passenger km million:										
Bus/Minibus	N/A	1,562	1,707	1,858	1,954	2,072	2,265	2,566	2,616	65.7
Taxi		0	5	9	20	59	79	103	126	3.2
Rail	315	48	48	41	30	27	28	24	27	0.7
Air	5,400	725	754	719	984	960	822	994	1,127	28.3
Metro	187	58	57	62	63	60	59	66	72	1.8
Trolleybus	176	35	27	19	23	22	18	16	15	0.4
Tram/Cable car (in above)		22	17	11	1	0	0	0	0	0.0
Total		2,450	2,615	2,719	3,075	3,199	3,271	3,769	3,983	100.0
Index 2001=100		100.0	106.7	111.0	125.5	130.6	133.5	153.8	162.6	
Average journey km:										
Bus/Minibus	N/A	13	13	13	12	12	11	12		
Rail	90	40	37	37	38	38	40	40		
Air	3,000	906	838	799	895	800	685	710		
Metro	4	4	4	4	4	4	4	4		
Trolleybus	5	5	5	5	4	4	4	4		
Tram/Cable car (In above)		4	4	4	1	1	1	1		
All		16	17	16	17	16	14	15		

Source: *Statistical Yearbook of Armenia 2009*. Note: * 1991 for metro, trolleybus and tram

4.5 Fuel Consumption

95. Transport sector fuel consumption increased by 74% 2001–2007, an average annual growth rate of 9.7% (Table 4-6). There was a major switch in fuel use, with CNG becoming the main fuel, due to its relatively low price. It accounted for 42% of consumption by weight in 2007.

Table 4-6: Transport Fuel Use by Type (%)

Type	2001	2002	2003	2004	2005	2006	2007
Petrol	66	57	52	54	47	39	34
Diesel	24	28	30	26	29	26	24
CNG	10	15	17	20	24	35	42
Total	100	100	100	100	100	100	100
Total '000 Tons	285	312	366	401	391	442	496

Source: *Sustainable Urban Transport in Yerevan*

4.6 Subsector Challenges

96. **Coordinated planning:** Ideally, road transport and the road subsector need to be considered as a single system, with the overarching objective of raising transport service quality and reducing operating cost. There is, however, no mechanism for users, providers, infrastructure and other agencies to jointly consider needs and priorities. For road safety, following intervention by the World Bank, coordination is being achieved. It needs to be extended to the whole subsector. Both passenger and freight services are heavily dependent on road transport. The challenge is to deliver efficient operation on a well-maintained road

network of appropriate standard. Effectively targeted donor support over the medium term is essential to achieve this. Government funding will be severely constrained by the economic depression.

97. Poorly maintained roads increase transport costs and reduce Armenia's international competitiveness. While network coverage is largely adequate and congestion is not a significant problem, the full potential of road transport will only be realized if existing deficiencies are addressed. There are development challenges, both physical and nonphysical. The physical challenges concern: (i) network standard and maintenance; and (ii) infrastructure at international borders. The nonphysical are: (i) limited institutional capacity; (ii) insufficient road maintenance funding; (iii) lack of human resources and action plan; (iv) weak construction industry and outdated design and construction standards; (v) deteriorating road safety record; and (vi) high cost of international trade, associated with border inefficiencies and constraints.

98. **Fleet renewal:** The private sector will find it increasingly difficult to finance vehicles in current circumstances, and a further aging of an already old vehicle fleet is in prospect. An old fleet: (i) reduces road capacity due to poor performance; (ii) increases accident rates; (iii) has higher fuel consumption; and (iv) greater noise and emission levels. The large economic benefits of fleet renewal need to be catalyzed with IFI/Government support. A short term waiver of import duties, a scrappage scheme (as in the US, Germany and the UK) or specific financial support for operators is needed.

99. **Urban and local roads:** An immediate challenge is urban and local roads, which are not the responsibility of ARD. These are essential for access to main routes and for urban mobility. Many are in very poor condition, without maintenance for many years. The economic cost in terms of time loss, damage to freight and increased vehicle operating costs is high. The administrative structure and availability of domestic finance is unfavorable for an early resolution of this problem. IFI intervention is essential. It will achieve a higher rate of return than the financing of more high profile projects.

100. **Road asset management:** This needs to be introduced to capitalize on the intensifying road improvement program. ARD maintains a road inventory and traffic database. Highway Design and Maintenance Model (HDM-4) is used to prioritize the maintenance program. This platform will have to be expanded to introduce fully integrated pavement and bridge management systems. Shortage of financing for the road subsector will impact the sustainability of the assets now being rehabilitated and/or reconstructed. The annual cost of an overlay program for network sustainability would be in the range of \$20–46 million. New sources of funding need to be found. Stable and secure funding is required, including application of the “user pays” principle, for example through the introduction of a transparent and autonomous road fund.

101. **Construction industry weakness:** The construction industry is fragmented and weak, but gradually building its capacity through donor funded roads and highways programs. However, there are no domestic contractors with the resources to tackle large scale contracts. International contractors have not worked in Armenia and alliances with international groups have not yet been tried. Contractors' equipment and technologies are outdated and inefficient. Bitumen and prefabricated concrete elements for road construction are imported.

102. Design, construction and pricing standards for civil works are outdated and do not comply with international best practice and standards. Inherited from former Soviet Union standards, they are not based on economy and efficiency. Unit prices are derived from outdated price schedules, with almost no competitively driven costs. Geometric design is based on the technical classification of the road (category I to V) without due regard to its function (trunk road or rural road) and construction specifications are not adjusted to modern

road construction equipment. These all contribute to high construction costs, together with an inefficient and outdated stock of construction equipment.

103. **Policy Framework:** The Government's short- to medium-term policy priorities are to: (i) define and implement a road development strategy; (ii) mobilize financial, technical and human resources to support strategy implementation; (iii) strengthen policymaking and the planning role of institutions; (iv) develop institutional capacity for efficient road management; (v) improve road safety; (vi) establish a legal and regulatory framework for private sector participation in network development, financing, maintenance and operation; and (vii) facilitate cross-border trade and transport through improved border infrastructure and border crossing procedures.

4.7 Institutional Capacity

104. At the 'macro' level, both MOTC and ARD operate effectively; yet there are institutional, technical, financial and operational constraints that demand urgent attention to fully utilize the benefits of higher investment and convert them into sustainable gains. Constraints are (i) shortage of financing for road maintenance and operations; (ii) absence of adequate planning and training of human resources integrated with universities' programs and curricula; (iii) lack of competitive and efficient construction industry; (iv) lack of competitive consulting engineers; (v) inadequate and outdated design, construction and pricing standards; and (vi) absence of road asset management and monitoring mechanisms. A strategy to address these issues was prepared under ADB technical assistance.²

105. MOTC and ARD lack adequate management and technical skills, systems and procedures. Retaining talented staff is a challenge and there are no programs that link industry with the engineering universities to supply needed human resources. With the planned investment, the workload will increase. This should prompt investment in developing human resources and a clear action plan to train highway engineers, economists and other related professionals to international professional standards.

106. The current environment is challenging: (i) GDP is expected to decline by over 15% in 2009, putting a great strain on Government budget resources over the medium term; (ii) a major increase in support from ADB and other donors is imminent, requiring the supervision of international contractors and the implementation of large projects; and (iii) there is a prospect of border opening with Turkey, which will transform road transport operations and change traffic flows and investment priorities. Staff resources within MOTC and ARD are limited, in accordance with the national lean administration policy. Work has focused on the short term, addressing immediate needs, with an *ad hoc* approach. Action is necessary to strengthen a number of areas to meet future challenges, including: planning, IT, databases, and overall management capacity.

107. MOTC has limited planning capability. Investment priorities evolve in a less than transparent manner, with the involvement of a number of agencies. Capacity development would result in better informed decisions, even if disagreements remain inevitable. ARD's supervisory and quality assurance capacities are stretched during the peak summer work period. While ARD structuring and staffing are consistent with its prime responsibilities and its technical capacity for routine work is adequate and in general it operates effectively in meeting its current responsibilities, capacity enhancement would be essential if ARD is involved with, for instance, international contractors. New financial management skills associated with more complex contractual structures are required for the implementation of projects under the MFF and other planned donor programs.

² ADB. 2007. Piggybacked to Loan 2351-ARM: Rural Road Sector Project. TA 4973-ARM Armenia Transport Sector Strategy 2020.

108. Table 4-7 sets out an institutional capacity development program for the road subsector.

Table 4-7: Road Subsector Institutional Capacity Development Program

Ref #	Issue	Responsibility/ Timing	Action	Cost \$ '000	Comment
1	Planning, prioritization and resource allocation	MOTC /ARD 2010–2011	Short-term training courses during MFF implementation.	50	The road subsector is not managed in accordance with long term plans, priorities or policies. Actions are determined by short term availability of funds. There is no Government consensus on priorities. The implications of the depression and possible border opening remain to be addressed. There is no clear line of responsibility for planning. TA assistance will be provided within MFF Tranche 1.
2	Asset Management Database	ARD 2010–2011	Update and improve ARD road and bridge inventory and traffic volume database. Disseminate to managers within MOTC/ARD	30	Database needs to be widely available to planners. Inventory, condition, contract documents, unit prices of contracts and available funds databases, need to be shared by headquarters and branch offices through a LAN. Item 5 supports improvement of traffic database.
3	Asset condition survey	ARD 2010–2012	Survey to support 2.	200	ARD's regional staff and facilities will need to be supplemented for roads, bridges and structures survey. Survey should include a sample of local and municipal roads not under ARD jurisdiction, as a needs assessment.
4	Medium term maintenance strategy	MOTC/MOF/ARD 2010–2012	Develop strategy consistent with prospective budget availability and result of item 1.	50.	MFF assurance requirement re availability of maintenance funds applies. Shortage for other roads likely to be significant as a result of the depression.
5	Support equipment	ARD 2010	Procurement of <ul style="list-style-type: none"> Traffic counters and viewing systems Highway measuring equipment Axle weight measuring equipment 	700 250 50	Existing equipment is worn out. MFF Tranche 1 allocates \$1 million for reequipment.

Ref #	Issue	Responsibility/ Timing	Action	Cost \$ '000	Comment
6	IT integration	MOTC/ARD 2010	Update/enhance IT support systems	300	MOTC/ARD IT systems are largely stand-alone, developed piecemeal by users. To improve oversight and planning capacity and to eliminate duplication, introduce integrated transport sector database on LAN or WAN.
7	Vehicle overloading	ARD 2010–11	Install permanent weigh scales on interstate network.	500	Permanent weigh scales need to be set up on interstate roads, with penalties imposed for overloading. Item 5 will provide additional equipment to better assess the extent of the problem.
8	Road safety	MOTC/ARD/Others 2010 onwards.	<p>Develop 2014–2019 safety strategy to follow on from 2009–2013 program developed with assistance from the World Bank.</p> <p>Assure continued financing of Road Safety Secretariat (currently limited to 18 months) at a cost of \$150,000 per annum.</p> <p>Mandate safety audits for all major projects.</p> <p>Strengthen speed management capacity, starting with enforcement on MFF projects.</p>	TBD	<p>Traffic accidents, fatalities and injuries are increasing. The 2009–2013 action plan targets a 10% reduction in fatalities through measures on seat belt enforcement (\$2 million), speed management (\$2 million), drunk driving (\$2 million) and vulnerable road users (\$1.5 million).</p> <p>MFF Tranche 1 includes a significant safety component for 4-lane sections of the M-1 and M-2.</p>
9	Financial management	MOTC/ARD 2010	Financial management training (available locally) for MOTC/ARD staff focusing on IFRS, commercial financial considerations and costing of projects/routine activities.	1,000	Staff are experienced in traditional budget-based accounting systems and procedures, but have minimal exposure to IFRS and commercial accounting limiting capacity to effectively monitor capital and recurrent activities.
10	Highway design standards	ARD 2010–2011	Review highway design standards against international norms and introduce consistent and affordable standards.	700	Existing standards are a combination of USSR and other standards. International standards, especially for geometry and pavement design, need to be adopted for technically and economically sound construction, safety and efficient use of investment resources.

Source: This Study, 2010

109. **Planning, prioritization, and resource allocation:** Given the relatively small numbers of staff available within the MOTC establishment, keenly focused human resource (HR) development programs are needed to ensure an appropriate range of technocratic expertise is available. Similarly to maximize the output from those limited personnel numbers, appropriate technological and associated resource support is critical.

110. **Asset Management Database:** MOTC does not have a computerized road database for maintenance. Information is currently stored in documents, which makes its further usage difficult and inappropriate for current needs. A road technical database should be developed, with description by section, current issues and the scheduling of current and past maintenance. This requires a specific database program, which could be developed by a local programming company. The system would preferably be in the form of a website, which will make it possible to access the database (both locally and through the Internet), to print the information needed, input new data and warn of critical road sections for maintenance. The database could subsequently be expanded to include intra-Marz and city roads, as well as other transport modes. The database program must be secure, with three levels of internal access: (i) user/collector, a specialist responsible for gathering information, investigating the site and inputting data; (ii) senior specialist, responsible for data verification; and (iii) database controller with overall responsibility. The database could function either within the MOTC website or on the Ministry's LAN system. The development cost is estimated at \$30,000 and could be implemented locally.

111. **Asset Condition Survey:** Inventory and condition surveys for all roads, bridges and structures need to be carried out and to be updated frequently to provide a computerized database for intervention programming. Inventory, condition, contract documents, unit prices of contracts and available funds databases, need to be shared by headquarters and branch offices through a LAN system, minimizing the cost and manpower for administration.

112. **Maintenance Strategies:** A major increase in the budget allocation for capital repairs was planned up to 2011. An additional budget for a periodic maintenance program is needed, plus funds to cover the roads transferred to ARD responsibility in 2008. The budget is at expected outturn prices. It is eroded by inflation, which was particularly high in 2007–2008. The strategic imperative is to have a more effective dialogue within the Government on resource allocation and use. MOTC/ARD must demonstrate to MOF that funds are being applied efficiently and used effectively by contractors. MOF must ensure that the allocation is sufficient for identified needs. Road maintenance has to be addressed as an asset management issue. At present, there is no objective function, no consideration of alternative maintenance strategies. Having hived-off maintenance work to contractors, ARD has limited its task to monitoring. It needs to be tasked with asset management and fostering contractor efficiency, and it needs to be better funded. MOTC needs to be tasked with network development planning and programming. A second round of three-year routine maintenance contracts stated in 2008, with 34 contracts under ARD supervision, covering 2,892km and winter maintenance of 3,127km. Some 2,277km of local road was transferred to ARD responsibility in 2008 (and largely re-designated as republican road), but without additional budgetary funding for maintenance.

113. **Axle Weight Controls:** Permanent weigh scales need to be set up on interstate roads, with fines imposed for overloading, which damages roads. A 33% increase in axleload from 15,000 to 20,000kg is equivalent to a 350% increase in ESA (Equivalent Standard Axle Load), from 15.5 to 55.5. Damage-causation is related to ESA.

114. **Road Safety:** Traffic accidents, fatalities and injuries are increasing. Workshops in September/October 2008 reviewed World Bank consultants' proposed road safety strategy. A broad consensus was achieved that initially a \$10 million program 2009–2013 is required, targeting a 10% reduction in fatalities (saving around 50 lives annually). The World Bank undertook to finance such a program, if requested by the Government. A Road Safety Board

chaired by the Prime Minister would be set up, to which a permanent Secretariat would report. The Secretariat (expected to be within ARD) would monitor Working Groups for: (i) data management; (ii) safety engineering; (iii) vulnerable road users; and (iv) other matters. A draft action plan includes measures on seat belt enforcement (\$2 million), speed management (\$2 million), drink driving (\$2 million) and vulnerable road users (\$1.5 million). If the initial program achieves its objective, strategy for 2014–2019 should be for a follow-on program, targeting at least a further 10% reduction in fatalities, for a similar investment. The second phase program should be able to attract grant support from international bodies.

115. **Financial Management:** There is a generalized need to address financial management capacity in ARD and MoTC, particularly in relation to interaction with the private sector. Specifically, whilst officers are well able to meet their financial responsibilities in relation to the traditional Government budgetary systems and reporting requirements, there is a widespread need to enhance financial management capacities in the commercial context and in response to the introduction of IFRS. These skills are urgently needed in the roads sub-sector to support the diversification of investment structuring and enhanced governance and to facilitate the required regulation and oversight responsibilities attendant thereto.

116. **Design Standards:** Standards are a mishmash of USSR and others and need to be reconsidered. International standards, especially for geometry and pavement structure, need to be adopted to obtain technically and economically sound construction work, safe driving and to promote more efficient use of investment resources. (See Appendix RD-2 for recommended standards.)

117. ARD's institutional development needs are relatively small and can be met with minimal resource commitment. Addressing them as a matter of urgency however is critical to the sustainable development of the sector and as such due priority should be given to their early implementation in accordance with the timescales noted in Table 4-7 above.

4.8 International Support

118. Many international financial institutions (IFIs) and other agencies, public and private, have provided assistance, substantially increasing subsector investment. Further assistance is planned by ADB, JICA, and the World Bank. Support and interventions are detailed below and in Table 4-8.

- (i) **Asian Development Bank (ADB).** Armenia became a member of ADB in September 2005. ADB's assistance focuses on upgrading and rehabilitating priority roads and bridges, strengthening road management capacity and supporting transport sector development. Under the *Country Operational Business Plan 2008–2010* interventions focus on: (i) rural development; (ii) private sector development; and (iii) regional cooperation.
 - (a) The *Rural Road Sector Project* is financing the rehabilitation of high priority LRNP roads. Loan 2351-ARM of \$30.6 million was signed on 15 November 2007. A supplementary loan of \$17.3 million was approved on 7 November 2008. Contracts have been let for the whole program: 227km of road.
 - (b) An MFF for the *North–South Corridor Development Program* was signed in 2009.
 - (c) An MFF for urban transport is expected to include funding for the metro and Yerevan Western Inner Relief Road. Project specification is in progress under a PPTA.

- (ii) **Armenian–European Policy and Legal Advice Center (AEPLAC).** AEPLAC commissioned a study to compare institutional arrangements in Armenia and the European Union (EU) in road and rail transport.
- (iii) **Armenian Social Investment Fund (ASIF).** ASIF, set up under World Bank auspices, has undertaken a number of small-scale rural road projects. ASIF develops projects at grass roots level and works in all villages of the country.
- (iv) **European Bank for Reconstruction and Development (EBRD).** An urban transport project of about \$20 million is in preparation.
- (v) **Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ):** It provided for the development of the PSRP-2 (together with the World Bank) and for urban transport improvements in Gyumri.
- (vi) **Japan International Cooperation Agency (JICA).** JICA is reviewing a proposed Yen loan project for rehabilitation of LRNP roads. Draft Final Report of *Supplemental Study for Feasibility Study* issued (May 2008, Central Consultant Inc.).
- (vii) **Lincy Foundation** of the United States. Lincy Foundation, established by the Armenian Diaspora in the US, has provided grants for road rehabilitation and development: (i) \$71.6 million (2001–2003) for rehabilitation of 427 km of interstate and republican roads, five bridges and two tunnels (Sevan–Dilijan and Spitak–Gyumri); (ii) \$13.6 million for rehabilitation of 22 km of streets in Yerevan (2002–2003); (iii) \$14.1 million for rehabilitation of 56.9 km of rural roads (2006–2008), including H-17 Gyumri–Getap; and (iv) \$18.4 million for construction/rehabilitation of 7.2km of Yerevan streets (2006–2008), including three underpasses on Khanjian Street. Lincy Foundation finances projects requested by the Government. Construction supervision is through its Road Project Implementation Unit (PIU).
- (viii) **Millennium Challenge Corporation (MCC)** of the United States: Rehabilitation of 24.5 km of H17 Getap–Armavir, adjoining the Lincy foundation project, has been completed.
- (ix) **Transport Corridor Europe Caucasus Asia TRACECA** has financed a number of transport sector studies (see www.traceca.am). Ongoing TACIS/TRACECA project *Trade Facilitation and Institutional Support for Armenia and 12 Countries*. Planned studies include *International Logistical Centers for Caucasus and Western NIS Countries* and *Improving the Rail Connection Tbilisi–Yerevan*.
- (xi) **Turkish–Armenian Business Development Council.** Sponsored report *The Stakes of Opening Turkish–Armenian Border*, October 2002.
- (xii) **United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).** Supported study on improving the Goris–Kapan section of the Asian Highway, 2007.
- (xiii) **United States Agency for International Development (USAID).** Prepared *Tourism Development Concept Paper*, 2007 under the Competitive Armenian Private Sector (CAPS) project and a study to develop tourism in Jermuk, 2008.
- (xiv) **World Bank.** The World Bank undertook a *Transport Sector Strategy Study* in 1997. A \$36.9 million *Highway Project* (September 1995–December 2000) included routine and periodic road maintenance, bridge and tunnel rehabilitation, road equipment and institutional strengthening of ARD. A

Transport Project (approved June 2000, completed December 2004) of \$28.4 million, including the Government component: (i) rehabilitated 227 km of road; (ii) provided routine maintenance on 786 km and 11 bridge improvements; (iii) included a road safety component of \$4.5 million with Technical Assistance (TA) for the National Road Safety Council, which was established in 2001; (iv) included a \$14.8 million railway component financed track and bridge rehabilitation over 70 km (Ayrum–Ani) of the Yerevan–Georgia Border line and improved financial management of Armenian Railways; and (v) \$0.9 million to support the Ministry of Transport and Communication (MOTC), primarily on legal issues.

The following projects are included in the World Bank *Country Assistance Program 2009–2012*: (i) Lifeline Roads 2009 \$12 million (to finance 120km of LRNP road); (ii) Rural Roads 2010 \$36 million (to finance 140km of LRNP road); (iii) Roads I 2010 \$43 million (to finance rehabilitation of sections of M-2, M-3 and M-6; and (iv) Roads II 2011 \$68 million (scope as for Roads 1).

Table 4-8: IFI Assistance to the Road Subsector

Source	Project Title	Amount (\$ mill.)	Date of Approval
A. Loan			
1. World Bank	Highway Project	36.90	1995
2. World Bank	Transport Project 227km	28.40	June 2000
3. World Bank	Lifeline Roads 2009 120km	25.00	2009
4. ADB	Rural Roads Sector Project 227km (L2351-ARM)	30.60	Sept 2007
5. ADB	Rural Roads Supplementary Loan (L2467-ARM)	17.32	Oct 2008
B. Grant			
1. Lincy Foundation	Rehabilitation of highways/secondary roads (435km)	73.40	2001
2. Lincy Foundation	Rehabilitation of city streets (22.3km)	13.50	2003
3. Lincy Foundation	Rehabilitation of secondary roads (87.4km)	16.50	2004
4. Lincy Foundation	Rehabilitation of city streets (7.5km)	20.90	2004
5. MCA#	Rural Roads Rehabilitation H-17	6.80	2005
6. JICA	Road Construction Equipment	5.00	
C. Non-lending			
1. ADB	Armenia Transport Sector Development Strategy 2020 (TA4973-ARM)	0.60	
2. ADB	Preparing the North–South Corridor Development Project (TA7208-ARM)	1.00	
Total		275.92	
D. Proposed Lending			
1. ADB	MFF North–South Corridor Development Program	500	Sept 2009*
2. ADB	MFF Urban Transport	36	2010*
3. World Bank	Rural Roads 140km	43	2010*
4. World Bank	Roads I 71km	68	2010*
5. World Bank	Roads II 75km		2011*

Sources: ADB, World Bank,. Notes: ADB = Asian Development Bank, MCA = Millennium Challenge Armenia, MFF = Multitranchise Financing Facility, TA = technical assistance. Note: # Grant of \$67.0 million, balance cancelled * indicative.

4.9 Investment Plan and Road Map

119. The two principal drivers of an investment plan are availability of: (i) funds and (ii) economically feasible projects. The onset of depression has improved (i) through access to IFI counter-cyclical support, but has limited (ii) by reducing future traffic volume and the benefits of investment. Optimal resource use requires that the improvement standard of each project is appropriate.

120. The ADB *Armenia Transport Sector Development Strategy 2020* developed a road investment plan, including non investment components focusing on priority reforms, development of regulations and operational procedures; encouragement of private sector participation in construction and maintenance; and capacity building for planning, monitoring, evaluation and reporting. The investment plan includes upgrading the principal north–south routes from Yerevan to the north and to the south as: (i) M2/M6: Bagratashen–Vanadzor, Vanadzor–Dilidjan, Yerevan–Ararat, \$100 million, (ii) Yerevan–Sevan–Dilijan (M-4), rehabilitation/widening 118km, 4-lane 3.65 carriageway, grade separation, \$131.5 million;

(iii) Yerevan–Gyumri (M-1), rehabilitation/widening 125km, 4-lane 3.65 carriageway, grade separation, \$150 million; and (iv) Yerevan–Yeraskhavan (M-2), rehabilitation 70km, 4-lane 3.65 carriageway, grade separation, \$56 million.

121. There are several risks of investment in the proposed tranches under the MFF, including macroeconomic instability in both Armenia and the sub region due to the global financial crisis, from with only recent positive growth is being shown; weak implementation capacity as highlighted in this Report; cost overruns due to escalation of prices, currency, and interest rates; traffic volume uncertainty due to economic conditions, and border openings; as well as risks of seismic activity. Armenia is considered to be at low risk of debt stress and economic conditions are expected to improve. Government commitment (as well as standard assurances) to the transport and economic corridors, mechanisms for efficient oversight and quality control of designs and works, and contingencies in the investment plan are necessary to help mitigate risks.

4.10 Monitoring Framework

122. Implementing the Action Plan requires: (i) incorporating objectives into annual work programs, with agencies “buying in” to the long term objectives; (ii) consistent project evaluation and planning; (iii) prioritization of programs in accordance with available resources; and (iv) regular updating and monitoring against benchmarks.

123. Table 4-9 shows a framework for investment program monitoring with performance indicators.

**Table 4-9: Road Subsector Investment Program
Impact Monitoring**

Objective	Impact	Performance Target	Measurement	Responsible Party
Economic growth	Sub regional trade benefits	Increase in imports/exports	Data from national economic and trade statistics	MOE / MOTC
		Increase in national freight transport by road from 5.07 tonnes (and 179 ton km) in 2008	Customs statistics	
			Freight haulage company surveys	
			Improvements to border facilities	

Objective	Impact	Performance Target	Measurement	Responsible Party
Road network development	An efficient, safe, and affordable network meeting the needs of Armenia and the subregion	Road subsector strategy for roads endorsed in 2010 and set for implementation	MOTC data, measurements of travel time and road condition	All concerned government agencies
		620km interstate roads and 1,200km rural roads are improved by 2017	Statistics from NRSC and Traffic Police	MOF/MOE for budget allocation
		Interstate roads are built to 100km/hr operating speed		MOTC/ARD for implementation and compliance with social, environmental and road safety requirements
		Average road roughness on rural roads brought to below 5m/km IRI		
		Road accident fatality rates reduced 10% annually		
		Road safety audit incorporated in all main road improvement works by 2017		
		Road projects comply with accepted environmental safeguards and impact mitigation requirements		
		Road projects comply with accepted social safeguards and impact mitigation requirements		
Road improvement and sustainable maintenance	Extended life of investments and road network	Cross border traffic increases		
		Inter modal facilities are developed		
		Average condition of roads rated "good" surpass 80% by 2017	Road condition surveys	MOF/MOE MOTC/ARD
		Average condition of roads rated "poor" brought to less than 10% by 2017	MOTC statistics and contracts	
		Performance-based maintenance contracts extended to all road maintenance activities	MOF and other government statistics	
		Budget for routine maintenance is kept at \$5,000–7,000 per km for interstate roads adjusted for inflation		
		Budget of \$10 million for annual periodic road maintenance activities is achieved		
		Revenue generating mechanisms through tolling and/or shadow tolling introduced by 2017		

Objective	Impact	Performance Target	Measurement	Responsible Party
Improve road subsector planning and management	An efficient planning and management capacity of road subsector agencies	<p>Economic appraisal and planning unit established under MOTC/ARD and staff is trained by 2010</p> <p>Social and environmental compliance unit established under MOTC/ARD and trained by 2010</p> <p>National road subsector human resource strategy and action plan adopted and programs with universities launched by 2012</p> <p>New national road design and construction standards introduced by 2014</p> <p>Automated traffic monitoring, safety monitoring and axle weight control system introduced by 2014</p> <p>Road asset management system is introduced and fully implemented by 2015</p> <p>National Road Safety Strategy implemented fully by 2015</p> <p>Advanced financial management systems and methodologies introduced and staff trained by 2015.</p>	<p>MOTC/ARD reports</p> <p>Other government agency reports</p>	MOTC/ARD/ National Road Safety Council
Socio economic	Reduction in poverty	<p>From PRSP-II:</p> <p>GDP per capita AMD 6,987 thousand (by 2021)</p> <p>Average monthly salary AMD 267,534 (by 2021)</p> <p>% population below poverty line 6.8%</p>	Data from relevant ministries	MOF / MOE / MOLS

Source: PRSP-II, 2008, and This Study, 2010

4.11 PPP Potential in Road Sector

124. The pace of global investment in infrastructure is considerable and Armenia has the same urgent need as other countries to support economic growth.³ The vast scale of investment will require more private-sector money. To attract that, developing countries need to offer investors a decent return and that will require reform of their regulatory systems and a move towards market pricing. In turn, the financing needs of massive infrastructure investment could encourage the development of domestic bond markets, bringing additional long-term benefits. The global recession, which commenced in late 2008 and profoundly impacted on Armenia, may reduce PPP investments in the short-term, due to restriction of

³ It is predicted that developing economies will spend USD 22 trillion on infrastructure over the next 10 years. China is spending around 12% of its GDP on infrastructure, compared with a total investment of around 5% a year at the peak of the UK's railway mania in the 1840s.

funds for private finance. However, the longer-term investment trends are likely to be maintained, supported in the short-term by government stimulus packages recently initiated by several major economies worldwide. Armenia needs to address these issues now, to ensure that the country is optimally positioned as economies improve in the coming years.

125. A Public-Private Partnership (PPP) constitutes a sustained collaborative effort between the public sector (government agencies) and private enterprises to achieve a common objective (e.g., the road project) while they pursue their own individual interests. In a PPP each partner:

- shares in the design of a road project;
- contributes a portion of the financial, managerial and technical resources needed to execute and sometimes operates the project in accordance with each partner's comparative advantage, and;
- partially shoulders the risks associated with the project and obtains the benefits—those expected by each partner—as defined in the project contract.

126. For PPP applications in the road sector to be even initially attractive they need to be financially feasible either through tolling (or shadow tolling) structures, adoption of alternative financial structures such as Government support modalities, or some other form of shadow pricing. The essence of that feasibility therefore devolves on cost /revenue relationships which have the potential for generating financially feasible applications.

127. PPP procurement costs can reach 5–10% of the capital cost for a reasonably large project and do not reduce pro rata for smaller projects. It follows from this that PPPs are not cost-effective for very small projects, unless they can be packaged together (in UK, projects of less than USD 40 million investment value are no longer considered for PPP). Equally, it is questionable whether PPPs are suitable for very large projects where the addition of extra complexity to the structure may make the project collapse under the weight of its own complications.

128. **Benefits of PPP:** A key advantage of having the private sector provide public services is that it allows public administrators to concentrate on planning, policy and regulation. The private sector, in turn, is empowered to do what it does best, and in particular improve the efficiency and quality of service.

129. The benefits of PPP are typically:

- The government can reduce their investment obligation
- Operation and maintenance can be improved through private sector's efficiency.
- Encouragement of public sector reform
- Wider connection will provide benefit to rural roads as well as the people who use rural roads.
- Improve level of service, especially for projects requiring road user charges (tolls or other).
- Promotion of economic and social growth by private direct investment.
- Transfer of modern technology to domestic public and private sectors.
- Promotion of environmental and social sustainability: the private sector focuses on efficient use of resources and materials over the project lifecycle.
- Extending private ownership and adopting a market-economy approach.
- Stimulation of domestic capital and debt markets.

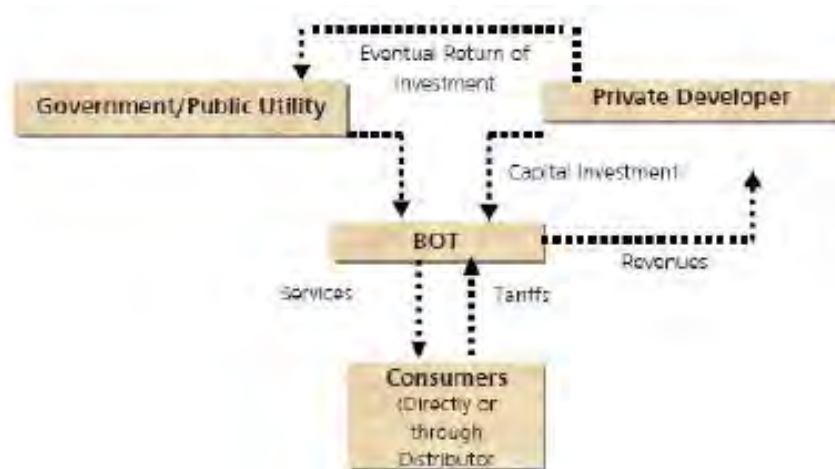
130. With regards to efficiency, the private sector has greater flexibility in work planning and organization to ensure timely performance. The life-cycle approach of PPP provides an incentive for contractors to define alternative solutions to meet performance requirements at lower cost and/or with higher efficiency. Research and development can allow the

improvement of quality and efficiency of construction techniques, processes and equipment. The contractor is able to balance expenditure over the project life and make effective trade-offs between investment, maintenance and operation costs without the constraints of public funding availability.

131. With regards to public sector reform, PPP encourages transparency and accountability and allows the public authority to act as a regulator concentrating on service planning and performance monitoring. The PPP process develops procurement skills which can spill over into conventional procurement.

132. Development of a trunk road can contribute to rural road development by connecting the rural production area to the urban market. Simultaneous development of both rural and trunk roads would expedite the growth of social and economic activities then would accelerate the effect of the road transportation.

133. **PPP Structure:** BOT is a concession in which a private firm builds, operates, and then transfers an infrastructure project according to performance standards set by the government.



Source: Heather Skilling and Kathleen Booth, 2007

Figure 4-1: PPP Structure

134. Alternatively, the public sector could construct the road and toll revenue be used to maintain the road.

135. **Sources of Revenue:** Tolls are a common source of revenue. Cross border traffic would allow Armenia to gain income from the transportation for goods through the country. Foreign currency fluctuation can be taken into consideration when deciding the toll structure.

136. Other sources of revenue for highway projects are:

- Shadow tolls
- Lease payments
- Vehicle taxes/fees e.g. % national motor fuel tax
- Land agreements
- Utility agreements e.g. a joint duct for fibre optic cable
- Tourism e.g. a PPP-based agency to develop tourism and supporting infrastructure

137. If the expected toll revenue is not considered adequate for private investment, innovative ideas to generate income should be allowed by the private sector. For example,

land along the road could be used for other purposes. A joint duct may provide an opportunity for trunk optical fiber telecommunication line operator.

138. **Current Status of PPP in Armenia:** PPP is present in Armenia in sectors including energy, telecommunication, transport, postal service, water distribution, local utilities and urban development. PPP has been instrumental in rehabilitation and maintenance of energy generation and distribution, national highways, water distribution networks, etc. All main types of PPP models – concessions, divestitures, Greenfield projects, and management and lease contracts are present in the country. These include a concession to upgrade and operate nation's main airports; management contracts to run the national postal service; urban and regional water supply networks; contracts to design, build and operate hydropower stations; etc. Additional PPP projects, including a concession to operate the national railways, are in the pipeline

139. At the present time, PPP and PPP instances are extremely limited in the Armenian road sector being restricted to the provision of roads maintenance services and some elements of transport service delivery. In the broader transport sector and economy as a whole, Armenia has some experience of PPP but this is primarily focused on service delivery franchising (water, railway sectors) and, to a lesser extent, facility management (airports).

140. Armenia's PPP/PPP experience profile is presented in the following table that provides a thumbnail overview of the current situation.

Table 4-10: Strengths and Weaknesses of Armenia's PPP Environment

Strengths	Weaknesses
Predominantly positive experience of PPP	Clarity, consistency & transparency in PPP imitation and administration
Government & society accepts private sector provision of infrastructure services	Legal & Regulatory framework has not ensured truly competitive bidding or systematically protected the public interest during PPP awards or subsequent implementation
Availability of regulatory tools for PPP	HR capacities in the civil service are limited in terms of ability to effectively conclude and manage PPP contracts
Effective cost recovery performance achieved in key infrastructure sectors	Impact assessment and performance evaluation systems are piecemeal and not consistently applied
Urgent need for transport infrastructure investment with diminishing capacity for public investment creates strong demand for PPP.	National financial institutions are at an early stage of development with the result that there is a strong dependency on grants and concessionary loans
	Limited impact on poverty reduction and regional economic development
	Civil society and the private sector retain doubts as to the 'fairness' of PPP policies adopted. Some public sector resistance to PPP growth.
	Current and projected economic climate is not conducive to the ready availability of private sector funds unless significant risk mitigation measures are available. ⁴

Source: Strategy Development Study and PPP in Armenia – A Concept Note: UNDP 2008.

141. **Constraints:** There are a number of aspects that may constrain the viability of PPP. Traffic volume to generate toll income is not assured, even if the forecast is accurate. In some cases, road users can choose the toll road or an alternative untolled route. However, certain traffic can be controlled and obliged to utilize the toll road by government policy. For

⁴ Source: The Consulting Team

example, large container trucks can be controlled to utilize the toll road in order to avoid entering built-up areas for safety and air protection.

142. In the majority of cases, however, the Government would normally wish to be able to offer users an alternative route so as to avoid monopolistic conditions that could have adverse impact on other economic objectives, such as equity of income distribution and broader issues of economic development.

143. PPP consortia are generally led by experienced international players with the required expertise and financial stability to assume the financing and risk of the PPP investment. This could be particularly applicable in Armenia where domestic construction capacity is tightly constrained. The predominant role of large foreign contractors may both have political implications and may directly affect the local contracting industry by restricting the implication of domestic players. However, it is evident that PPP developers need to rely on a wide array of domestic suppliers, contractors and consultants under sub-contracting arrangements.

Table 4-11: Risk Allocation and Methods of Mitigation

Risk	Responsibility	Mitigation
Construction Cost Over-runs	Concessionaire/ Contractor	Fixed price, lump sum, turnkey contract Completion guarantees Insurance program
Construction completion	Concessionaire/ Contractor	Fixed date for completion Penalties for delay Insurance program
Operation	Concessionaire/ Operator	Proven track record of similar projects
		O&M Agreement defining levels of service and rewards/penalties
Traffic Volume	Concessionaire	Contract extended in case of non-achievement Independent traffic study Additional revenue from Government (cash support guarantee)
Tariff Adjustment Mechanism Failure	Government	Concessionaire compensated to cover expenditure and agreed rate of return
Foreign Exchange Fluctuation	Government	Support to concessionaire by payments based on exchange rate deviations from an agreed base case
Interest rate	Concessionaire	Fixed interest rates
Legal	Concessionaire Government	Case study or common law, concession agreement Compensation to cover change in law on project revenues
Land acquisition	Government	
Revenue	Contractor	Tolls can be revised annually through an indexation formula
Inflation	Government	Toll adjustment mechanism
Political	Concessionaire/ Government	Insurance/compensation
Force Majeure	Concessionaire/ Government	Insurance coverage and temporary toll review Compensation/termination

Source: This Study, 2010

144. **PPP Framework:** Experience with PPPs worldwide, suggests that is useful, if not essential, to have a framework in place, to instill confidence and understanding in all participants in the PPP process. This includes both public and private partners. The following components provide framework for accelerating the development of PPP into signing of PPP agreements (closure of the PPP transaction) and the completion of funding (financial closure)

145. A specific PPP framework would include:

- The legal and regulatory framework,
- Procurement guidelines,
- Model PPP contracts, and
- Risk Management Framework,
- Financial guidelines (Tariffs, payments and Government support),
- The Project Cycle and the role of Advisors,
- Technical design and service standards,
- Institutional and Approvals Framework (Including Dispute resolution mechanisms).

146. If foreign private investors are to be invited, it will be necessary to permit the exchange and transfer of foreign currency freely.

147. **Government Commitment:** As it is quite new for the private sector to make an investment in the road sector in Armenia, the predictability of the government is indispensable for appreciation by the private financial market. Therefore, once the government has decided the policy to develop the roads in a PPP manner, continuous and visible support by the government should be arranged and disseminated. For example, all of the cost and necessary action for land acquisition and compensation should be carried out by the government. The government may also keep its flexibility on the detail of concession contract with private investors. Private investors may take part of the commercial risk, but the sovereign risk should be supported by the government.

148. **Policy Considerations:** Public-private partnerships cannot be implemented in isolation. They must form part of a national highway program and be implemented within the context of national policies for private participation in the public sector. They must respond to a specific history and heritage of relationship between the public and private sectors and a culture of public tradition related to private sector involvement in providing public infrastructure.

149. **Institutional Considerations:** PPP policy may accompany a wider restructuring of the road agency with a reduction in the number of civil servants and / or transfer to the private sector. If not carefully planned and conducted in conjunction with social measures, these programs can lead to de-motivation and opposition from road agency personnel. This is potentially a critical point for GoA to address.

4.12 The North–South Corridor

150. **Description:** The North–South Road Corridor (NSRC) runs 556km from the border with Georgia at Bavra (M-1, km 173), via Gyumri (M-1, km 125), Ashtarak (M-1, km 28), Yerevan (M-1/M-2, km 0), Goris (M-2, km 238), Kapan (M-2, km 300) to the border with Iran at Meghri (M-2, km 383). It is 2-lane throughout, with the exception of km11.8–30.2 on the M-1 (Yerevan–Ashtarak) and the M-2 (Yerevan–Ararat section), which are dual 2-lane.



Source: This Study, 2010

Figure 4-2: The North–South Corridor

151. The whole NSRC is part of the Asian Highway Network – AH81/82 (Table 4-12). The Intergovernmental Agreement on the AHN entered into force on 4 July 2005, under the auspices of UNESCAP. Contracting Parties are obliged to develop Asian Highways to conform with the classification and design standards. The AHN network in Armenia comprises 966km: the principal international links between Iran, Georgia and Azerbaijan (currently non-operational). The Yerevan–Aragat section of the M-2 is also part of north–south European route E-117 from the Russia/Georgia border via Tbilisi, Dzoramut and Vanadzor.

Table 4-12: Asian Highways

AH No.	Route	Length km
AH81	Bagratashen (Georgia Border)–Yerevan–Eraskh	271
	Agarak–Meghri	61
AH82	Bavra (Georgian Border)–Gyumri–Ashtarak	158
	Eraskh–Goris–Kapan–Meghri	324
AH82	Aigehovit (Azerbaijan Border)–Sevan–Yerevan	152

Source: UNESCAP, 2003, Asian Highway Handbook.

152. Border crossings: There are three border crossings with Georgia, at Bagratashen (M-6), Dzoramut (M-3) and Bavra (M-1) and one with Iran, at Meghri (M-2). Trucks entering Armenia from Georgia are primarily from the Russian Federation and other Commonwealth of Independent States (CIS) countries, and from Europe and Turkey. Turkish trucks on the Transports Internationaux Routiers (TIR) system are authorized to enter from Georgia, but

Armenian trucks are not able to enter Turkey. The daily average number of trucks entering in 2007 was 84 via Meghri (from Iran) and 114 via Bagratashen (from Georgia). In 2008, an average of 59 trucks per day entered via Bagratashen after transit through Georgia: 47% from the port of Poti, 6% from the port of Batumi and 40% from Sarpi (Georgia–Turkish border). Only 8 loaded trucks per day via Bagratashen transited from Armenia through Georgia.

153. **Georgia connections:** The principal subregional corridor through Georgia is the East–West Highway (E-60) and the adjoining E-70, which connects Europe and Asia. It runs north from the Turkish border at Sarpi, via the Black Sea port of Batumi to the port of Poti, then east via the second largest city Kutaisi to Tbilisi, and south–east to the border with Azerbaijan at Red Bridge. Three corridors run south from Tbilisi to the Armenian border at Sadakhlo/Bagratashen, Guguti/Dzoramt and south of Ninotsminda/Bavra. The road condition immediately north of the border of the last two corridors is poor and nearly all traffic currently travels via Bagratashen. The Ninotsminda–Bavra section is under rehabilitation by Millennium Challenge Georgia for completion by October 2010. This will facilitate use of the NSRC through Bavra,

154. **Road condition:** Average sectional IRIs in 2008 on the M-1/M-2 ranged from 4.1–6.1 (Table 4-13).

Table 4-13: NSRC IRIs 2008

Section	IRI 2008	Length Km
1. North–South Corridor M-1:		150
Bavra (km173)–Gyumri N. (km130)	5.52	43
Gyumri S.(km119)–Talin (km70)	5.18	49
Talin (km70)–Begin 4-lane (km30)	5.18	40
Km30–Yerevan (km9)	4.68	18
2. North–South Corridor M-2		368
M-2/M-15 (km15) – Yeraskh (km65)	4.10	50
Yeraskh (km65) – M-2/M-10 (km120)	5.45	55
M-2/M-10 (km120) – M-2/Jermuk (km147)	6.07	27
M-2/Jermuk (km147) – Goris (km238)	5.51	91
Goris (km238) – Kapan (km300)	4.95	62
Kapan (km300) – Iran Border (km383)	4.69	83

Source: ARD

155. **Traffic volume:** Annual average daily traffic volume (AADT) in 2008 on each section of the interstate network is shown in the figure “Interstate Roads Traffic Volume 2008” at the end of this report. There are automatic traffic counters at ten locations on six interstate routes. Annual average traffic 2005–2008 is given in Table 4-14. In 2005–2006 there was a growth of 12%, in 2006–2007 of 7%, but a decline of 5% 2007–2008.

Table 4-14: Traffic Counts on M-Routes 2005–2008

Counter Location	2005	2006	2007	2008
M1 Yerevan–Gyumri–Georgia border, 20+700m NSRC	9,738	10,323	9,953	11,620
M2 Yerevan–Meghri–Iran border, 9+380m NSRC	22,625	23,599	24,551	20,965
M2 Yerevan–Meghri–Iran border, 200+320m NSRC	760	1,002	N/A	N/A
M2 Yerevan–Meghri–Iran border, 367+250m NSRC	670	804	840	1,240
M3 Margara–Vanadzor–Georgia border, 125+830m	2,210	3,348	4,195	4,799
M3 Margara–Vanadzor–Georgia border, 135+160m	861	1,417	1,381	2,478
M4 Yerevan–Sevan–Ijevan–Azerbaijan border, 80+300m	1,455	2,301	961	783
M4 Yerevan–Sevan–Ijevan–Azerbaijan border, 10+320m	19,484	22,877	25,386	21,505
M5 Yerevan–Armavir–Ijevan–Turkish border, 9+400m	19,046	19,815	23,202	21,471
M6 Vanadzor–Alaverdi–Georgia border, 59+050m	721	1,365	1,297	2,116
Total	77,570	86,851	91,766	86,977

Source: Armenian Roads Directorate

156. In addition to the above data, the consultants carried out traffic counts in May and October 2009. The results are summarized in Table 4-15 (full details are given in Appendix 2).

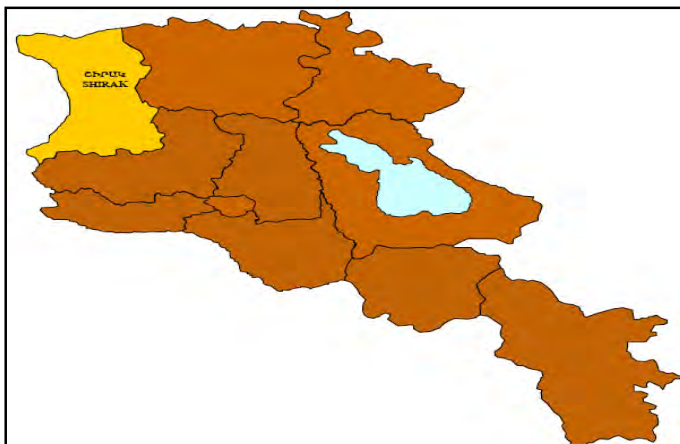
Table 4-15: Consultants' Traffic Counts 2009

Location	Car	Pickup	Minibus	Bus	2- axle	3- axle	4- axle+	Total	PCUs	% ADT Peak Hr.
M-1 Bavra	214	40	30	0	0	2	9	295		
M-2:										
Km16	9,163	944	824	164	447	521	269	12,332	14,035	7.8
Km228	1,170	114	142	14	72	127	117	1,756	2,167	5.9
Km270*	520	83	48	3	46	125	95	920		
Of which: Iranian plates	24	0	0	3	0	8	87	122		
Km296	2,357	229	203	36	158	216	66	3,265	3,786	7.7
H-46*:										
Devil's Bridge**	68	7	8	0	11	0	0	94		
10km from Kapan***	260	7	3	6	6	2	0	284		
Composition %:										
Km16	74.3	7.7	6.7	1.3	3.6	4.2	2.2	100.0		
Km228	66.6	6.5	8.1	0.8	4.1	7.2	6.7	100.0		
Km270	56.5	9.0	5.2	0.3	5.0	13.6	10.3	100.0		
Km296	72.2	7.0	6.2	1.1	4.8	6.6	2.0	100.0		

Source: This Study, 2010 Notes: * 6 October 2009 ** 14-hour *** 12-hour

157. **Description of Marzes:** The NSRC passes through six marzes, described in Boxes 1 through 6. It provides access to important tourist attractions, including Tatev monastery and Jermuk (25km from the M-2), famous for its mineral waters and spa. In both places, major developments are planned, including a 5km cablecar at Tatev. A *Comprehensive Development Plan: Jermuk as a Destination Spa and Winter Tourism Center* December 2008, CAPS envisages a threefold increase to 100,000 in the number of annual visitors.

Box 1: Shirak Marz



Marz capital – Gyumri

Districts - Artik, Akhuryan, Ani, Amasia, Ashotsk

Towns - Gyumri, Artik, Maralik

Shirak marz is in the north–west (see map). It borders Turkey to the west, Georgia to the north, Lori marz to the east and Aragatsotn marz to the south. At a height of 1500–2000m (52 villages are at a height of 1500–1700m and 55 villages at 2000 m), it is the coldest region of the country, with temperatures as low as –46°C in winter.

The main rail and road routes Armenia–Georgia pass through Gyumri, with connections to Turkey (closed). On the River Akhuryan and forming the border with Turkey is the Akhuryan reservoir, the largest in the country, with a volume of 526 million m³.

The leading industries of Shirak marz are production of food, including beverages and production of other non-metallic mineral products. Tufa and pumice of Artik and Ani are well-known.

Freight and passenger transport are by road, rail and air (Gyumri airport provides connections to CIS countries and is the alternate to Yerevan).

In 2007 the contribution of Shirak marz to the national economy was: industry 2.3%, agriculture 10.0%, construction 1.5%, retail trade 2.0% and services 1.9%.

Gyumri (population 147,000) is 120km north of Yerevan at a height of 1550m on the left bank of the River Akhuryan. It is the second city in terms of population and importance. Gyumri accounted for 59% of industrial production of the marz in 2007 and is the main retail centre.

Box 2: Aragatsotn Marz



Marz capital – Ashtarak

Districts – Ashtarak, Aparan, Aragats, Talin

Towns – Ashtarak, Aparan, Talin

Aragatsotn lies between Yerevan and the highest mountain peak, Aragats. To the west it borders Turkey, to the north Shirak and Lori marzes, to the east Kotayk marz, to the south–east Yerevan and to the south Armavir marz.

Freight and passenger transport are by road.

The famous Byurakan Observatory and the Institutes of Radiophysics and Electronics, Physical Research of the National Academy of Sciences are in Aragatsotn.

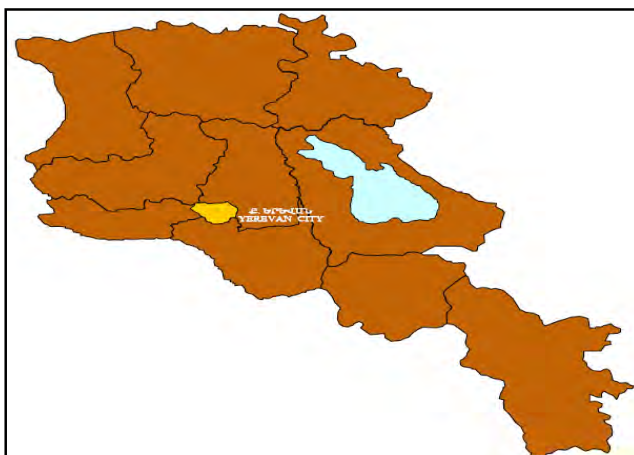
The main economic activities are industry and agriculture. Industry is principally the manufacture of food products and beverage, precious articles and the

quarrying of building materials. The location and climate are favorable for both crops (grain, potatoes, grass and forage crops) and cattle breeding.

In 2007, the marz' contribution to GDP was: industry 1.3%, agriculture 7.6%, construction 1.0%, retail trade 0.5% and services 0.5%.

Ashtarak (end-2007 population 20,800) lies on the bank of the River Kasakh, 20 km north–west of Yerevan, close to the junction of the M-1 and M-3. Ashtarak is a satellite town for Yerevan. It is the administrative and political, economic, scientific, educational and cultural centre of the marz.

Box 3: Yerevan



Districts: Ajapnyak, Avan, Arabkir, Davtashen,

Towns: Erebuni, Kentron, Malatia–Sebastia,

Nor Nork, Nork–Marash, Nubarashen, Shengavit, Kanaker–Zeytun

Yerevan is situated in the north–east of the Ararat Valley. It borders Aragatsotn, Kotayk, Ararat and Armavir marzes. While its area of 227sqkm is only 0.8% of the country, its population of 1.11 million is 34.3% of the total.

Yerevan is the national capital and by far the largest city. It is the residence of the president, the National Assembly and the Government, all ministries and principal departments, public and other

organizations, unions, foundations, commissions, legal-juridical bodies, the overwhelming majority of banks and exchanges, and most of the mass media are situated in the capital.

Yerevan is the dominant economic center. In 2007, Yerevan's contribution to the national economy was: industry 48.5%, agriculture 0.9%, construction 87.2%, retail trade 84.8% and services 90.4%. The main industry is manufacture of food products, including alcoholic beverages and chemical and metallurgy industry.

Freight and passenger transport are by road, rail, air and subway.

Box 4: Ararat Marz



Marz capital – Artashat

Districts – Ararat, Artashat, Masis

Towns – Ararat, Artashat, Vedi, Masis

Ararat marz lies south of Yerevan. It also borders Armavir and Kotayk to the north, Gegharkunik to the east and Vayots Dzor to the south. It has an international border with Turkey.

Ararat is one of the most economically developed marz. Its contribution to GDP in 2007 comprised: industry 7.3%, agriculture 13.0%, construction 1.0%, retail trade 1.6% and services 0.9%. Ararat specializes in viticulture and fruit and vegetables. The major industries are food processing and canning, beverages, tobacco and non-metallic mineral products, cement, lime carbonate, asbestos, stone cutting and processing.

The M-2 Yerevan–Yeraskh–Gharabagh and the (currently little used) Yerevan–Yeraskh railway run through Ararat.

The population of the capital Artashat in 2007 was 25,000. It is 29 km from Yerevan and 10 km from the historic site of Artashat.

Khosrov public nature reserve at a height of 1600–2300m is in the marz.

Box 5: Vayots Dzor Marz



Marz capital – Eghegnadzor

Districts – Vayk, Eghegnadzor

Towns – Eghegnadzor, Jermuk, Vayk

Vayots Dzor lies in the south of the country, bordering Gegharkunik to the north, Ararat to the west and Syunik to the south. It also borders Azerbaijan (Nakhichevan). It is surrounded by high mountains of various ranges, separating it from the neighboring marz.

It has a varied fauna and flora. Natural forests comprise 5.7% of the area. The surface is particularly variegated. Volcanic forces, earthquakes, the River Arpa and its tributaries have created mysterious canyons, mountain passes, plateaus and other features.

Vayots Dzor's contribution to GDP in 2007 comprised: industry 0.8%, agriculture 4.3%, construction 0.9%, retail trade 0.5% and services 0.3%. Agriculture is mainly cattle breeding, which accounts for 63.0% of

agricultural output. Viticulture, fruit and vegetables are also significant. The production of non-alcoholic beverages (in particular, Jermuk mineral water bottling is the main industry, 60.0% in 2007), with wine 20%.

Eghegnadzor, population 8200 in 2007, is an ancient settlement 119km from Yerevan. Jermuk, population 5200, is situated on a lava plateau at a height of 2070m, 170km from Yerevan. It was an important spa in the Soviet Union and continues to be a tourist center, with its warm water springs, famous 60m waterfall and winter sports facilities. "Jermuk" mineral water is widely distributed. There are plans to further develop tourism.

Box 6: Syunik Marz



Marz capital – Kapan

Districts – Kapan, Goris, Sisian, Meghri

Towns – Kapan, Goris, Sisian, Meghri, Agarak, Qajaran, Dastakert

Syunik marz is in the extreme south. To the north, it borders Vayots Dzor marz, to the south Iran (the border is 42 km), to the west Nakhijevan and to the east Azerbaijan.

It is the richest marz for minerals. The most important are non-ferrous metals (copper, molybdenum, zinc, lead) and noble metals (gold, silver) and also non-metal minerals (construction and decorative stones, basalt raw materials, limestone and burnt shale

marble and granite resources).

The biggest sycamore park in the world is in the River Tsav pass, south of Kapan, 60ha with very old trees of diameter up to 3m and height up to 45m. At 4km from the town, on the right bank of the River Voghji is Shikahogh state reservation. In the depths of forest Vahanavanq (Xth century is situated, which is one of spiritual and cultural centers of Syunik marz and in 25 km distance in narrow defines and the depths of forest the Shikahogh state reservation). Shaki waterfall, the biggest waterfall (18 m) of Small Caucasus Mountains is situated in 6 km distance from Sisian.

The River Meghri River begins from Lake Kapuyt 3250m and Kaputjugh River – from melt water of Mount Kaputjugh (3905m) that interlacing with Qajarants River to form the River Voghji.

Tatev hydro-electric station, the first of the Vorotan hydro-electric station cascade and Shamb reservoir are situated in Vorotan pass, from where water is tunnelled 18km to the turbines of Tatev hydro-electric station.

Syunik occupies a strategically and geographically important position, with its rich resources of natural raw materials, industrial capacity and is one of the biggest administrative and economic regions, while sparsely inhabited and economically undeveloped.

Freight and passenger transport is entirely by road. The M-2 passes through the marz. In 2007 the Kapan–Tsav–Meghri road was opened, as an alternative route to Kapan–Qajaran–Meghri.

The most developed branches of economy are industry and agriculture. The main branches of marz industry are mining industry and production of electric energy. The prevailing part of electrical energy produced in the marz belongs to Vоротan hydro-electric station cascade. Agriculture is mainly grains and potatoes and animal husbandry (especially cattle farming).

The contribution of Syunik marz to the national economy in 2007 was: industry 17.2 %, agriculture 9.1 %, construction 3.6 %, retail trade 0.9 % and services 0.8 %.

Kapan (population 46,000) lies at the foot of Mount Khustup (3201m). It is one of the largest industrial towns in the country. The major industry is mining, especially non-ferrous and noble metals production.

Manufacturing industry (food, clothing, non-metallic construction materials aluminum and metal plastic products, wood and wood products, furniture and equipment) and electricity production are also significant. There are 18 industrial plants, 3 agricultural farms, hunting and forestry, 6 construction, 2 transport, 36 services providing companies, as well as 77 retail outlets in the town.

Manufacturing industry, in particular, production of food and beverages, textile and sewing produce, machines and equipment, electric energy production and distribution comprised considerable part in the Goris (population 23,000) economy. The footwear production was re-started (different types of sport and active rest footwear is produced). There are 16 industrial plants, 3 construction, 2 transport, 26 services providing companies, as well as 71 retail outlets in the town.

158. MFF Tranches for N–S Road Corridor: As shown in Figure 4-3 below, Tranche 1 is defined as Yerevan–Ashtarak and Yerevan–Ararat as per ADB's RRP, September 2009. The candidate Tranche 2 Project comprises the highway sub project from Ashtarak to Gyumri. Further tranches may be made from seven possible sub-projects.



Source: This Study, 2010

Figure 4-3: NSRC Tranches and Sub Projects

159. **Potential of Road Segments for PPP Structuring:** Under many international instances where PPP has been successfully applied, the analysis is focused on new routes or entire roads between designated points, whereas under the current NSRC focus, prime consideration is relative to upgrading and enhancing existing facilities.

160. For a PPP initiative to be even initially attractive, the revenue stream needs to be identified. This will depend on the appropriateness of the road section for tolling. A number of parameters should be considered, including:

- toll culture (willingness to pay)
- traffic volume
- competition/connectivity with other modes
- whether the route is already established or a new route
- alignment and topography (inclusion of bridges/ tunnels)
- strategic importance, of the route
- plans for land use
- % of goods and commercial vehicles
- savings in time due to the new route
- cross border aspects
- provision of an alternative route

161. Potential traffic flows and forecasts will be a prime determining factor as this is a fundamental determinant of financial viability regardless of the precise structuring of subsequent business models such as tolling, shadow tolling or BOT. Traffic flows will of course need to be consistent with construction cost estimates to generate a financially viable proposition.

162. The main constraint applicable to possible PPP participation devolves on financial feasibility. With the (possible) exception of Yerevan area proposed road enhancement, particularly that applicable to MFF Tranche 1, projected traffic flows for all other segments of NSRC are evidently insufficient to support commercial viability in the PPP context. Consequently, for PPP initiatives to be even remotely feasible, either Government or IFI support would be needed which at this stage of Armenia's development seems to be unlikely and indeed, given the depth of support potentially required, could well obviate many of the possible PPP benefits.

163. The second core constraint to be considered relates to the physical attributes of potential PPP applications. In the context of the roads sector, the availability of alternative routing possibilities is normally a major consideration as is the capacity to install and effectively operate tolling facilities. Clearly the criticality of these considerations is dependent on the PPP business model to be applied, but in the case of the NSRC only option 2 of the Ashtarak–Gyumri and the Goris–Kapan option 2 segments, fulfill this requirement.

164. Having noted these problems there is of course the potential for adopting PPP structures with support being derived from Government or IFI sources rather than relying on either direct user charges – or shadow equivalents. The precise structuring of such initiatives will however need to be determined once Government has established a structured PPP policy, but it should be noted that, regardless of details, in the absence of financial feasibility, such initiatives would need to constitute pilot or test cases rather than being indicative of total commitment. It should also be noted that without financial feasibility, overall impact on the investment program will be neutral or indeed incremental when taking into account additional facilities that may be required for tolling and administrative overheads associated with shadow structuring.

165. Under these circumstances, the appropriate way forward is for Government to develop the required PPP policy framework and then revisit the question of PPP initiatives at a later date when traffic flows have matured and/or border issues have been resolved.

166. The core need is for the development of a PPP/PPP framework that cannot be addressed other than over a comparatively long period of time. Given timing constraints it is therefore unlikely that the required progress can be realized within the timeframes of existing subsector road map and investment program, in terms of providing an enabling environment for successful adoption of PPP structuring for currently envisaged road sector projects. There is however, an urgent need for the required detailed policy frameworks to be developed and implemented as a means of setting the groundwork for future projects and this is an area that must be addressed through technical assistance under the currently envisaged MFF. It is therefore recommended that a preparatory TA be undertaken as a matter of urgency to determine precise requirements and detailed approaches to be adopted. Cost is estimated at US\$0.5 million.

167. **Estimated Toll Rates:** The expected level of toll rates can be fundamentally estimated from the costs of the project and the traffic volume. The following assumptions may be made concerning the project financing (ignoring the value of discounted cash flows).

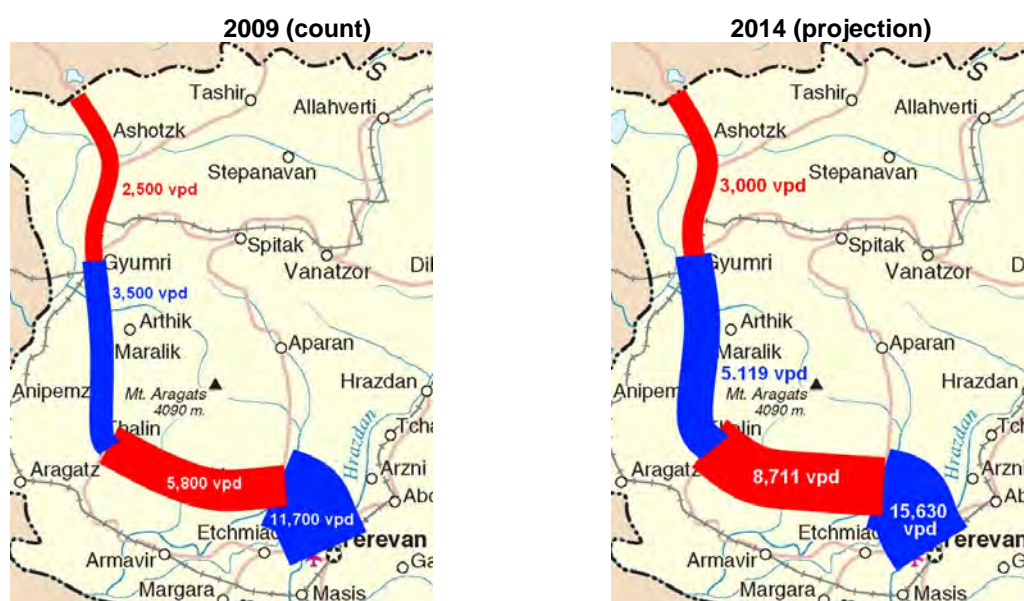
- Construction Cost: approximately \$250 million
- Pre-Financing: \$40 million
- Operation Cost (10% of all investment cost): \$29 million
- Amortization 10% + Interest (LIBOR) 2%: \$34.8 million
- Annual Cost: \$63.8 million
- Repayment Period: 10 years

168. Table 4-16 shows an estimation of toll rates considering volume of traffic. Whilst traffic volume is discussed in later sections, the graphical presentation below provides an indication of the flows, which can be compared to applicable toll prices.

Table 4-16: Applicable Toll Considering Traffic Volume (Vehicles/day)

3,000	5,000	8,000	34,959	87,397
\$ 58.26	\$ 34.96	\$ 21.85	\$ 5.00	\$ 2.00

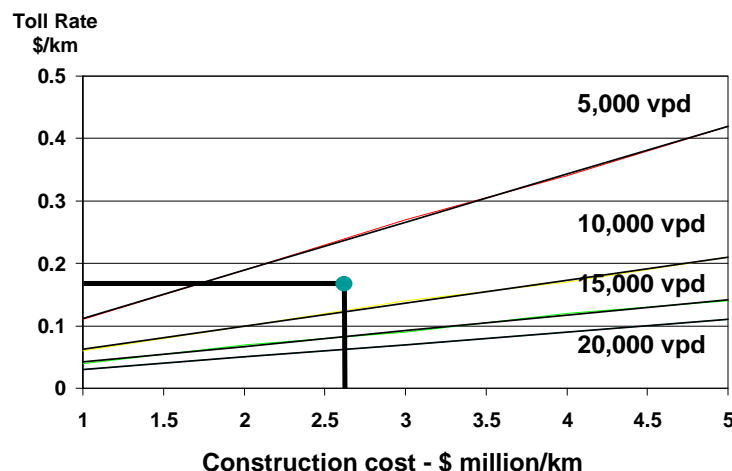
Source: This Study, 2010



Source: This Study, 2010

Figure 4-4 Traffic Volume on N–S Corridor

169. From the above, it is clear that traffic volume between Ashtarak and Gyumri is insufficient for acceptable toll rates for a fully financed private BOT. Figure 4-5 below indicates the required toll rate per km for the parameters of the N–S corridor. Further analysis on the Financial Internal Rate of Return (FIRR) is shown in Volume III of this Report.



Source: This Study, 2010

Figure 4-5 Estimated Toll Rate for Cost and Traffic Volume

4.13 PPP Potential for Tranche 2

170. While the above discussion pointed out the difficulties of developing a fully functioning PPP as a prime means of developing the expanded road facilities through the corridor, developing a public-private partnership in the road sector really relies on three concerns, namely:

- The first is whether there is an adequate enabling environment to support development of PPP structures in the road sector;
- The second is whether there is an opportunity and enthusiasm from the government to enter into a PPP project structure;
- The third is whether there is capacity and interest within the national or international private development community to participate with the government in a PPP.

171. **Enabling Environment** As noted above while there has not been significant investments in PPP in the road sector, there is some evidence of positive experience in Armenia in development of PPP structures in other sectors. This indicates that, as with many other countries, while Armenia does not have a fully functioning legal and regulatory environment to support PPP, nonetheless, companies are comfortable in entering into PPP agreements with the government under the right circumstances. So the lack of an enabling environment is not a strong impediment to development of PPP projects in the road sector. The critical factor is whether the opportunity is sound and whether the commitment of the government to support that opportunity makes financial sense for the private investor.

172. **PPP Opportunity** At least some parts of the proposed improved road may support a PPP project – depending on the level of government support possible. Under the current proposal, the government is likely to arrange at least partial financing for the road improvement from the IFI community – potentially the ADB. At a mid range EIRR of about 15%, the project is within the potential funding approval range of the ADB. In China for instance, many projects with similar levels of economic return and very low financial return have been tolled. The tolls in the Chinese case tend to be around US\$0.05 per pcu km. While that level of tolling is not likely to support full recovery of the capital and operating cost

of the road as indicated in Figure 4-5 above, it will allow for partial recovery of costs, particularly operating costs and as the traffic builds over time, increasingly the tolls collected will contribute to the capital cost as well.

173. Further, the traffic indicated in the southernmost section is estimated to be at the 15,000 vpd level by 2014. Depending on the specifics of the tolling, a traffic level of approximately 20,000 vpd would be needed to reduce the tolls needed to cover both capital and operations to the US\$0.05 to 0.08 range. However, interim PPP options may be viable. These are discussed below.

174. The second part of the issue of opportunity, is the willingness of the government to enter into a PPP. In this case while a full “design–finance–build–operate” option is not viable, the government may choose other options that provide the benefits of public sector financing with private sector construction and operations.

175. **Local and International Capacity** Most developing countries are seeking investment from the private sector for infrastructure. The private investment funds can pick the most attractive opportunities from a wide range of potential projects. This project is not a prime investment opportunity for the international investment community. Faced with the same situation a decade ago, India decided to gradually develop its domestic capacity for road development and operation by two means: first to provide capital support up to 40% of the capital cost of the project directly to the potential investor in cases where that level of support or less would result in a financial return that was attractive to the private investors; and second, to develop what are called “annuity based BOTs”. The annuity based BOT requires the investor to mobilize the needed capital for the investment, build the road and to commit to operating the road for a period of 20 years, during which period the government commits to paying a biannual annuity equal to the average discounted value of the capital and operating cost of the road.

176. This approach in essence stretches the payment for the road over a 20 year budget period rather than over a shorter 2 to 4 year payment period, and second, because of the lower risk to the private sector, it has allowed for development of local road development and operating capacity within the Indian construction and financing community. Under this option, the road may or may not be tolled and the government may or may not collect the tolls itself or require the operator to collect the tolls.

177. The attraction of the annuity based BOT is the requirement that the constructor of the facility also be the maintainer, which ensures that the quality of construction is linked to the cost of the following maintenance over a 20 year life. Further, it also ensures that because the full capital cost of the facility is born by the contractor/financial investor at the outset and only recovered over 20 years, there is a heavy penalty for default on the concession because the financial backer would lose the full cost of the facility less any annuity payments received.

178. Considering the situation in Armenia at present, an annuity based BOT may be viable and it would offer an opportunity for the local construction and financial community to develop some expertise in road financing, development and operation.

179. **Practical Options:** Given the current situation in Armenia, and the state of transition in the traffic on the target road, which is not yet of a volume sufficient to justify a full PPP with significant risk assumed by the private partner, the options essentially revolve around ones where the road department assumes a significant portion of the risk, but gradually allows for private sector participation over time to both target improved efficiency and accountability for the work undertaken, but also to gradually create capacity within the Armenian contracting community for this type of road development and maintenance.

(1) Capital Support BOT

180. If traffic by opening day can be confirmed to be approximately 15,000 vpd, the section of road running northward from Ashtarak to Talin may possibly be attractive as a capital support BOT. At this point the traffic estimates are still uneven and the viability of a capital support BOT will depend strictly on the level of traffic that can be expected. Investors will necessarily take a pessimistic view of the traffic forecasts and factor in a large measure of safety to offset the high traffic risk. It is therefore likely, even with the first section of the route from Ashtarak to Talin generating traffic in the range of 15,000 vpd in 2014, that any potential investor will require a capital support of at least 40% of the capital cost plus land for construction free and clear from the government. However, the final result of this kind of bidding process will only be known when the bids are received. In India, for instance, one section of the highway between Delhi and Jaipur generated two BOT bids with capital support ranging between 38 and 39%. That section did however get built.

181. This option may be viable but there is a strong risk that the capital support needed to make it so will be greater than 50% and in that event it would likely be more viable to just build the road with IFI and GOA funding and lease out operation and toll collection to a private contractor after construction and early operation has been established. This is discussed further below.

Box 7: Annuity Financing of Highway Construction

The GOA may negotiate the construction and ongoing maintenance of several road segments using the annuity method of financing. Beginning once the road enters operation, the GOA will make annuity payments to the contractor.

The GOA effectively bears the cost of the interest rate differential between its own borrowing rate and the borrowing rate of the contractor. The advantage is that the contractor is provided with a strong incentive to construct a high quality road, and to maintain it well. As long as the differential does not exceed 2-3%, and given proper project monitoring, the quality benefits should outweigh the funding costs.

The annuity payments made by the GOA may be met out of the Road Department's normal ongoing capital budget, or they may be pre-funded, by GOA purchasing an annuity with cash inflows that exactly match the cash outgoings to the road contractor.

The GOA could pay for the annuity out of its normal capital budget, or it could borrow the money from the ADB. The ADB provides financing at a concessional rate. The combination of annuity payments to contractors with ADB concessional borrowing results in a high quality road being provided at low cost. Because the ADB does not provide its loan finance by way of annuity payment, the GOA must employ the services of a financial intermediary to generate the requisite back-to-back annuity inflows.

(2) Annuity Based BOT

182. A potentially viable option would be to follow the Indian lead and introduce an annuity based BOT. This model is well established and offers benefits to both the potential bidders and the Government as discussed briefly above. The option of combining an annuity based structure with an IFI loan is slightly more complicated, but can be structured as outlined in the text box.

183. The annuity approach can be both with and without tolling. If the road is tolled, the tolls may be collected by the Roads Department or by the contractor, depending on the annuity agreement. It is more often normal to have the annuity net of tolls with any toll revenue collected and transferred directly to the Government. An outline of the steps needed to structure this type of annuity option is shown in the following figure.

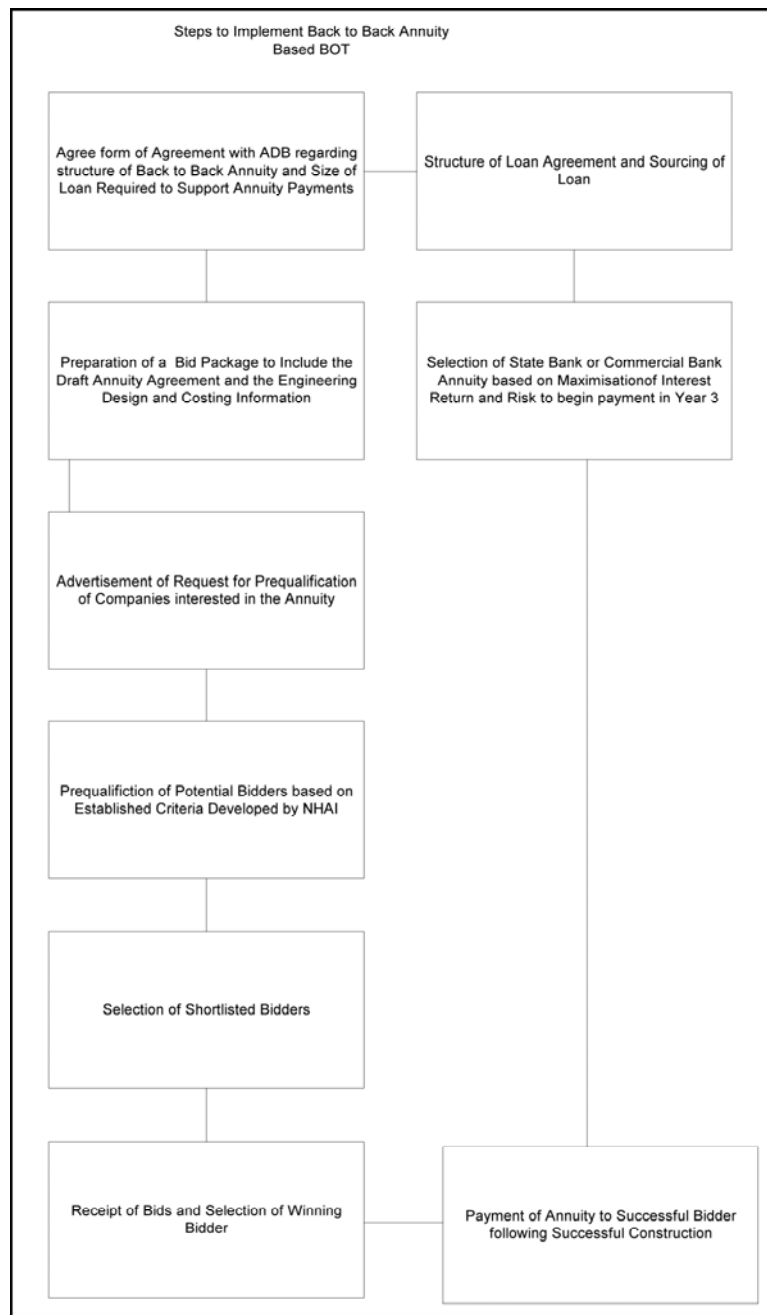


Figure 4-6 Steps for Annuity Based BOT

(3) Operating and Maintenance Contract

184. In cases where the traffic is likely to be too low to support either a capital support BOT or even to make an annuity based BOT attractive, the most viable form of PPP is to contract out the operation and maintenance of the road with or without tolling. This option would see the Roads Department construct the road with IFI money or a combination of IFI and GOA money. Following the construction, the operation and maintenance of the road would be contracted out on a performance basis (PBC) to private contractors.⁵ The attraction of PBC is based on the following:

⁵ Many excellent references exist on the internet to describe how best to proceed with the process of developing a performance based contract.

- Typically PBCs result in longer term savings in operating and maintenance cost of approximately 40%. A table showing the international range of cost savings is shown below;
- Accountability for maintenance is significantly improved because the contractual relationship requires performance before payment of the invoices;
- Long term development of operating and maintenance capacity for roads in Armenia is improved through introduction of this kind of PBC to the current local contracting community.

Country	Cost savings, %
Norway	About 20–40%
Sweden	About 30%
Finland	About 30–35%; about 50% less cost/km
Holland	About 30–40%
Estonia	20–40%
England	10% minimum
Australia	10–40%
New Zealand	About 20–30%
USA	10–15%
Ontario, Canada	About 10%
Alberta, Canada	About 20%
British Columbia, Canada	Some, but might be in the order of 10%
Source: Pakkala 2005.	

185. The rationale for moving to contract maintenance for those countries that have made that change is based on the following logic⁶. PBC can lead to cost savings through:

- incentives to the private sector for innovation and higher productivity;
- reduction in administrative expenses and road agency overheads, due to better packaging of contracts, requiring fewer agency personnel to administer and supervise contracts;
- significantly greater flexibility in the private sector (than in the public sector) to reward performance and react quickly against non-performers.
- The PBC helps insure that variation orders are minimized and that the contractor is generally paid in equal monthly instalments throughout the contract period.
- The risk for cost overruns is transferred to the contractor and the road agency faces fewer unpredictable costs.
- In the PBC approach, fewer contracts have to be processed and administered, and there is no need to measure vast quantities of inputs as a basis for payments. Due to the reduced administrative effort needed, the road agency can manage its network with fewer in-house personnel.
- The PBC can deliver higher customer satisfaction by aligning contractor payments with the needs of the customer/road users. These needs are directly reflected in the performance indicators specified in the contract.

186. A further option exists: the PBC can be setup to be based on tolling only for the recovery of operating and maintenance costs. Bidding can then be done net of toll revenue. This assumes that the contractor collects the tolls, uses the tolls to cover the cost of the operation and maintenance and bids on the basis of the net subsidy required from the

⁶ THE WORLD BANK, WASHINGTON, DC, Transport Note No. TN-27, Performance-based Contracting for Preservation and Improvement of Road Assets, Natalya Stankevich, Navaid Qureshi and Cesar Queiroz , 2005

government to cover the cost of operation and maintenance. If traffic is growing quickly, the government may decide to set a trigger rate of traffic below which the subsidy would be paid and a second trigger at a higher traffic level above which the contractor would repay any subsidy paid earlier by the Government plus interest cost plus a portion of the revenue as a contribution to the capital cost of the road. Too many options exist for setting up this kind of O&M contract to discuss here. Clearly, if the Roads Department chooses this option, a careful assessment of traffic estimates on the section of the road chosen for this approach would be needed plus a careful consideration of the likely best modality to choose to balance the risk to the private sector and the risk to the Government.

4.14 Assessment of Environmental Impacts from Road Sub Projects

Environmental Assessment and Review Framework (EARF) Summary⁷

187. The EARF is designed to guide the EA when implementing sub-projects under the MFF and to:

- i. Carry out environmental assessments when designing and implementing sub-projects under it
- ii. Identify the environmental impact mitigation and monitoring activities required to ensure impact prevention and mitigation of sub-project activities
- iii. Comply with RA laws and ADB policies.

188. The key pertinent RA law is the *Law on Environmental Impact Assessment* (1995) administered by the Ministry of Nature Protection (MNP). The MNP reviews and approves environmental impact assessment (EIA) reports and projects and, when necessary to protect the environment, adds conditions to the approval given. The MNP also inspects projects to ensure compliance with conditions imposed by the MNP and with the project Environmental Management Plan (EMP) and Monitoring Program.

189. MFF funded projects will follow the RA EIA and project approval process.

190. The ADB, *Environment Policy* (2002) requires that the environment be considered in all ADB operations. The ADB *Environmental Assessment Guidelines* (2003) set out the approach to be followed and categorize projects, according to the significance of potential impacts, into categories A, B, C, and FI.

191. All MFF sub-projects will fall under the “A” or “B” categories. Category “A” projects are defined to have the potential to cause significant adverse environmental impacts and an EIA is required. Category “B” projects are defined to cause some adverse impacts but of lesser degree and/or significance than Category “A” projects and an Initial Environmental Examination (IEE) is required. A key purpose of conducting an IEE is to determine whether or not significant environmental impacts warrant full EIA.

192. It should be noted that the RA does not differentiate between IEE and EIA and that an environmental management plan (EMP) is required to be prepared for all approved projects. Based on RA and ADB environmental policies, the sub-projects to be financed under the MFF will all be subject to EIA.

⁷ The EARF can be found in Appendix 12 to this report. However, the new ADB Safeguard Policy Statement (SPS) 2009 needs to be taken into account. For example, regarding Section F, para 17 of the EARF, a SEIA/SIEE is no longer required.

Execution of the MFF funded North–South Roads Corridor Program

193. The MOTC, the Executing Agency (EA) of the NSRCIP, appointed the Armenia Roads Directorate (ARD) to manage sub-projects funded under the MFF.⁸ For each sub-project, the EA will be responsible to:

- i. Prepare the terms of reference (TOR) to conduct the identified EIA.
- ii. Hire an environmental consultant to prepare the EIA report, EMP and Summary EIA.
- iii. Ensure that the EIA Report is prepared in compliance with the requirements of the RA and the ADB and that there is adequate consultation with affected people.
- iv. Review the EIA Report, Summary EIA Report and EMP to ensure their compliance with the requirements of the RA and ADB and submit them and any other documents to the ADB.
- v. Obtain necessary permits and/or clearance as required from the MNP and other pertinent RA agencies, ensuring that all regulatory clearances are obtained before commencing any civil work on identified road sections.
- vi. Ensure that the pertinent EMP is included in the bidding documents.
- vii. Ensure that each Contractor has a copy of the EIA and EMP Report of the project concerned, and understands the responsibilities to prevent/mitigate the associated environmental impacts.
- viii. Ensure and monitor that the EMP and environmental monitoring are properly implemented.
- ix. Prepare and implement (in consultation with the MNP, other pertinent government agencies, and the ADB) an environmental emergency program as necessary, should unpredicted environmental impacts occur during project implementation.
- x. Identify when supplementary assessment may be required should a project need to be realigned during implementation, prepare the TOR for undertaking that assessment and hire an environmental consultant to carry it out.
- xi. Undertake environmental due diligence and monitor implementation of the EMP and prepare appropriate reports.
- xii. Submit to the MNP and the ADB Semi-Annual and Annual Reports on implementing the EMP (including implementing an environmental emergency program when in place).
- xiii. Ensure that environmental assessment documents, including the Environmental Due Diligence and Monitoring Reports are described in the Project Semi-Annual Annual Reports and properly and systematically kept as part of the project record.
- xiv. Ensure that the ADB has the access needed to undertake environmental due diligence.

194. The ADB will be responsible for:

- i. Review of the rapid environmental assessment checklist as a basis to issue approval for a sub-project to proceed.
- ii. Review of the EIA Report and Summary EIA Report and display them on the ADB website.
- iii. Periodical monitoring of EMP implementation and due diligence.
- iv. Advising the EA in carrying out its responsibilities to implement the EMP for each sub-project.
- v. Undertaking environmental due diligence for all sub-projects.

195. Under the RA Law on EIA, the MNP makes all EIA reports and EMPs available to affected communities, ministries and agencies, and the public.

196. Future sub-projects selected for financing under the MFF shall:

⁸ On 28th October a Primer Ministerial decree ordered the creation of a new entity for this purpose.

- i. Be for the upgrading, rehabilitation and/or expansion of existing national roads forming part of the North–South Roads Corridor
- ii. Avoid passing through any RA designated wildlife sanctuaries, national parks, other sanctuaries, or areas of international significance
- iii. Avoid passing through any RA designated cultural heritage site or site known to exist by the RA Institute of Ethnography and Archaeology.

Due Diligence to Ensure Compliance with ADB Environment Policy

197. The MOTC was to assist the ADB in its periodic environmental due diligence analyses on any sub-project. Whilst the exact organization and responsibilities of the new EA body remain to be fixed, as EA the MOTC was to have the main responsibility for performing periodic environmental due diligence analyses, as well as for monitoring the implementation of all sub-projects to ensure compliance with RA laws, ADB environmental policies and overall environmental standards.

Environmental Settings of Sub Projects Under the MFF

198. Volumes II and III of this Report identify the environmental settings along the corridors through which existing roads pass and potential roads may pass, recommend whether IEE or EIA may be required for each section of road, and set out a framework to address impact prevention and/or mitigation. All routes and potential routes were driven, notes taken and environmental elements identified.

199. Because of the diversity of landscapes and environmental features, it is not possible to adequately assess the environmental setting along the existing N–S roads corridor as a single entity. The environmental conditions vary and, thus, the associated likely impacts arising from construction and operation of an expanded road system will vary from one environmental zone to the next. For environmental assessment purposes, the area is, therefore, separated into components and related to specific sections of the road corridor. A summary of the environmental features and the environmental sensitivity is presented below for each section of road – corresponding to the potential sub-projects that may be included under the MFF.

200. The environmental assessment needs are proposed on the basis of the environmental complexity and sensitivity on a scale of 1 to 3, where 1 indicates a relatively stable landscape of no particular sensitivity and 3 indicates a sensitive landscape with physical, ecological or other significant attributes. Factors considered included: rock type, slope stability, steepness of slopes, soil type and productivity, water bodies and streams, ecological productivity, forests, protected areas, historical, pre-historical or archeological important areas within the ROW and its close vicinity.

**Asian Development Bank TA7208-ARM
Ministry of Transport and Communication
Republic of Armenia**

**Preparing the North-South Road Corridor
Development Project**

VOLUME II

Tranche 1 Preparation

**FINAL REPORT
May 2010**



VOLUME II TRANCHE 1 PREPARATION

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ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
AC	Asphalt Concrete
ADB	Asian Development Bank
AGR	European Agreement on Main International Traffic Arteries
AMD	Armenian Dram
AP	Affected People
AR	Armenian Railways
ARD	Armenia Roads Directorate
ASIF	Armenia Social Investment Fund
BOQ	Bill of Quantities
DMS	Detailed Measurement Survey
EA	Executing Agency
EBRD	European Bank for Reconstruction and Development
ECRP	Emergency Contingency Response Plan
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EM	Environmental Manager
EMA	Emergency Management Agency
EMOP	Environmental Monitoring Plan
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
EO	Environmental Officer
ERT	Emergency Response Team
EU	European Union
GEF	Global Environment Facility
GDP	Gross Domestic Product
GoA	Government of Armenia
HDM	Highway Design Model
HH	Household
IDA	International Development Association
IDPR	Internally Displaced Persons and Refugees
IDPRDF	The Internally Displaced Persons and Refugees Development Framework
IDPRDP	Internally Displaced Persons and Refugees Development Plan
IDPRSA	Internally Displaced Persons and Refugees Specific Action
IEE	Initial Environmental Examination
IES	International Environmental Specialist
IFI	International Financial Institutions
IMF	International Monetary Fund
IRI	International Roughness Index
IRR	Internal Rate of Return
IT	Information Technology
IUCN	International Union for the Conservation of Nature
ILCS	Integrated Living Condition Survey
km	kilometer
kph	kilometer per hour
marz(es)	administrative region(s)
marzpet	Marz Governor
MCA	Millennium Challenge Account - Armenia
MCC	Millennium Challenge Corporation (USA)
MHPI	Modified Human Poverty Index
MDG	Millennium Development Goals

MFF	Multitranche Financing Facility
MM	Mitigation Measure
MNP	Ministry of Nature Protection
MOFE	Ministry of Finance and Economy
MOTC	Ministry of Transport and Communications
MTA	Ministry of Territorial Administration
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organization
NPE	Nature Protection Expertise
NRSC	National Road Safety Council
NSS RA	National Statistical Service of Republic of Armenia
OECD	Organization for Economic Co-operation and Development
PA	Protected Area
PIU	Project Implementation Unit
PMU	Project Management Unit
PPP	Public-Private Partnership
PPTA	Project Preparatory Technical Assistance
PRSP	Poverty Reduction Strategy Paper
RA	Armenian Government
RoA	Republic of Armenia
REC	Regional Environmental Centre (for Central and Eastern Europe)
ROW	Right-of-Way
RP	Resettlement Plans
RPF	Resettlement Policy Framework
RRC	Regional Resettlement Committee
RRSL	Rural Roads Sector Loan
RRSP	Rural Roads Sector Project
SE	Senior Engineer
SEEC	Department of State Environmental Expertise Commission
SEI	State Environmental Inspectorate
SIEE	Summary Initial Environmental Examination
SME	Small and Medium-sized Enterprise
SNCO	State Non-commercial Organization
SNP	Sevan National Park
SR	State Reservation
SSTA	Small Scale Technical Assistance
TA	Technical Assistance
TRACECA	Transport Corridor Europe Caucasus Asia
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCBD	United Nations Convention on Biological Diversity
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics (former)
WUA	Water Users' Association

SECTION 1 INTRODUCTION

1. This Section presents the results of the Feasibility Study for the MFF Tranche 1 Project.¹ MFF Tranche 1 will: (i) reconstruct the dual 2-lane section of the M-1 Yerevan–Ashtarak (18.38km) and improve the M-1/M-3 intersection to internationally acceptable standards; and (ii) improve traffic safety measures, etc. on the dual 2-lane M-2 section Yerevan–Ararat (37.97km).
2. The TA consultants carried out: (i) existing road condition survey of road and pavement including topographic and geological survey with a sounding, and existing conditions of structures as well as traffic survey, (ii) preliminary design including improvement plan of the road, and recommendation plan of interchange improvement and structures, (iii) quantity and cost estimation, (iv) traffic and economic analysis, (v) preparation of bidding documents for the civil works, and (vi) preparation of a draft TOR of the supervision consultant.
3. The Construction *Norms of the Republic of Armenia* (CNRA) IV11.05.02—99, which came into effect in 2000, are proposed as the geometric design standard for the preliminary design, with some adjustments taking account of E-Road standards, referring to the current Georgian Road Standard. The road is a Category 1 road.
4. Roadworks are planned to be fully confined to the existing ROW to mitigate resettlement impacts, and one carriageway at a time, in order to enable continued use of the road. There will be no change to vertical or horizontal alignment.

¹ As outlined and approved in the Report and Recommendation of the President to the Board of Directors (RRP), September 2009.

SECTION 2 ENGINEERING CONSIDERATIONS

2.1 Project Scope

5. MFF Tranche 1 will: (i) reconstruct the dual 2-lane section of the M-1 Yerevan–Ashtarak (18.38km) and improve the M-1/M-3 intersection to internationally acceptable standards; and (ii) improve traffic safety measures, etc. on the dual 2-lane M-2 section Yerevan–Ararat (37.97km). Road works are planned to be fully confined to the existing ROW and to be constructed in stages, one carriageway at a time, in order to enable continued use of the road. There will be no change to vertical or horizontal alignment.

6. The scope of work comprises the following:

A. M-1 Yerevan–Ashtarak Improvement

- (i) Reconstruction of sub grade, road base and pavement structure including surface pavement;
- (ii) Reconstruction of road shoulders and road drainage system including cross drainage and side ditches;
- (iii) Improvement of traffic safety measures, including traffic signs, direction signs, traffic delineators, guardrails, traffic markings, waiting lanes and interchanges, etc.;
- (iv) Installation of speed warning and traffic monitoring equipment;
- (v) Improvement of road lighting at key locations and major interchanges;
- (vi) Repair of road structures, including bridges, overpasses, underpasses, and cutting/embankment slopes; and
- (vii) Landscaping.

B. M-2 Yerevan–Ararat Improvement²

- (i) Improvement of traffic safety measures, including traffic signs, direction signs, traffic delineators, guardrails, traffic markings, waiting lanes, etc.; and
- (ii) Installation of speed warning and traffic monitoring equipment.

2.2 Road Condition

7. The Yerevan–Ashtarak section of the M-1 (18.38km) is dual 2-lane. It was constructed in the mid-1980s, with some pavement rehabilitation 1990–2004. Its condition has deteriorated, in spite of routine maintenance, and is of variable standard such that the road-bed and pavement structures need improvement to meet the design and construction standards appropriate for an international transit route. The bridge crossing the River Kasakh was expanded to dual 2-lane in 2002–2003. The 37.97km M-2, 4-lane road section south of Yerevan was constructed in the mid-1970s and substantially rehabilitated 2002–2003, and is in relatively good condition.

8. Both road sections are located in arid areas. The M-1 is in gently rolling upland; the M-2 is flat. There are no unique areas, no protected areas, and no forests or ecological reserves, but along the M-1 there are two known archeological sites and there may be undiscovered archaeological remains or artifacts below ground. Existing major landmarks

² It was determined during this TA that only traffic safety sign and drainage/shoulder improvement would be included for this road section. Road pavement improvement is not required as the road was improved by the Lincy Foundation Fund. Whilst the Consultants recognize that existing overpasses do not meet requirements of design and seismic norms and beams have sustained damage, surveys for structural rehabilitation were not included in this TA due to priorities for Tranche 2. Details of items including parapets, underground crossings for people and animals in the settlements, stations, and safety measures on the junctions of rural roads and the highway, would be provided at the project's Detailed Design stage.

and structures to be considered for the detailed design and construction are shown in Table 2-1.

Table 2-1: Yerevan–Ashtarak Major Landmarks and Structures

Distance from Republic Square	Distance from Start of Project	Landmark/Structure
Km11+800	Km 0+000	Start point of the Project
Km15+820	Km 4+020	Ministry of Defence
Km16+370	Km 4+570	Grade Separation I: underpass for the State Farm 'Proshyan'
Km18+170	Km 6+370	Overpass for railway
Km 20+700	Km 8+900	Police Post
Km21+960	Km10+160	Overpass for pedestrians
Km22+300	Km10+500	Grade Separation II: To Yeghvard
Km22+440	Km10+640	Grade Separation II: underpass
Km22+720	Km10+920	Grade Separation II: underpass (Ashtarak–Yeghvard)
Km23+510	Km11+710	River Crossing Bridge start (River Kasakh)
Km23+890	Km12+090	River Crossing Bridge end
Km24+960	Km13+160	Overpass (Ashtarak–Karbi)
Km25+010	Km13+210	Grade Separation III: To Mugni
Km25+400	Km13+600	Grade Separation III: overpass (Ashtarak–Aparan)
Km26+400	Km14+600	Grade Separation IV: To Parpi
Km26+550	Km14+750	Grade Separation IV: underpass
Km29+540	Km17+740	Grade Separation V: underpass (Ashtarak–Byurakan)
Km30+180	Km18+380	End point of the Project

Source: This Study, 2010

9. Some substructures have been exposed without proper slope protection and some of the superstructure has been covered with unnecessary pavement, thickened through repeated overlaying, and these need rehabilitation to ensure structural integrity. The Kasakh Bridge is in good condition, requiring only minor repairs.

10. The consultants made a series of geotechnical observations in investigating the existing condition of the pavement and road base (see Annex 1, Appendix 4).³ A total of 20 samples (56mm diameter core) were taken from the existing asphalt pavement and road base, including sub-base, in order to investigate the thickness of asphalt concrete, base course, and sub-base. Four samples (131mm dia. core) were taken from the designated locations at km0.0, km11.7, km12.6 and km17.2. The drilling was performed to a depth of 70 cm for 56mm diameter and 200 cm for 131mm diameter respectively. The results show that existing asphalt concrete thickness varies between 10cm and 18cm, and thickness of the existing base course and sub base is 12–18cm in all. It is very thin as a base course and sub-base. Also, the sub-grade materials at the embankment point (km17.2) are of unsuitable soil, including boulders. Therefore, most of the existing asphalt pavement and road base needs to be replaced with properly engineered materials and density specified in the detailed design, e.g. AASHTO (American Association of State Highway and Transportation Officials), though full geotechnical surveys should be made during the detailed design stage for final judgment. (A layout of the entire project road is given in Annex 1 Appendix 5 (pages N1–N8).

2.3 Preliminary Design

11. **Geometric Design Standard:** The *Construction Norms of the Republic of Armenia* (CNRA) IV11.05.02—99, which came into effect in 2000, are proposed as the geometric design standard, with some adjustments taking account of E-Road standards, referring to the current Georgian Road Standard. The road is a Category 1 road. Based on the road class

³ Further more detailed investigations were not undertaken due to the diversion of survey resources to Tranche 2.

and terrain conditions, the geometric design standards are summarized in Table 2-2. The geometric features could be relaxed, maintaining safety and comfortable driving, if design speeds were set according to terrain and land use along the road.

Table 2-2: Geometric Design Standard

No.	Main Parameter	Unit	Flat	Rolling	(Mountainous) Not in the tranche 1 Project
1	Design speed	Km/h	120	100	80
2	Number of lanes		4/2	4/2	4/2
3	Land Width	M	3.75	3.75	3.75
4	Shoulder width	M	3.0	3.0	3.0
5	Maximum longitudinal gradient	%	4	5	6
6	Median to be applied over 4-lane	M	2	2	2
7	Minimum horizontal curvature	M	670	425	250
8	Super elevation at minimum horizontal curvature	%	6	6	6
9	Minimum radius of vertical curves: crest	M	12,500	8,000	5,000
10	Minimum radius of vertical curves: sag	M	6,000	4,500	1,500
11	Cross fall of carriageway	%	2	2	2
12	Cross fall of shoulder	%	4	4	4

Source: *This Study, 2010*

Note that there will be no changes to the vertical or horizontal alignment.

12. **Pavement improvement:** Taking account of the geotechnical observations, most of the pavement and road base needs to be replaced with properly engineered materials at the density specified in the detailed design, e.g. AASHTO, although further geotechnical surveys are needed during the detailed design work for final judgment.

13. The proposed pavement consists of 50mm fine-grained asphalt concrete as a surface course (wearing course), 70mm coarse-grained asphalt concrete as a binder course, 80mm aggregate mix with bitumen and 350mm aggregate as a base course (road base), and 150mm gravel-sand layer as a sub-base (preliminary pavement design is given in Annex 1 Appendix 6.)

14. However, the pavement structure needs to be checked during detailed design by a capable pavement specialist, using a cumulative equivalent standard axle load (ESA) for design life and sub-grade strength. The sub-grade needs to be checked through an appropriate test, such as the California Bearing Ratio (CBR). The three most important factors affecting pavement thickness are traffic loading, sub-grade strength, and pavement materials, including surface, base course, and sub-base. Besides the traffic volumes and heavy vehicle requirements, a surface layer of asphalt concrete deals with wear of the pavement caused by climatic affects and snow tires and salt spreading during the winter season, particularly significant in this region.

15. If overloading of heavy vehicles is not controlled, the pavement structure would deteriorate rapidly. Strict enforcement is important. Table 2-3 shows axle loading as recorded by ARD in 2008, with 13–71% of heavy vehicles on interstate roads overloaded. ARD proposes that legislation be strengthened and weighing stations be set up in 12 places.

Table 2-3: Axle Load Survey 2008

1st trimester Jan.-March											
Measurement Period – 3 days											
Road	Measurement Location	Trip Direction	Number of Cars	%	Cars with overloaded Axle				Maximum Axle Load t	Maximum Total Weight t	Total Cargo Loading Measured
					>10 t <11.5 t Republic	%	>11.5 t Interstate	%			
M2	Yeraskh	Yerevan<->Syunik	66	55%	15	23%	9	14%	13.7	40.32	1492.38
		Yerevan<->Vayots Dzor	9	8%	3	33%	3	33%	12.4	31.14	224.13
		Yerevan<->Iran	44	37%	15	34%	3	7%	13.4	43.76	1494.54
		Total	119	100%	33	28%	15	13%			3211.05
2nd trimester April-June											
Measurement period – 3 day											
Road	Measurement Location	Trip Direction	Number of Cars	%	Cars with overloaded Axle				Maximum Axle Load t	Maximum Total Weight t	Total Cargo Loading Measured
					>10 t <11.5 t Republic	%	>11.5 t Interstate	%			
M2	Kapan	in Syunik marz	92	38%	20	22%	58	63%	15.9	39.1	2803.59
		Iran<->Yerevan	116	48%	23	20%	31	27%	15.8	45.02	3313.32
		Yerevan<->Syunik	36	15%	7	19%	25	69%	15.8	36.42	1022.59
		Total	244	100%	50	20%	114	47%			7139.5
3rd trimester July-Sept.											
Measurement period – 3 day											
Road	Measurement Location	Trip Direction	Number of Cars	%	Cars with overloaded Axle				Maximum Axle Load t	Maximum Total Weight t	Total Cargo Loading Measured
					>10 t <11.5 t Republic	%	>11.5 t Interstate	%			
M3	near Vanadzor, Tumanyan & Bagratashen	in Lori Marz	114	65%	29	25%	19	17%	16.9	40.49	2224.84
		Lori<->Yerevan	10	6%	2	20%	2	20%	16.2	28.12	197.86
		Lori<->Shirak	7	4%	2	29%	5	71%	16.8	46.43	244.44
		Georgia<->Yerevan	44	25%	18	41%	4	9%	15.8	47.76	1519.65
		Total	175	100%	51	29%	30	17%			4186.79
4th trimester Oct.Dec.											
Measurement period – 3 day											
Road	Measurement Location	Trip Direction	Number of Cars	%	Cars with overloaded Axle				Maximum Axle Load t	Maximum Total Weight t	Total Cargo Loading Measured
					>10 t <11.5 t Republic	%	>11.5 t Interstate	%			
M2	Kapan	in Syunik Marz	144	52%	24	17%	91	63%	17.7	42.24	4440.38
		Iran<->Yerevan	92	33%	25	27%	12	13%	16.1	47.54	3268.05
		Yerevan<->Syunik	40	14%	9	23%	8	20%	13.7	31.49	958.69
		Total	276	100%	58	21%	111	40%			8667.12
4th trimester Oct.Dec.											
Measurement period – 3 day											
Road	Measurement Location	Trip Direction	Number of Cars	%	Cars with overloaded Axle				Maximum Axle Load t	Maximum Total Weight t	Total Cargo Loading Measured
					>10 t <11.5 t Republic	%	>11.5 t Interstate	%			
M3	near Vanadzor	in Lori Marz	116	52%	22	19%	25	22%	15.5	38.72	2473.23
		Lori<->Yerevan	7	3%	1	14%	2	29%	13.8	33.79	170.89
		Lori<->Shirak	8	4%	3	38%	4	50%	14.9	29.26	160.72
		Georgia<->Yerevan	93	42%	22	24%	19	20%	14.8	49.96	3280.41
		Total	224	100%	48	21%	50	22%			6085.25

Source: This Study, 2010

16. It is recommended that pavement structure and materials be designed to internationally accepted standards or methods (AASHTO and/or BS British Standard). It is also suggested for detailed design that cement concrete pavement (rigid pavement) mixed with basalt fiber⁴, produced widely in Armenia, as well as chemical stabilized sub-base be studied in comparison with conventional asphalt concrete pavement, taking account of quality, cost, and practical performance of the works on site.

⁴ Recommended by the Ministry of Economy.

17. **Cross section:** Most of the existing asphalt pavement and road base needs to be replaced with properly engineered materials at the density specified in the detailed design, (e.g. AASHTO), although further geotechnical survey is needed during detailed design for final judgment. The investigation for preliminary design found the road base course and sub-base course to be of poor quality for the pavement. Also, the embankment filling materials need to be replaced.

18. Figure 2-1 presents typical sections of the preliminary road pavement design: (i) case 1 (marked as “I alternative” in Figure 2-1) presents the cross section, which needs replacement of the existing asphalt pavement and road base; (ii) case 2 presents the section which needs asphalt overlaying on the existing road surface; and (iii) case 3 presents the cement concrete pavement (preliminary pavement design is given in Annex 1 Appendix 6).

19. **Structures and safety measures:** Neither carriageway is adequately drained, the shoulders in some parts are narrow and not properly paved, and there are randomly located U-turns. Signage, road markings, and lighting are also absent or inadequate, there are insufficient crash barriers and median separation barriers, and traffic flow at some interchanges is unsafe. A key objective is to redress these deficiencies, to ensure both structural integrity and compliance with road safety requirements.



Side drainage needed



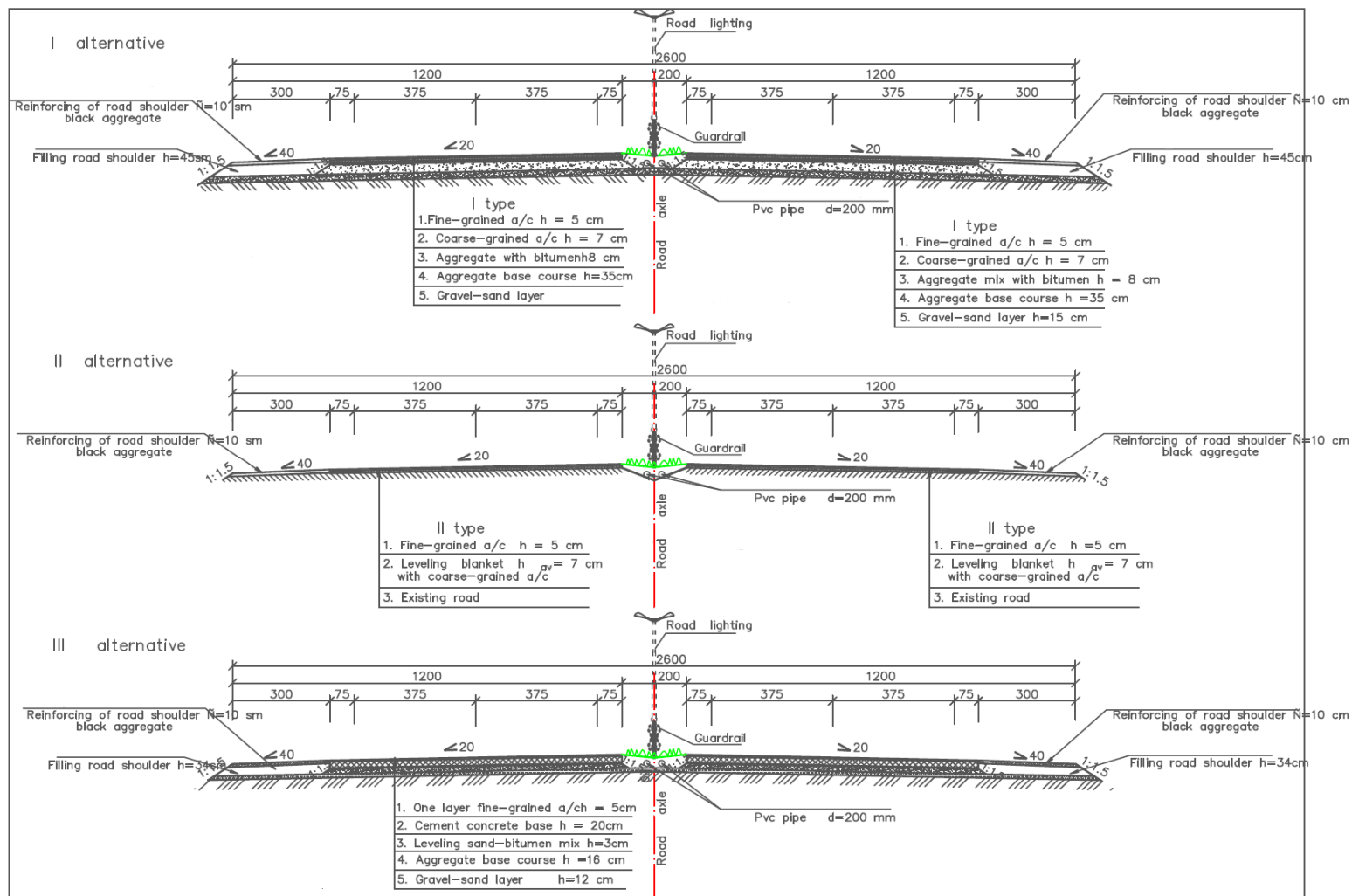
Sufficient road marking and sign for turning needed



Bridge foundation repair needed



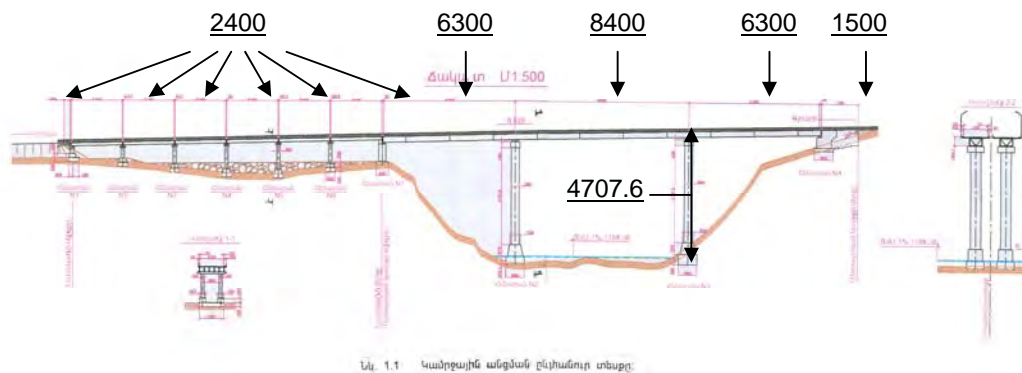
Slope protection needed



Source: This Study, 2010

Figure 2-1: Typical Section for Preliminary Road Pavement Design

20. Kasakh Bridge is in good condition, requiring only minor repairs, such as painting of steel girders and hand rails, repair of expansion joints, etc., though further investigation is needed during detailed design.



Source: This Study, 2010

Figure 2-2: Kasakh Bridge

21. **Interchange improvement⁵:** The design of the M-1/M-3 interchange is unsafe, with conflicting traffic movements, and needs to be improved. Two alternatives are provided Annex 1 Appendix 5 (pages N9/N10) for further consideration during detailed design. The major requirements are to improve traffic flow and to construct an overpass connecting Ashtarak and Mughni, which is incomplete.

22. **Materials and equipment:** Construction materials, such as embankment soil, aggregate, gravel, sand, and cement are locally available at reasonable distances. Detailed material source study and analysis will be required during detailed design, or prior to construction. Other materials, such as bitumen, steel, high-strength cement, mechanical/electrical material and equipment, and spare parts will be imported. Dismantled asphalt pavement materials can be used for the road bed, or as recycled asphalt pavement material, if the material can be treated satisfactorily and quality be maintained successfully in tests required prior to construction.

23. The soil for embankment can be obtained at borrow pits alongside of the project road, and the other construction materials are abundant locally as shown in the table and figure below:

Table 2-4: Source of Construction Materials (local)

Construction Materials		Source of Location		
Item	Estimated Q'ty	Marz	City	Distance from Yerevan (km)
Cement	5,000 ton	Ararat	Ararat	50–60
		Kotayk	Razdan	50–60
Aggregate for base course and sub-base	200,000m ³	Yerevan	Yerevan surroundings	20–60
		Kotayk	Arzni, Balahovit, Nurnus	~ 80
		Aragatsotn	Ashtarak, Talin	~40–50
		Armavir	Ejmiadzin	~70
		Shirak	Ashotsk	~80–90

Source: This Study, 2010

⁵ Details of minor crossings including pedestrian crossings would be proposed at Detailed Design stage.



Source: This Study, 2010

Figure 2-3: Source of Construction Materials

24. The materials shown in the following table need to be imported.

Table 2-5: Materials to be Imported

	Estimated Q'ty	Country (options)			
Bitumen	4,000ton	Georgia	Kazakhstan	Turkmenistan	Middle East
Steel Bar	800 ton	Ukraine	Turkey	Georgia	Moldova
High-Strength cement	If required	Ukraine			
Mechanical Equipment or Material	If required	China	Japan	Germany	USA
Electrical Equipment or Material	If required	Italy	Europe	Turkey	China

Source: This Study, 2010

25. Steel can be imported from Ukraine. Another option is Turkey, but steel produced in Turkey tends to be lower quality than from Ukraine. Further options are Georgia, but product variety is very limited, and Moldova, where a plant has been bought by Italians and quality is appropriate to European standards. Also, prices tend to be less than from Ukraine. Finally, an option is Kazakhstan, where ArcelorMittal has a large plant. However, in this case there would be logistical issues and transportation costs would raise the price.

26. As for bitumen, there are a few importers within Georgia, who are supplied by Azerbaijan, and who distribute bitumen to other CIS countries as well as European countries. Due to political issues, Azerbaijan and Armenia would not trade bitumen. Another option is Central Asian countries, such as Kazakhstan, Turkmenistan, or Middle Eastern countries.

27. **Construction Labor:** Most skilled, and all unskilled, labor is available in Armenia for both road and structures construction. About 50% of the unskilled workers will be available in local villages or town alongside of the road and the rest will be from Yerevan. Skilled workers

such as operator of construction equipment for earthwork can be recruited locally. However operator of paver for asphalt and base course needs to be recruited in Yerevan or surrounding.

28. **Utilities:** There are many aboveground and underground utilities in the Project area which need to be shifted, removed or replaced. The following data of the utilities should be surveyed by the detail design consultant for preparation of the bidding documents including existing utility list/plan, the construction cost estimates and specification:

Table 2-6: Utility Information Required for Detailed Design

Utility	Information to be required for Detail Design				
Water Pipeline	Location from existing road center	Depth from existing ground	Size of pipe	Pipe material	Capacity of water
Gas Pipeline	Location from existing road center	Depth or height from existing ground	Size of pipe	Pipe material	Capacity of gas pipe
Electric Cable/Pole	Location from existing road center	Depth or height from existing ground	Size of cable and number of pole	Cable/Pole material	Capacity of cable
Telephone Cable/Pole	Location from existing road center	Depth or height from existing ground	Size of cable and number of pole	Cable/Pole material	Capacity of cable

Source: This Study, 2010

29. The location of the aboveground utilities should be obtained by the site survey of the detailed design consultant, but the other data should be provided by the government authorities concerned listed in the table below:

Table 2-7: Source of Utility Information

Utility	Government / Organization	
Water Pipeline	Ministry of Territorial Administration, State Committee of the Water Economy	Department of Water and Wastewater Management
Gas Pipeline		RusGasArd
Electric Cable/Pole	Ministry of Transport and Communication	Armentel
Telephone Cable/Pole	Ministry of Energy	Electric Networks CJSC

Source: This Study, 2010

30. The EA's assistance for getting the data from the government concerned is required, and also need to determined before the tender of the construction works who will shift, remove or relocated these utilities for the Project, whether the EA or the contractor.

31. **Major work quantity and cost estimate:** Estimated work quantities and construction costs are given in Table 2-8 (Annex 1 Appendix 10 provides details.)

Table 2-8: Major Work Quantities and Construction Cost

Work Item	Unit	Quantity	Construction Cost (\$ million)*
Earthworks:			4.5
Dismantling of Existing Road Pavement	m ³	50,000	
Excavation	m ³	500,000	
Embankment	m ³	280,000	
Road Pavement:			16.9
Pavement	m ²	330,840	
Road Shoulder			2.1
Road Furniture for Traffic Safety			7.3
Drainage			2.9
Road Lighting			1.0
Interchange Improvement			2.5
Miscellaneous			0.6
Total Construction Cost (Excluding VAT and Contingency)			37.8

*Exchange rate: \$1 = 370 AMD as of June 2009.

Source: This Study, 2010

SECTION 3 TRAFFIC ANALYSIS

3.1 Traffic Surveys and Base Year Traffic Volume

32. The consultants undertook classified traffic counts in May and July 2009 on the Tranche 1 section of the M-1, with a border crossing count at Bagratashen. The results are summarized in Table 3-1 (complete data are provided in Annex 1 Appendix 2). ARD monthly count data for interstate roads indicates that volume in May is typical of annual volume and no seasonal adjustment is applied. Volume in July at the ARD automatic counter at km20.7 (the site of the consultants' July count) is on average 19.7% higher than annual average volume (AADT). The July count has been adjusted by a factor of 0.835 to AADT.

33. **Tranche 1:** Tranche 1 has three homogeneous sections for traffic analysis: (i) from the project start point (the beginning of the dual carriageway km11.8) to the junction for Ashtarak (km23.2); (ii) from the junction to the M-3 intersection (km25.2); and (iii) from the intersection to project end-point, the end of the dual carriageway (km30.2). Traffic volume on section (ii) is estimated to be 70.0% of that on section (i) and volume on section (iii) 43.0% of that on section (i). The distance weighted average volume for Tranche 1 is then 81.3% of the count volume on section (i). Base year 2009 volume after seasonal adjustment and weighting of homogeneous sections is 11,257 ($16,582 \times 0.835 \times 0.813$).

34. **Diversion to Bavra route:** The international route via Bavra is currently unsuitable for heavy vehicles, due to poor road conditions in Georgia, immediately north of the border. Repairs should be completed by October 2010, before completion of Tranche 1. Traffic for western Georgia and Turkey via Bagratashen will then switch to the much shorter M-1 route. The consultants' OD survey at Bagratashen indicates that 56% of traffic, 423 vehicles per day, will divert. These vehicles have been added to normal traffic, increasing base year volume to 11,680 (Table 3-1). Composition is predominantly light vehicles, with medium and heavy vehicles accounting for only a 2.6% share.

Table 3-1: Tranche 1 Traffic Counts

Location	Car	Pickup	Minibus	Bus	Truck			Total	PCUs	Peak Hr (% of AADT)
					2-axle	3-axle	>4-axle			
M-1: Km20.7*	13,761	938	965	217	446	191	64	16,582	17,275	8.1
Km30	4,755	493	341	72	351	117	36	6,165	6,749	7.8
Bagratashen	527	26	34	3	15	6	145	756	1,004	7.4
Composition(%)										
M-1 Km20.7*	83.0	5.7	5.8	1.3	2.7	1.2	0.4	100.0		
M-1 Km30	77.1	8.0	5.5	1.2	5.7	1.9	0.6	100.0		
Bagratashen	69.7	3.4	4.5	0.4	2.0	0.8	19.2	100.0		
Weighted Average:										
Km11.8–30.2	9,601	650	672	149	311	138	159	11,680		
Composition										
%	82.2	5.5	5.7	1.3	2.7	1.2	1.4	100.0		

Source: the Consultants. AADT = annual average daily traffic, PCU = equivalent passenger car unit,

M = Motorway, km = kilometer.

Note: * 23 July, other counts May 2009.

Source: This Study, 2010

3.2 Traffic Growth

35. Traffic growth rates for the analysis period are based on relating vehicle fleet growth to GDP growth and transport demand elasticity. While transport demand and traffic growth is

related to economic activity and changes in population structure, the nature of the relationship and elasticities are difficult to establish, as: (i) there is no vehicle fleet time series; (ii) few traffic count time series; (iii) the economy has moved from boom to depression 2008–2009; and (iv) there is an aging population.

36. **Georgia study:** In 2009, ADB TA7059-GEO *Ajara Bypass Roads Development Project*, developed demand elasticities for Georgia. The elasticity of vehicle registrations to GDP for 2001–2008 was estimated at 1.34. The elasticity of imports to GDP is higher, as fleet growth is net of scrapping. Elasticities applied in other Georgia studies for traffic growth rates typically ranged between 1.0 and 1.2. For the Ajara bypasses economic analysis, elasticities of 1.2 for passenger and 1.4 for freight vehicles were applied. The GDP growth rate for Georgia from 2013 onwards was assumed to be 4.0%, giving annual traffic growth rates of 4.8% for passenger and of 5.6% for freight vehicles from 2013.

37. **Past performance:** Per capita GDP 2001–2008 increased at an annual average rate of 26.2% in dollar terms and by 17.5% in Dram. These rates are far higher than traffic growth over the period, implying a relatively low demand elasticity. Fuel consumption by the transport sector, for example, increased at an annual rate of 9.6% 2001–2007 (Table 2-10 of Volume I). ARD data show annual traffic growth of only 3.9% at M-route count stations 2005–2008 (Table 4-14 of Volume I).

38. **Population factor:** In 2009, the population aged 0–9 years was 75% of that aged 20–29. The population aged 10–19 was 85% of the 20–29 year cohort. Over the next 20 years the demographic impact will reduce growth in transport demand, by say 1% pa.

39. **Vehicle fleet:** If the annual scrappage rate is assumed to have been 4%, the vehicle fleet will have increased from 330,000 as of end-2006 (Table 3-2) to some 380,000 end-2009. Scrapping of 15,000 is almost the same as vehicle imports in 2009 (Table 2-4 of Volume I), with little growth in the fleet. A significant increase in imports is unlikely until the economy recovers, while scrappage rates will necessarily increase over time as the fleet ages. By 2014, the fleet is unlikely to exceed 420,000.

40. Over the long term, a normal relationship between imports and per capita GDP will be reestablished. Clearly, both 2008 and 2009 were atypical years, the height of a boom and the depth of a depression. If imports recover to 33,000 in 2014 and were then to grow at an elasticity of 1.5 to GDP, less 1% for demographic factors, the vehicle fleet would be as shown in Table 3-2. This assumes that the scrappage rate rises to 5% by 2030. In 2030, the fleet is 316 per thousand population, approaching a saturation level at which the growth rate falls sharply. Thus, the fleet growth forecast is, if anything, optimistic.

41. **Traffic Growth:** Fleet growth does not transmit directly into traffic growth, other factors such as fuel prices impact on vehicle usage. As more vehicles are acquired, average usage per vehicle may gradually fall. However, fleet growth can be taken as a proxy for growth in normal traffic. It might be argued that 2009 is not a representative base year, being in the depths of the depression. However, fuel prices were very low in the first half of the year and nearly all M-1 traffic is light vehicles. There is no evidence of a significant fall in traffic.

42. Tranche 1 connects the two largest cities. Whether the traffic growth rate will be above the national average is a complex question: (i) Yerevan has been the driver of economic growth; (ii) Gyumri is targeted by the Government for development; and (iii) the vehicle fleet per thousand in Yerevan in 2006 was double that in other Marz (Table 3-3). For the medium term, growth on the M-1 section is likely to be higher due to (i) and (ii), but in the long term (after 2020) Yerevan will see much slower vehicle fleet growth than other areas, being closer to the saturation level.

Table 3-2: Vehicle Fleet Forecast

Item	2009	2014	2020	2030
Scrappage rate % pa	4.0	4.2	4.5	5.0
GDP %	–15.6	4.5	5.0	6.0
Imports '000	17.0	33.0	48.0	104.0
Fleet end-year '000	380.0	420.0	539.0	949.0
Growth rate % pa	–	2.0	4.2	5.8
Fleet/'000 population	118.0	130.0	168.0	316.0

Source: This Study, 2010

43. Combined generated and induced traffic has been assumed to be 10% of normal traffic (this includes the impact on the section of improvement of the adjacent section under the candidate Tranche 2 Project). On the basis of projected GDP growth and the estimated income elasticity of demand in Armenia, traffic on the improved Yerevan-Ashtarak road is projected to grow by 8.3% annually, with average daily traffic increasing from about 13,060 vehicles in 2012 to 65,605 in 2032.

Table 3-3: Tranche 1 Traffic Forecast

Section	2012	2015	2020	2025	2032
With project	13,060	17,110	24,490	36,660	65,605
Without project	13,060	15,550	22,270	33,330	59,641

Note: "With" case includes generated traffic.

Source: This Study, 2010

SECTION 4 ECONOMIC ANALYSIS

4.1 HDM4 Parameters

44. The Highway Design and Maintenance 4 (HDM4) model parameters used in the economic analysis are given in Table 4-1.

Table 4-1: Typical Vehicle Base Data

Item	Car	Minibus	Bus	2-axle	3-axle	4+-axle
Economic cost \$'000	17	16	40	20	30	80
Fuel cost cents/liter	74	74	57	74	57	57
Oil cost \$/liter	5.5	4.1	4.1	2.7	2.7	2.7
Tire cost \$/tire	51	76	144	212	212	255
Maintenance labor \$/hour	4.9	8.6	8.2	9.6	9.6	11.0
Crew wages \$/hour	0.0	1.0	1.3	1.7	1.7	2.3
No. of passengers	2.5	15	40	0	0	0
Passenger work time \$/hour 2009	2.00	2.00	2.00	–	–	–
Non-work time \$/hour 2009	0.65	0.65	0.65	–	–	–
Work-related time %	75	75	75	–	–	–
Annual utilization km'000	20	60	70	30	86	86
Vehicle life years	10	7	8	12	14	14

Source: This Study, 2010

4.2 Economic Analysis Tranche 1

45. **Economic costs:** The economic cost comprises: (i) capital investment, including civil works and physical contingency, environmental mitigation and consulting services for construction supervision; and (ii) net road maintenance during the analysis period. All cost elements are valued at border prices, using a world price numeraire, with all taxes and duties excluded. A standard conversion factor of 0.97 is applied to non-tradable items and labor. A shadow wage rate factor of 0.7 is used to estimate the economic price of unskilled labor, estimated to account for 5% of the construction cost. The total economic cost for the improvement of the 18.4km carriageway is estimated at \$29.6 million. There is additionally, \$6.8 million investment in improving safety and road furniture, road lighting, and for the improvement of the M-1/M-3 interchange.

46. **Economic benefits:** The economic benefits comprise savings in vehicle operating costs (VOC) and travel time, due to the improved condition of the road. These were calculated using the HDM4 model. The benefits considered for normal and generated traffic are: (i) vehicle operating cost savings from the improvement in the road surface quality and the provision of paved shoulders; and (ii) time savings. The average IRI in 2009 was 5.4m/km, which will be reduced to 2.0m/km by the project. Generated and induced traffic benefits are evaluated at 50% of normal traffic benefits. There is no diverted traffic for benefit purposes, as diversion from Bagratashen will occur before project completion and such traffic is included under normal traffic.

47. **Value of time:** The value of time (VOT) in 2009 is taken as \$2.00 per hour for work-related trips (the average monthly wage January–October 2009 was AMD98,600, an hourly wage of AMD590, with \$1=AMD390 (as of 17 November 2009) and an overhead factor of one-third). Real wage rates (after adjusting for inflation) are expected to increase in the future. GDP is forecast to be 17% higher in 2014 (from its depressed 2009 base), with a further growth of 34% to 2020 and of 79% to 2030. Cumulative GDP growth for 2009–2030 is

181%, but for 2008–2030 137%. Growth does not all feed through to higher real wages, as labor participation rates will increase considerably from their current low level. VOT has accordingly not been increased to 2014, by 4% pa 2014–2020 and by 5% pa 2020–2030. VOT per hour in 2020 (at 2009 prices) is then \$2.50 and in 2030 \$4.10. For non-business trips, one third of the work value is taken, as a proxy for willingness to pay. The time saved for freight in transit is estimated at \$1.00 per ton per hour.

48. **EIRR and NPV:** The economic internal rate of return (EIRR) and the economic net present value (at a discount rate of 12%) were calculated by comparing the with-project and without-project scenarios for a 20-year period of project operation. In the without-project case, surface condition is calculated within HDM4, based on typical maintenance of an interstate highway.

49. Economic benefits accrue in the form of lower vehicle operating costs and road user time savings. The EIRR is 16.8%. The NPV for the Project is estimated at \$12.4 million (Table 4-2). The cost and benefit streams are shown in Table 4-3.

Table 4-2: Tranche 1 Construction Cost and EIRR

Location	Length (Km)	Economic Cost (\$ mil)	IRI	2009 AADT	EIRR	NPV (\$ mil)
Yerevan – Ashtarak	18.4	29.6	5.4	11,680	16.8	12.4

Source: This Study, 2010 and Asian Development Bank estimates

Table 4-3: Tranche 1 Costs and Benefits (\$ million)

Year	Cost				Benefit			
	Initial Investment	Periodic Maintenance		Total Cost	VOC Saving	Time Saving	Total Benefit	Net Benefit
2010	8.87	0.00	0.00	8.87	0.00	0.00	0.00	(8.87)
2011	14.79	0.00	3.59	11.20	0.79	0.40	1.20	(10.00)
2012	5.91	0.00	0.00	5.91	0.94	0.49	1.43	(4.48)
2013	0.00	0.00	0.00	0.00	1.27	0.08	1.35	1.35
2014	0.00	0.00	0.00	0.00	1.62	0.31	1.93	1.93
2015	0.00	0.00	0.00	0.00	2.04	0.60	2.64	2.64
2016	0.00	0.00	3.59	(3.59)	2.54	0.98	3.51	7.10
2017	0.00	0.00	0.00	0.00	1.88	0.29	2.18	2.18
2018	0.00	0.00	0.00	0.00	2.39	0.65	3.04	3.04
2019	0.00	2.76	0.00	2.76	3.00	1.10	4.10	1.34
2020	0.00	0.00	0.00	0.00	3.62	1.69	5.31	5.31
2021	0.00	0.00	3.59	(3.59)	4.48	2.44	6.92	10.50
2022	0.00	0.00	0.00	0.00	3.15	1.07	4.23	4.23
2023	0.00	0.00	0.00	0.00	3.95	1.79	5.74	5.74
2024	0.00	0.00	0.00	0.00	4.92	2.71	7.63	7.63
2025	0.00	0.00	0.00	0.00	6.06	3.87	9.92	9.92
2026	0.00	2.76	3.59	(0.83)	7.41	5.26	12.68	13.50
2027	0.00	0.00	0.00	0.00	6.13	2.63	8.75	8.75
2028	0.00	0.00	0.00	0.00	7.67	4.00	11.67	11.67
2029	0.00	0.00	0.00	0.00	9.46	5.77	15.23	15.23
2030	0.00	0.00	0.00	0.00	11.68	7.72	19.40	19.40
2031	0.00	0.00	3.59	(3.59)	14.36	10.46	24.82	28.41
2032	(8.87)	0.00	0.00	(8.87)	17.52	13.83	31.35	40.22
EIRR								16.8%
NPV								12.4

Source: This Study, 2010 and Asian Development Bank estimates

50. **Sensitivity Analysis/Switching Values:** In addition to the impact of a cost increase of 20%, a benefits decrease of 20% and a combined cost increase and benefit decrease of 20% on the project EIRR and NPV are shown in Table 4-4. The EIRR is reduced to 14.9% when the capital cost is increased by 20% and to 14.6% when road user benefits are reduced

by 20%. In the case of simultaneous increase in cost of 20% and reduction in benefit of 20%, the EIRR is reduced to 12.9%. The switching values are 67% for cost increase, 40% for benefit reduction, and 25% for a combination of cost increase and benefit reduction.

Table 4-4: Tranche 1 Sensitivity Analysis and Switching Values

Item	EIRR (%)	NPV (\$ mil)	
Base Case	16.8	12.4	
Cost + 20%	14.9	8.9	
Benefits –20%	14.6	6.2	
Cost/Benefits +/-20%	12.9	2.6	
	Cost	Benefits	Cost/Benefits
Switching values*	+67%	–40%	25%

Note: * to equate NPV to zero.

Source: This Study, 2010 and Asian Development Bank estimates

SECTION 5 ENVIRONMENTAL IMPACT AND STRATEGY

5.1 Environmental Assessment and Review Framework (EARF) Summary⁶

51. The sections of road to be improved under Tranche 1 of the MFF are the Yerevan to Ashtarak and Yerevan to Ararat sections of the North–South Roads Corridor. Both sections are existing 4-lane divided roads. There are no unique or sensitive areas, no forests, and no protected areas within 1km of the alignment and environmental impacts can be expected to be minor and easily prevented or mitigated. As such, the ADB assessed this sub-project to be a Category “B” project requiring an IEE. The IEE Report and Summary were displayed on the ADB Website in August 2009, translated to the Armenian language and, under RA EIA requirements, circulated among RA ministries and project-affected communities.

5.2 The Initial Environmental Examination (IEE) for the Tranche 1 Project

52. The Initial Environmental Examination (IEE) Report of the Tranche 1 Roads Improvement Project was completed and the Summary IEE (SIEE) displayed on the ADB website. The full IEE and the SIEE can be found in Appendix 13. Included in them are the Environmental Management Plan and the Monitoring Program.

53. The two selected roads form parts of the Armenian north–south road corridor to be rehabilitated, reconstructed and expanded under the ADB funded multi-tranche funding facility (MFF) designed to rehabilitate and upgrade national north–south roads. The Project, financed from Tranche 1 under the MFF, is to improve: the M-1, 4-lane section of road north from Yerevan to Ashtarak, and the M-2, 4-lane section of road south from Yerevan to Ararat.

54. Both road sections are located in arid areas (annual precipitation less than 400mm) with most precipitation falling as rain in spring and autumn. The geology is very mixed but essentially a combination of volcanic basalt, faulted uplift and sedimentary infill overlying lava. The landscape north of Yerevan along the M-1 Project road corridor is gently rolling uplands 1,060m to 1,270m in elevation. The landscape south of Yerevan along the M-2 Project road corridor is flat and about 1,100m in elevation.

55. The original fauna in the road corridors, including steppe and semi-desert species, have been largely supplanted. There are no unique areas, no protected areas and no forests or ecological reserves within 100m either side of either of the rights-of-way.

56. The existing 4-lane roads form important features of the existing environmental baselines along both road corridors. There are no industrial buildings, facilities, commercial operations or residences located within either right of way. No land purchase or resettlement will be necessary, and neither road section passes close to any villages.

57. The areas near the Yerevan ends of both alignments are semi-urban transition zones where vacant land, industrial activities, run-down and disused industries and small residential areas are intermixed with remnant agricultural uses. The remainders of both road corridors sections are different. Agriculture along the north road section is limited to small orchards and a few hay fields towards Ashtarak. In complete contrast, agriculture predominates along both sides of the road section in the south. The flat, irrigated land is intensely cropped with vineyards, wheat, orchards and market-gardens wherever irrigation is possible.

⁶ The EARF can be found in Appendix 12 to this report. However, the requirements of ADB's latest Safeguard Policy Statement (2009) should be considered.

58. Close to the north road section there are two important archeological sites protected by the Department of Historical Monuments. There may also be undiscovered archaeological remains or artifacts below ground. There are no known sites close to the south road section.

59. Eight construction activities (all related to activities to improve the M-1 road) with potential to impact on the environment, including human safety, are as follows:

1. Undertake earthworks: Prepare work sites, Dispose of surplus material
2. Operate quarries borrow pits
3. Transport materials
4. Operate asphalt plants
5. Construct and extend culverts
6. Store/handle diesel and waste oil
7. Manage traffic in and near work sites
8. Operate work camps, including storage/disposal of sewage, domestic and solid waste

60. All eight works-related activities have the potential to create significant impacts on the environment or human safety. However, all impacts and safety issues can be prevented or mitigated by following sound engineering practices and implementing the impact prevention and mitigation measures set out in the EMP. The operation or use of the improved roads will impact the environment in only minor incremental but positive ways.

61. The improvement works will impact the baseline environment only via minor impacts. Earthworks, construction activities and quarry and borrow-pit operations may create short-term impacts on air and land quality, health and safety, may cause local flooding (by diverting runoff) and unearth archaeological sites or artifacts. Other activities that may cause negative impacts are asphalt plant operations, transport of materials, storage and handling of diesel, traffic in and near work sites, and work camp site preparation and operations.

62. The Project will not change the vertical or horizontal alignments. There will be no removal of top-soil, no new cut or fill sections and no bridge construction. Most construction works will be confined to the 18.4km 4-lane north road section from Yerevan to Ashtarak, where the road-bed itself will be improved by removing the old asphalt, digging out and removing sub-standard road-bed materials and replacing both with new materials.

63. Short-term negative impacts will be created on water, land and air quality (and noise) and health and safety. These environmental elements are most likely to be impacted along the north road section, and rural roads may be damaged by the heavily laden trucks carrying earth, gravel and other works materials—depending on the truck routes taken.

64. As the area is arid there is very little water that may become affected and impacts on water quality are expected to be insignificant.

65. There are no ecologically important or sensitive environmental elements and few human use factors that may be seriously affected. The most important possible impact issue is the potential to unearth archaeological sites or artifacts (addressed in the EMP).

66. Air quality impacts will be confined to localized dust nuisance. This may be significant but manageable. Similarly noise may be significant, localized and manageable. Impacts on land quality are expected to be very minor because works will be minor on the south road section and confined to the existing right of way of the north road section. Hence, the likely impact on land is considered to be insignificant and manageable.

67. Health and safety impacts may be significant but preventable at all locations.

68. Actual impacts will be short-term and insignificant. Nevertheless, all impacts have been addressed in the EMP and the Monitoring Program. Environmental Management seminars are proposed to ensure understanding of and compliance with good environmental practices.

69. Short-term positive impacts will be created via local employment and spin-off effects and the associated increase in short-term expenditure. Households and small businesses will benefit significantly over the short-term.

70. It is recommended that:

1. The clauses set out in the Summary EMP and the IEE Report be included in the Contract Documents
2. The Contractor prepare an EMP and the operating plans specified in the IEE Report
3. The ARD and SEI ensure that the impact prevention and mitigation measures specified in the IEE, EMP and operating plans be implemented.
4. Environmental Management Seminars be developed and delivered by the International Environmental Specialist
5. Environmental monitoring be carried out as specified in the EMP and Monitoring Program
6. The EA ensure that the completed road meets the requirements under the European Agreement on Main International Traffic Arteries to which the RA is a signatory.

SECTION 6 LAND ACQUISITION AND RESETTLEMENT (LAR) AND SOCIAL DEVELOPMENT

6.1 General

71. This section covers the Land Acquisition and Resettlement (LAR) activities of the TA team for Tranche 1. An initial task was to generalize the Terms of Reference (TOR) into specific deliverables. This analysis is attached as Annex 1 Sub Appendix 14.3 to this report. The outline of this chapter follows the TOR deliverables for Tranche 1 as specified in this analysis.

72. The scope of the work following the TOR deliverables included preparation of a LARF and LARP for Tranche 1. The LARF was prepared in consultation with the Government of Armenia and ADB. The MFF Program's Tranche 1 Project will: (i) reconstruct the dual 2-lane section of the M-1 Yerevan–Ashtarak (18.38km) and improve the M-1/M-3 intersection to internationally acceptable standards; and (ii) improve traffic safety measures on the dual 2-lane M-2 section Yerevan–Ararat (37.97km). Road works are planned to be fully confined to the existing ROW and to be constructed in stages, one carriageway at a time, in order to enable continued use of the road. There will be no change to vertical or horizontal alignment. While no LARP for Tranche 1 was required, the consultants at the verbal request of ADB carried out a Due Diligence of Tranche 1 to verify that no LAR impacts will occur (Annex 1 Sub Appendix 14.6). A gender sensitive HIV/ADS program was also prepared for Tranche 1 and will be conducted for the local communities and the workers involved in the road construction.

6.2 LAR Framework (LARF) for Multi-Financing Facility (MFF) under Tranche 1

73. A Land Acquisition and Resettlement (LAR) Framework (LARF) was developed early in June and sent to the ADB's Senior Social Development and Resettlement Specialist (SSDRS) at the Central and West Asia Department (CWAD), Mr. Lanfranco Blanchetti–Revelli, for review. It was also given to Deputy Director General of ARD, Mr. Karen Badalyan, for review on June 11th.⁷ Higher level review of the LARF commenced on the arrival of the ADB 15–29 July 2009 MFF Fact-Finding Mission, during which the SSDRS, with the TA's close collaboration, met on July 22nd with among others Mr. Karen Badalyan and the Head of MOTC's Foreign Relations Department, Mr. Gagik Grigoryan, and also with the Municipality of Yerevan's Investing Projects Implementation Unit, Director Mr. Robert Haroutunyan and Vice Director Mr. Samvel A. Mkrtchyan, to seek relevant legal and institutional information to review and update the original draft LARF to be more relevant to Armenia's legal framework and established LA procedures.⁸ The LARF prepared for the loan is attached as Annex 1 Appendix 17. Its main provisions describing Armenia's LAR legal framework and its entitlement matrix will be incorporated into the LARP for the candidate Tranche 2 and for future Tranches.

⁷ The draft LARF was a composite of a recently prepared LARF for a similar transportation project in Georgia, which was forwarded by the TA's Project Manager, Mr. Rustam Ishenaliyev, as a model and the LARF earlier prepared for the ADB-financed Rural Roads Project. A Chief Environmental Specialist, Armine Yertigaryan, at ARD was assigned on June 15th to coordinate with the TA and in particular to review the draft LARF; which was also translated by the TA into Armenian, and numerous comments were received and incorporated into both the English and Armenian drafts.

⁸ Among legal documents reviewed were the Land Code Article 102, 104, the Civil Code (1998), Articles 218 through 221 and in the Law of RA On the Alienation of the Private Property for Public and State Needs adopted on 27 November 2006 and Armenia's Constitution (1995). From the ADB Mission's departure until the LARF was sent to ADB on July 30th to be an RRP attachment for circulation in the ADB, meetings were held with ARD's TA Coordinator, with ARD's Chief Environmental Specialist originally assigned to work with the TA and a second Chief Environmental Specialist, Ms. Edita Vardgesjan, to reach provisional ARD approval of the LARF before submitting it for wider circulation and the RA Government and official approval prior to loan negotiations.

6.3 LAR Plan (LARP) for Sub Project under Tranche 1

74. As indicated in the Memorandum of Understanding (MOU) of July 29th and the ADB's July 2009 RRP, the outputs for the Tranche 1 Project will be (i) reconstruction of 18.4 km four-lane section of Yerevan–Ashtarak road, (ii) improved road safety for Yerevan–Ararat road, (ii) design and bidding documents for the candidate Tranche 2 Project, and (iii) support for implementing road subsector plan under the transport sector strategy.

75. The classification of the Tranche 1 Project for resettlement impact is category C. All civil works will take place within the existing right-of-way or on unused state-owned land. No relocation of households or acquisition of productive land is expected. Borrow pits or quarries are also available in state-owned empty land, within easy access and away from residential areas. Therefore, no Land Acquisition and Resettlement Plan for the Tranche 1 subproject is required.

6.4 Indigenous Peoples Development Plan under Tranche 1

76. There were found to be no groups with characteristics of indigenous people (as defined by ADB's Policy on Indigenous Peoples [1998]) affected by the Tranche 1 Project. Therefore, the Tranche 1 project is classified for impact on indigenous people category C. It is reported that the population in the Project area consisted of 99% Armenians and other nationalities included Kurds and Russians, who have lived in the same region for a long time and integrated in the same economic and social structure. The road alignment touches only the Armenian settlements and none of them will be adversely affected.

6.5 Stakeholder Consultation and Participation Plan under Tranche 1

77. As mentioned in para. 75 above, no LARP is required for the Tranche 1 subproject. However, in accordance with ADB involuntary resettlement policy, a Land Acquisition and Resettlement Framework (LARF) was prepared for the MFF to guide preparation of LARPs for future subprojects. The following indicates the LARF (and ADB) requirements for stakeholder consultation and public participation for all LARPs prepared under the MFF.

6.6 Gender Action Plan under Tranche 1

78. As the MFF Program has only some gender benefits there was no Gender Action Plan prepared. As part of the Summary Poverty Reduction and Social Strategy, men and women will be given equal employment opportunities.

79. Also, as per the LARF, it is recognized that women have important economic roles in project areas and engage in a very wide range of income making activities in the agricultural and marketing sector. The Project will pay particular attention to ensure that women are the recipients of the compensation pertaining to their activities and to ensure that women who are de-facto household heads are clearly listed as beneficiaries of compensation and rehabilitation proceedings under the loan. In order to ensure the above the following actions will be considered:

- Include women in the impact enumerators.
- Impact assessment of AFs/APs indicating the total number of families and people must be gender-disaggregated to pinpoint how many women are likely to be affected by the Project and establish their pre-Project conditions.
- Women will be major participants in the consultation processes to determine and negotiate for compensation entitlements and implement the LARP.
- Special attention will be given to the impact of resettlement on women and other vulnerable groups during monitoring and evaluation of the LARP; and.

- The need for public toilets for females along the road will be assessed during implementation, to be maintained by local communities.

6.7 Preliminary Presentation of the Social Dimensions of the Road Sector North–South Road Map under Tranche 1

80. The TA's International and National Social Development and Resettlement Specialists visited the entire length of the North South Corridor MFF on June 3rd (M-1 to the North) and June 5–6th (M-2 to the South), as well as the first M-2 Tatev Alternative along H-46. A large collection of photographs was compiled; Google Earth images showing possible impacts along the N–S Corridor; and extensive use of governmental statistical databases available on the Internet, as well as others⁹ were used to begin a preliminary presentation of the social dimensions of the Road Sector N–S Road Map. A second trip to view the second and third M-2 Tatev Alternatives along E-117 through Lor and through Ltsen (both in Syunik Marz) was carried out August 14–15th and results incorporated into the M-2 South alternatives analysis. These documents are found in Annex 1 Appendix 14.

6.8 Further Tasks under Tranche 1

81. **Due Diligence for LAR Impacts on Tranche 1.** The TA carried out a Due Diligence Field Trip for the new Tranche 1, found in Annex 1 Sub Appendices 14.7 and 14.8. While no LAR Impacts were observed, it was noted that there were numerous fruit vendors along the highway (See Annex 1 Sub Appendix 14.6 for more fruit vendor details). While income loss is not likely to be an immediate problem for the fruit vendors, there are long term considerations for the design of the North South Corridor. At present levels of traffic volume and speed, there does not appear to be any safety issues with these vendors. However, with traffic volume and speed increasing, safety may become an issue. It is recommended that the areas of existing highways be surveyed in preparation of candidate Tranche 2 and 3 Projects to determine where seasonal vendors are concentrated, their overall contribution to local economies and design features be added to the roads to better and more safely accommodate these seasonal businesses. It may be that widening the shoulders may more safely provide informal access to the highways, or pull off lanes and areas may be accommodated in the designs.

82. It is worth mentioning that households/vendors involved in the “roadside” retail trade can completely lose their income source of “roadside” retail trade if, after reconstruction of the highway, traffic is strictly regulated and cars passing by are not allowed to stop (as it is now) and buy products offered at the roadside. In this case, households/vendors involved in “roadside” retail trade can be included into the group of permanently affected businesses, which assumes complete cessation of the trade and as a result permanent loss of income source.

83. **Public Transportation.** Most of the nine hundred thousand people living around the highway corridor have no access to private transportation and no means to purchase their own car in the near future. For that reason they heavily depend on public transportation. The improvement of the road alone will not improve their transport options. A public-private partnership with public transportation agencies will be explored during implementation to increase public transportation. Additionally, resting facilities with male/female toilets will be explored to improve the quality of travel (also for truck drivers).

⁹ National Statistical Service of the Republic of Armenia: <http://www.armstat.am/en/?nid=150>; Armeniapedia: http://www.armeniapedia.org/index.php?title=Main_Page; Wikipedia (Extensive Information on Marz and Community Levels): <http://world-gazetteer.com/wg.php?x=&men=gpro&lng=en&des=wg&geo=-17&srt=npan&col=abcdefghinoq&msz=1500>; World Gazetteer: <http://world-gazetteer.com/wg.php?x=&men=gpro&lng=en&des=wg&geo=-17&srt=npan&col=abcdefghinoq&msz=1500>; Guide to Aragatsotn Marz: <http://www.tacentral.com/aragatsotn.asp> Guide to Shirak, Giumri, Alexandropol: <http://www.tacentral.com/regions.asp>

84. **Emergency Transport Facilities.** Apparently, there is a problem to reach health care facilities in case of emergencies. A public emergency transport facility such as an ambulance traveling along the highway and connecting medical facilities will be explored during implementation, initiated with local NGOs or thru the Government. This will help with road safety.

SECTION 7 POVERTY ANALYSIS AND STI PROGRAM

7.1 Initial Poverty and Social Assessment (IPSA)

85. The Initial Poverty and Social Assessment (IPSA) is prepared for a TA's pre-design stage. However, as construction for the first tranche of the MFF has been scheduled soon, the TA was conducted at the design stage, and therefore during the ADB 15–29 July 2009 MFF Fact-Finding Mission, the IPSA was updated to a more in depth Summary Poverty Reduction And Social Strategy (SPRSS)¹⁰ for more advanced loan processing and submitted to ADB on July 27, 2009, to be attached to the Report and Recommendation of the President (RRP). The SPRSS is Annex 1 Sub Appendix 14.4 to this report.

7.2 Action Plan for Sexually Transmitted Infections (STI) Prevention Along the Road

86. A meeting was held on June 16th with Co-president Hovhanes Madoyan at *Real World, Real People* (RWRP), an NGO specializing in HIV Education and Prevention to seek their cooperation in developing an Action Plan for Sexually Transmitted Infections (STI) Prevention along the Road. The NGO provided relevant documentation about the current HIV/AIDs situation in Armenia, emphasizing that Yerevan is followed by Shirak Marz, then one of the two marzs in what was at that time the tranche one, the Ashtarak–Gyumri road.¹¹ The problem in Shirak was compounded by one of the worst rates of poverty in Armenia and a high migrant level to Ukraine and Russia for employment.

87. The draft Draft STI Education and Prevention Program is attached as Annex 1 Sub Appendix 14.5. As per the RRP of July 27, 2009, the budget and further development of the draft STI Education and Prevention Program is a requirement for the construction companies, and the plan as developed under the TOR will be an invaluable resource:

Information and periodic seminars on HIV/AIDS prevention will be made available through the construction company to people directly and indirectly associated with the Project and also to residents in the project area. These outreach activities will be designed by the construction company and submitted to the EA/IA for approval as part of the health and safety management part of the quality assurance/quality control plan. ADB will review and make specific recommendations, if necessary. The responsibility for preparing and implementing such a plan will be an integral part of the construction contract (RRP, July 27, 2009).

88. The HIV/AIDs awareness and prevention program should begin as soon as possible before construction commences so that when laborers reach their peak, the community has already had the benefit of the program, as it is after all primarily education and prevention. The gender sensitive HIV/AIDs programs will be conducted for the local communities and the workers involved in the road construction. The SPRSS uses the modality of putting the HIV/AIDs program as a conditionality for contractors in their bidding instructions, which is the

¹⁰ For explanation of IPSA and SPRSS within the ADB's Project Cycle see <http://www.adb.org/Documents/Others/Social-Analysis-Toolkit/sat0600.asp>

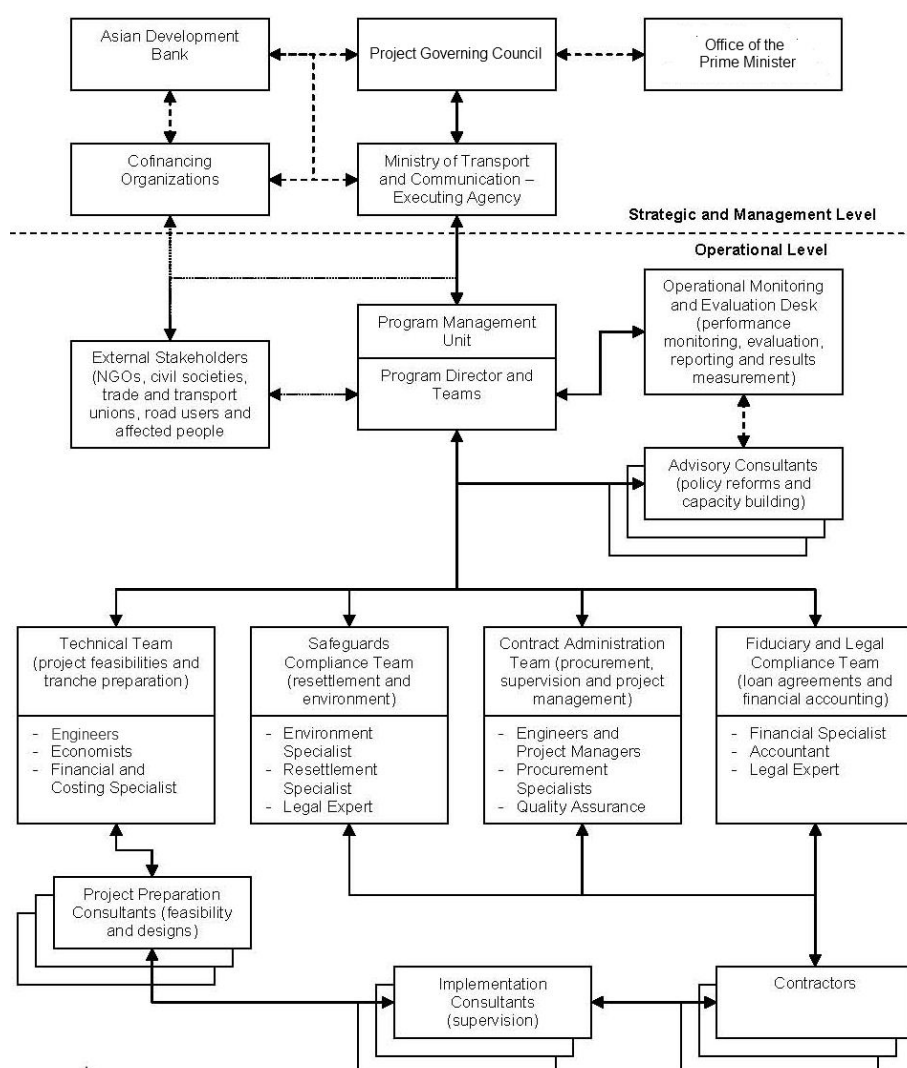
¹¹ Government of the Republic of Armenia. 2007 *HIV Epidemiological Surveillance in the Republic Of Armenia*. Yerevan, *Ministry of Health*. 'The maximum number of HIV cases was reported in Yerevan, the capital: 258 cases, which constitute 48% of all the registered cases. Shirak Marz (the country regional unit) follows next with 9.9% of all the registered cases...Analysis show that the maximum number of the registered HIV cases per 100,000 populations is in Yerevan (23.4). Shirak Marz follows next (18.8), then - Lori Marz (17.3) and other Marzes.' Page 11. See also United Nations Children's Fund.2006. *Rapid Assessment and Response Of Hiv/Aids Among Especially Vulnerable Young People In The Republic Of Armenia: Rapid Assessment and Response Analysis*. Yerevan. http://www.unicef.org/media/files/RAR_ENG.pdf

common practice., though International Resettlement Specialist had an NGO prepare a draft HIV/AIDs program, as part of his TOR.

SECTION 8 IMPLEMENTATION SCHEDULE, ARRANGEMENT, AND PROCUREMENT PLAN¹²

8.1 Program Implementation Organization Chart

89. The MFF for the North-South Corridor Investment Program will have a comparatively high value. Therefore, a strong project implementation unit will be essential for its success. Its composition will need to include not only administrators and engineers, but also procurement, legal, financial and environmental and social experts. The smooth start-up of the project implementation depends on the timely establishment and staffing of the PIU with experienced and competent personnel. The risk of slippage in implementation is greatest at the beginning of the program when procedures and responsibilities are not yet clearly understood or in the worst case not yet properly defined. The agreed Project Implementation Organization Chart is presented in Figure 8-1.



Source: Aide Memoire, March 2010

Figure 8-1: Program Implementation Organization Chart

¹²This section also includes some information on Tranche 2 implementation, arrangement, and procurement.

8.2 Implementation Schedule

90. The implementation schedule demonstrates to all involved in the decision taking process the dependence of activities on the road to achieve the project goals. The project implementation schedule is a generic document, which needs to be reviewed periodically.

91. An implementation schedule has been prepared for the MFF. In compiling the implementation schedule, it was assumed that 2 full working seasons are required for the construction works of Tranche 1 and that the construction works should be completed by the onset of winter, namely December 2012. An extension beyond that date by a couple of months will not be beneficial due to the climatic conditions.

92. The implementation schedule and the procurement plan form the basic guidance for the PIU in monitoring the project activities. During the project implementation, activities may slip or may also be undertaken more speedily or speeded up to recover time lost earlier. Delays may also occur if land acquisition, provision of social and environmental safeguards shifting of public utilities are not implemented ahead of the construction activities.

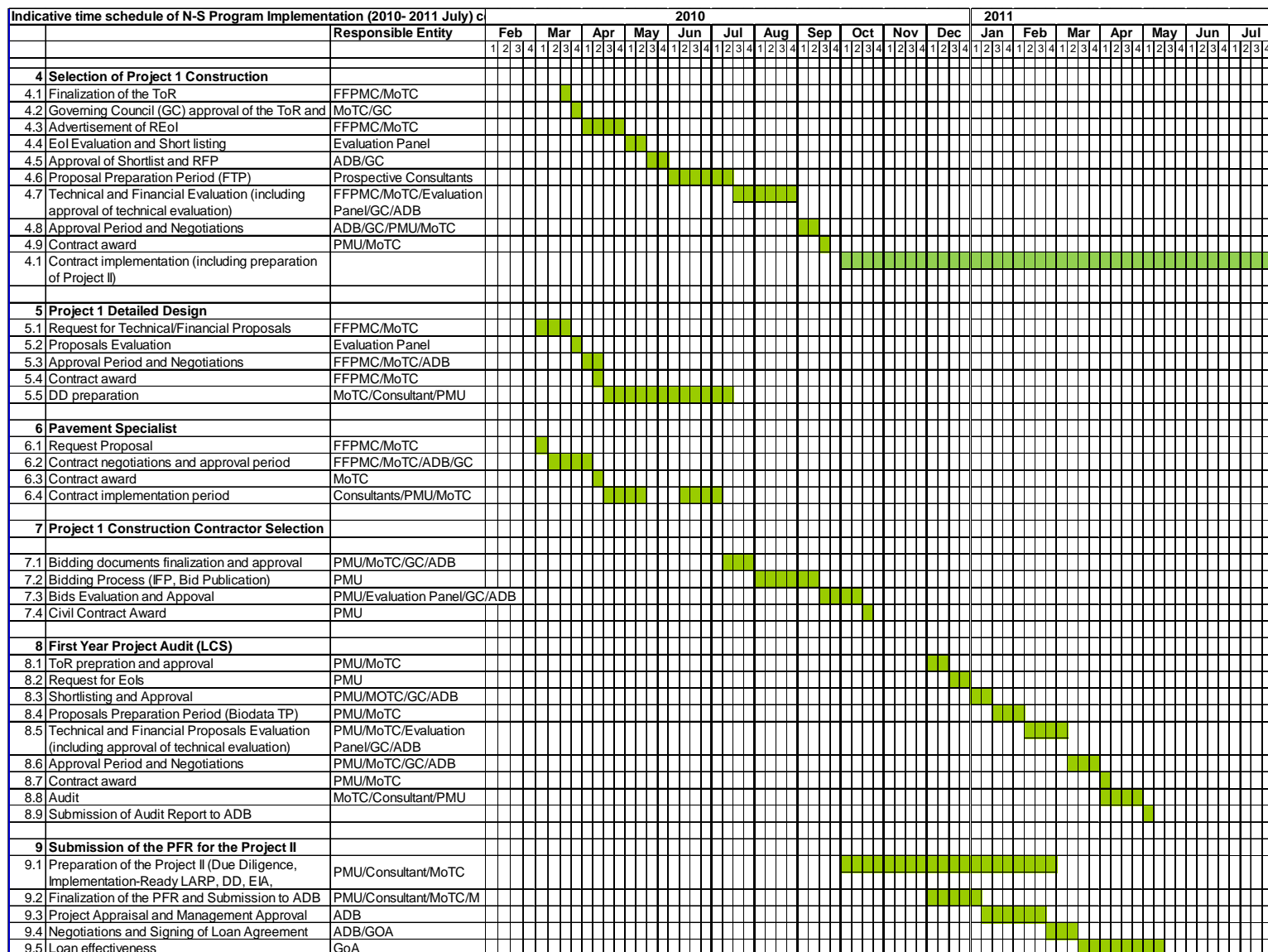
93. Under this MFF the following procurement activities formulate the start of the program.

- a) Detailed Design of Tranche 1
 - Advertisement for Expression of Interest for designer (local) and pavement specialist (foreign)
 - Evaluation of documents received
 - Negotiating and concluding the contract
 - Detailed design and preparation of Bidding Documents
- b) Construction Supervision of Tranche 1 and Detailed Design Tranche 2
 - Advertisement for Expression of Interest
 - Evaluation of documents received
 - Invitation for proposals
 - Evaluation of documents received
 - Negotiating and concluding the contract
 - Commencement of services by consulting firm
 - Detailed design for Tranche 2 and preparation of Bidding Documents
 - Assistance in pre-construction activities
 - Construction supervision
- c) Construction of Tranche 1
 - Advertisement for Bidding
 - Bid and qualification evaluation of
 - Negotiating and concluding the contract
 - Commencement of Works

94. Inspection of the above reveals that the initial progress of the MFF North-South Road Corridor Investment Program, Tranche 1, hinges on the preparation of the design for Tranche 1. A delay in the activity under a) will inevitably delay activity c). While activity b) could go ahead as it also comprises a component for design of Tranche 2. If activity a) is delayed, it could be of advantage to undertake Pre-Qualification of Contractors which, once successfully completed, can reduce the time span of activity c).

95. More details can be seen in the Implementation Schedule, which is presented in Figure 8-2 on the following

29



Source: This Study, 2010

Figure 8-2: Proposed Implementation Schedule

8.3 Procurement Plan

96. The Procurement Plan summarizes the procurement which needs to be undertaken during the project cycle, in particular the initial 18 months, and highlights, among others, the type of works, value and mode of procurement. The plan will be updated annually. The following procurement plan was developed:

Table 8-1: Procurement Plan

Project Name: MFF North–South Road Corridor Development Program	MFF Number: to be assigned PFR 1 Number: to be assigned
MFF Amount: \$500 million Tranche 1 PFR Amount: \$60.0 million	Executing Agency: Ministry of Transport and Communications
Date of first Procurement Plan: 29 July 2009	Date of this Procurement Plan: March 2010

Source: This Study, 2010

Table 8-2: Indicative List of Procurement Packages Required Under the Tranche 1 Project

General Description	Estimated Value (\$ million, cumulative)	Estimated Number of Contracts	Procurement Method	Domestic Preference Applicable	Comments
Works					
Civil works contract package for improvement of Yerevan–Ashtarak road (km 11.8–30.2) and road safety improvement of Yerevan–Ararat road	38.0	1	ICB One-envelope single stage without prequalification	No	
Goods					
Traffic management and monitoring equipment	1.0	several	Shopping	No	
Consulting Services					
Design of Civil Works Tranche 1	0.15 0.05	several	CQS and individual consultant	Yes No	
Construction Supervision for Tranche 1 and Design of Tranche 2 Project	3.8	1	QCBS with FTP	No	quality-cost ratio 80/20
Project Management Unit	0.9	several	individual consultant	Yes	To be determined depending on need.
External Financial Audit	0.1	1	LCS	Yes	

CQS = consultant's qualification selection, FTP = full technical proposal, ICB = international competitive bidding, LCS = least cost selection, QCBS = quality- and cost-based selection.

Source: This Study, 2010

8.4 The Procurement Process

97. Through the Procurement Plan, the procurement procedures and subsequent documents are defined. The procurement process follows the requirements of ADB as defined in the Procurement Guidelines. The guidelines, as well as the standard format of the documents, are available on the ADB web-site.

98. The following documents have been prepared for the project's procurement process:
- Tranche 1 – Terms of Reference for detailed design
– Terms of Reference for Pavement Design Specialist
– Invitation for the above
– Prequalification Document for the Construction Works (abandoned)
– Bidding Document with Post Qualification for Construction Works
- Tranches 1 and 2
– Terms of Reference for construction supervision of Tranche 1 and detailed design of Tranche 2

Terms of Reference for Detailed Design – Tranche 1

99. The works under Tranche 1 are predominantly pavement rehabilitation and road safety improvement measures. After due consultations with ADB and the EA, it was decided that the design works could be procured from firms within the region and most likely from within Armenia. In addition, the pavement design will be supervised/undertaken by an external Specialist. CQS (Consultants' Qualifications Selection) was determined to be appropriate for this purpose. Its definition is reproduced below:

Consultants' Qualifications Selection

40. Consultants' qualifications selection (CQS) is a method for selecting a consulting firm by asking for amplified and detailed expressions of interest (EOIs) submitted in a standard template and selecting the consultant best qualified for the assignment based on an evaluation of EOIs received.*

100. The documents prepared for the selection of consultants for the design of Tranche 1 can be found in Annex 2 Appendix 2.

Terms of Reference for Pavement Design Specialist – Tranche 1

101. The rehabilitation of the existing Yerevan–Ashtarak road will mainly comprise the full depth reconstruction of the pavement. While of course the expertise of designing pavements in consideration of Armenia's climatic conditions is available locally, it was considered advantageous to introduce up-to-date technical considerations into the design and specifications and the possibility of considering concrete pavement. This specialist assignment will be procured through CQS.

102. The document prepared for the selection of the Pavement Design Specialist for the design of Tranche 1 can be found in Annex 2 Appendix 1.

Terms of Reference for Construction Supervision of Tranche 1 and Detailed Design of Tranche 2 Project

103. A firm of consultants will be selected to undertake the construction supervision of Tranche 1 and the detailed designs for Tranche 2 Project. Following a call for expressions of interest, a short-list will be established. Short-listed firms will be invited to present their technical and financial proposals. This process is known as QCBS. Its definition is reproduced below:

Quality- and Cost-Based Selection

QCBS is a method of selecting a consulting firm based on both the quality of the technical proposals and the costs of the proposed services in the financial proposals. This selection method consists of four steps:

- (i) an evaluation of the technical score of each firm's proposal based on 1,000 points,*
- (ii) the elimination of firms scoring below 750 points,*
- (iii) the opening and evaluation of financial bids for firms scoring 750 points and above, and*

(iv) the weighting and combining of the technical and financial scores to reach a final score and a ranking among firms.

To calculate the firms' total scores, the technical proposals will normally be given a weight of 80% and the financial proposals a weight of 20%. This is the standard approach for QCBS and reflects the primary focus on quality but with some appreciation for cost factors in selection.

104. The standard weighting of 80%–20% has been adopted for this procurement.

105. The document prepared for the selection of the Pavement Design Specialist for the design of Tranche 1 can be found in Annex 2 Appendix 1.

Procurement Documents for the Construction Works

106. The value of the construction contract for Tranche 1 is estimated to be about US\$ 38 million. For civil works contracts with an estimated value of more than US\$ 10 million, ADB's Standard Bidding Document for Large contracts shall be used. This process is defined in the Procurement Guidelines, which can be found at the ADB website:
<http://www.adb.org/Documents/Guidelines/Procurement/Guidelines-Procurement.pdf>.

107. Procurement of Works may be undertaken with or without pre-qualification of bidders. The following provides guidance in this respect:

- Procurement of Works following Prequalification shall be applied for all large and complex works.
- Procurement of Works without Prequalification may be used for the procurement of simple and unsophisticated works contracts.

108. The works under Tranche 1 comprise predominantly pavement works. It was decided to adopt the:

Single-Stage: One-Envelope Bidding Procedure

In the Single-Stage: One-Envelope bidding procedure, Bidders submit Bids in one envelope containing both the Price Proposal and the Technical Proposal.

The envelopes are opened in public at the date and time advised in the Bidding Document. The Bids are evaluated, and following approval by the ADB, the Contract is awarded to the Bidder whose Bid has been determined to be the lowest evaluated substantially responsive Bid.

8.5 Bidding Documents for Construction Works

109. The Bidding Documents will comprise 5 volumes.

- Volume 1, Commercial part of the bidding documents
- Volume 2, BoQ
- Volume 3, Technical Specifications
- Volume 4, Detailed Design Drawings
- Volume 5, Factual Geotechnical Report

110. The TA has prepared outline documents for Volumes 1 to 3, which will require updating as a result of the investigations and design undertaken for the Tranche 1 Project.

111. Volume 1, the “commercial” part of the bidding documents, has been developed from the Standard Bidding Document for Procurement of Works—without prequalification—Asian Development Bank, October 2006. This document contains the bidding procedures and the bidding and contract forms. Following the completion of the designs for the Tranche 1 Project it will be required to verify and update as necessary in particular the section referring to the qualification data, as well as references to dates and locations when and where various activities of the bidding procedure will take place.

112. Volume 2 presents the Bills of Quantities which cover the works and miscellaneous items as anticipated at the time of preparing these and they serve as a guideline for developing the final version. The items have been numbered in relation to the relevant sections of the Technical Specifications.

113. It is recommended that separate Bills of Quantities will be developed for the sections Yerevan–Ashtarak and Yerevan–Ararat which will avoid ambiguity regarding where the works shall be executed. This will also be in recognition of the different geographic setting, namely the distinct difference in altitude and subsequent ambient temperatures and other weather conditions.

114. Volume 2, the Bill of Quantities, and Volume 3, Technical Specifications, have been prepared in anticipation of the scope of work. However, detailed project designs were not yet available at the time of preparing these Bill of Quantities and Specifications. Thus both documents need to be reviewed and supplemented in line with the designs for the Tranche 1 Project which will be prepared, both for relevance of the item as well as for the quantities.

115. The Republic of Armenia does not have its own Standard Specifications for construction works. The governing specifications of Armenia are those of the former Soviet Union which are in Russian language and are not readily available in the English language, which commonly is the contract language of internationally funded projects. Previously, internationally funded projects were procured under LCB, therefore, language was not of an issue.

116. Volume 3 provides outline Technical Specifications for the execution of the proposed construction works under the Tranche 1 Project. These are based on the Highway Construction Standards 1998, prepared under Assistance of The Asian Development Bank TA No. 5733-REG. They have been prepared in 2 languages, namely English and Russian; both texts are presented side by side in the said document.

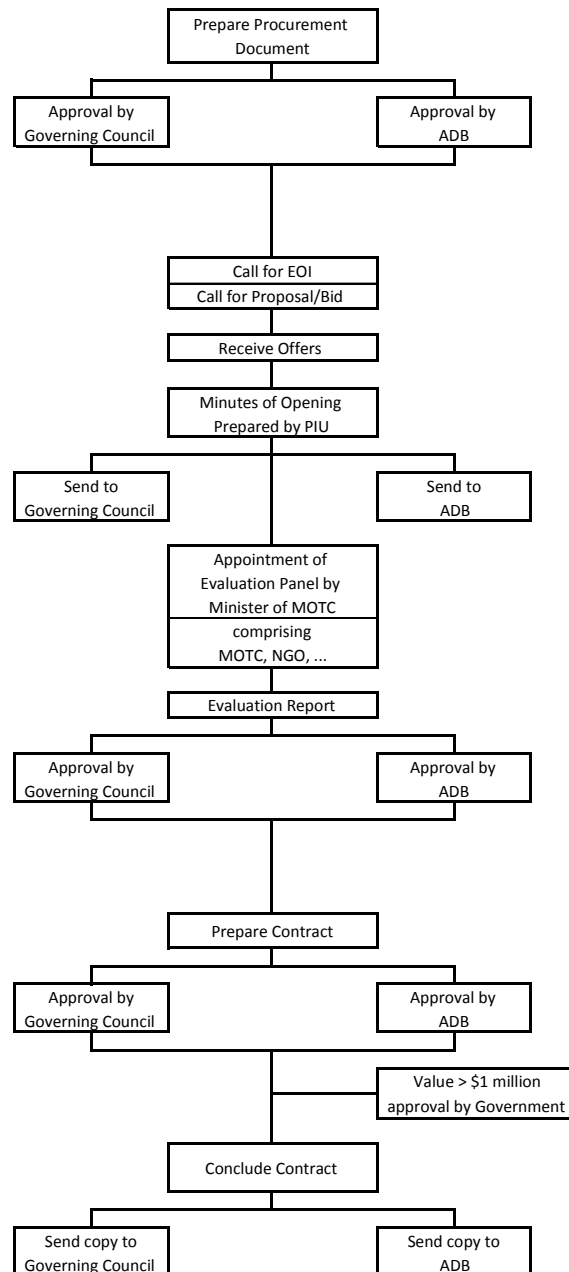
117. The Standard Specifications are supplemented by the Supplementary Specifications. These have been developed on previous projects in the Central Asian Region. They are considered to be applicable to the present project because the climatic conditions of the region for which these were developed do not differ substantially from those encountered in Armenia. The Supplementary Specifications cover the works and miscellaneous tasks as anticipated at the time of preparing the document and shall serve as a guideline for developing the final version.¹³

8.6 Evaluation of Proposals and Bids

118. Under the regulations in force in Armenia, proposals and bids will be evaluated by an Evaluation Panel which will also include members from other Ministries. The evaluation report will then be forwarded to ADB for obtaining the “No Objection.” The report also needs approval from the Governing Counsel.

¹³ The Supplementary Specifications in Annex 2 of this Report are modifications of the the Highway Construction Standards 1998 prepared under Assistance of The Asian Development Bank TA No. 5733-REG cited above and are specific to this TA.

119. Finally, according to RA Law, if the contract amount exceeds one million US dollars, it needs to be approved by the RA Government.



Source: This Study, 2010

Figure 8-3: The Procurement Process

**Asian Development Bank TA7208-ARM
Ministry of Transport and Communication
Republic of Armenia**

**Preparing the North-South Road Corridor
Development Project**

VOLUME III

Tranche 2 Preparation

**FINAL REPORT
May 2010**



VOLUME III TRANCHE 2 PREPARATION

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ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
AC	Asphalt Concrete
ADB	Asian Development Bank
AGR	European Agreement on Main International Traffic Arteries
AMD	Armenian Dram
AP	Affected People
AR	Armenian Railways
ARD	Armenia Roads Directorate
ASIF	Armenia Social Investment Fund
BOQ	Bill of Quantities
DMS	Detailed Measurement Survey
EA	Executing Agency
EBRD	European Bank for Reconstruction and Development
ECRP	Emergency Contingency Response Plan
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EM	Environmental Manager
EMA	Emergency Management Agency
EMOP	Environmental Monitoring Plan
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
EO	Environmental Officer
ERT	Emergency Response Team
EU	European Union
GEF	Global Environment Facility
GDP	Gross Domestic Product
GoA	Government of Armenia
HDM	Highway Design Model
HH	Household
IDA	International Development Association
IDPR	Internally Displaced Persons and Refugees
IDPRDF	The Internally Displaced Persons and Refugees Development Framework
IDPRDP	Internally Displaced Persons and Refugees Development Plan
IDPRSA	Internally Displaced Persons and Refugees Specific Action
IEE	Initial Environmental Examination
IES	International Environmental Specialist
IFI	International Financial Institutions
IMF	International Monetary Fund
IRI	International Roughness Index
IRR	Internal Rate of Return
IT	Information Technology
IUCN	International Union for the Conservation of Nature
ILCS	Integrated Living Condition Survey
km	kilometer
kph	kilometer per hour
marz(es)	administrative region(s)
marzpet	Marz Governor
MCA	Millennium Challenge Account - Armenia
MCC	Millennium Challenge Corporation (USA)
MHPI	Modified Human Poverty Index
MDG	Millennium Development Goals

MFF	Multitranche Financing Facility
MM	Mitigation Measure
MNP	Ministry of Nature Protection
MOFE	Ministry of Finance and Economy
MOTC	Ministry of Transport and Communications
MTA	Ministry of Territorial Administration
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organization
NPE	Nature Protection Expertise
NRSC	National Road Safety Council
NSS RA	National Statistical Service of Republic of Armenia
OECD	Organization for Economic Co-operation and Development
PA	Protected Area
PIU	Project Implementation Unit
PMU	Project Management Unit
PPP	Public-Private Partnership
PPTA	Project Preparatory Technical Assistance
PRSP	Poverty Reduction Strategy Paper
RA	Armenian Government
RoA	Republic of Armenia
REC	Regional Environmental Centre (for Central and Eastern Europe)
ROW	Right-of-Way
RP	Resettlement Plans
RPF	Resettlement Policy Framework
RRC	Regional Resettlement Committee
RRSL	Rural Roads Sector Loan
RRSP	Rural Roads Sector Project
SE	Senior Engineer
SEEC	Department of State Environmental Expertise Commission
SEI	State Environmental Inspectorate
SIEE	Summary Initial Environmental Examination
SME	Small and Medium-sized Enterprise
SNCO	State Non-commercial Organization
SNP	Sevan National Park
SR	State Reservation
SSTA	Small Scale Technical Assistance
TA	Technical Assistance
TRACECA	Transport Corridor Europe Caucasus Asia
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCBD	United Nations Convention on Biological Diversity
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics (former)
WUA	Water Users' Association

SECTION 1 INTRODUCTION

1. This Section presents the results of the Pre-Feasibility Study for the candidate MFF Tranche 2 Project. Improvement of the M-1 Ashtarak–Gyumri (km29.9–118.3) is proposed under MFF Tranche 2. The road section is a continuation northwards from the end of Tranche 1 and is currently a single 2-lane carriageway.
2. The TA carried out (i) existing road condition survey of road and pavement including topographic and visual geological survey, and existing conditions of structures as well as traffic survey, (ii) preliminary design including an improvement plan of the road and structures, (iii) quantity and cost estimation, (iv) traffic and economic analysis, and (v) preparation of a draft TOR of the supervision consultant.
3. The *Construction Norms of the Republic of Armenia* (CNRA) IV11.05.02—99, which came into effect in 2000, are proposed as the geometric design standard for the preliminary design, with some adjustments taking account of E-Road standards, referring to the current Georgian Road Standard. The road alignment is designed to follow the existing road as much as possible to mitigate the resettlement impacts.¹
4. Several options of the road improvement plan were developed for future determination of the project scope of works.

¹ A number of meetings were held with the Working Group, including deep discussions of the alignment option and a presentation by the Team Leader.

SECTION 2 ENGINEERING

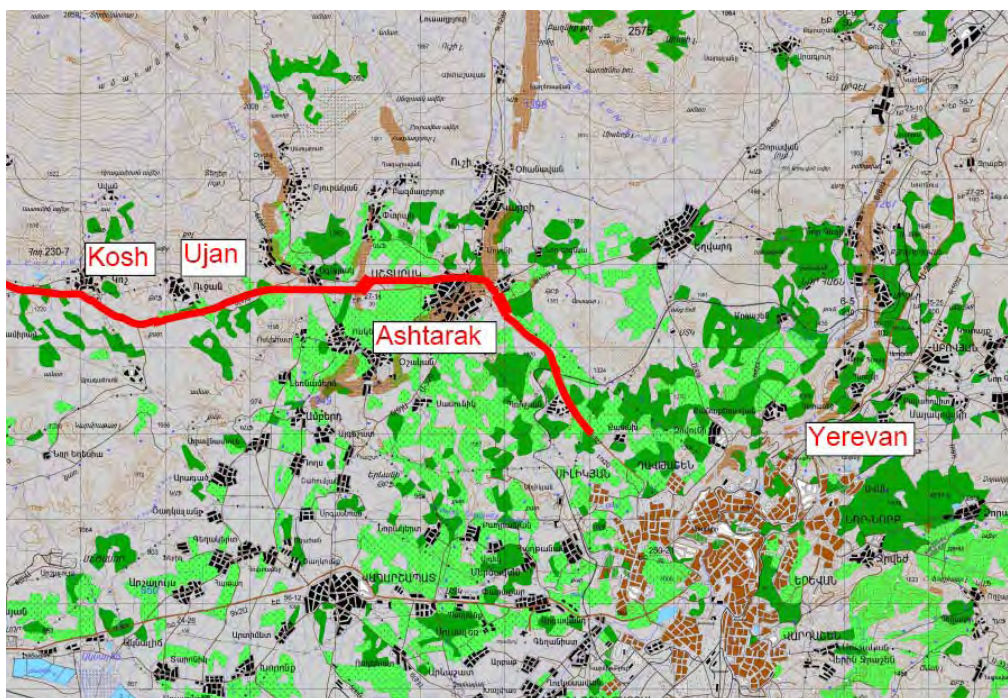
2.1 Existing Project Road Conditions

5. Improvement of the M-1 Ashtarak–Gyumri (km29.9–118.3) is proposed under MFF Tranche 2. This section is a continuation northwards from the end of Tranche 1 and is currently a single 2-lane carriageway. It runs through varied terrain: flat, rolling and mountainous. After Ashtarak, elevation increases from 900–1,100m within 20km, then more steeply to 1,400m in the following 10km. Between Mastara (km79) and Maralik (km96), there is a 10km section of hairpin bends. The maximum elevation is approximately 1,800m, at 86km. From Maralik–Azatan the road descends to 1,400m. Steep gradients and sharp curves impede traffic flow on some sections (Figure 2-1). In 2009, the average IRI Ashtarak–Mastara was 5.1 and for Mastara–Gyumri 5.5.



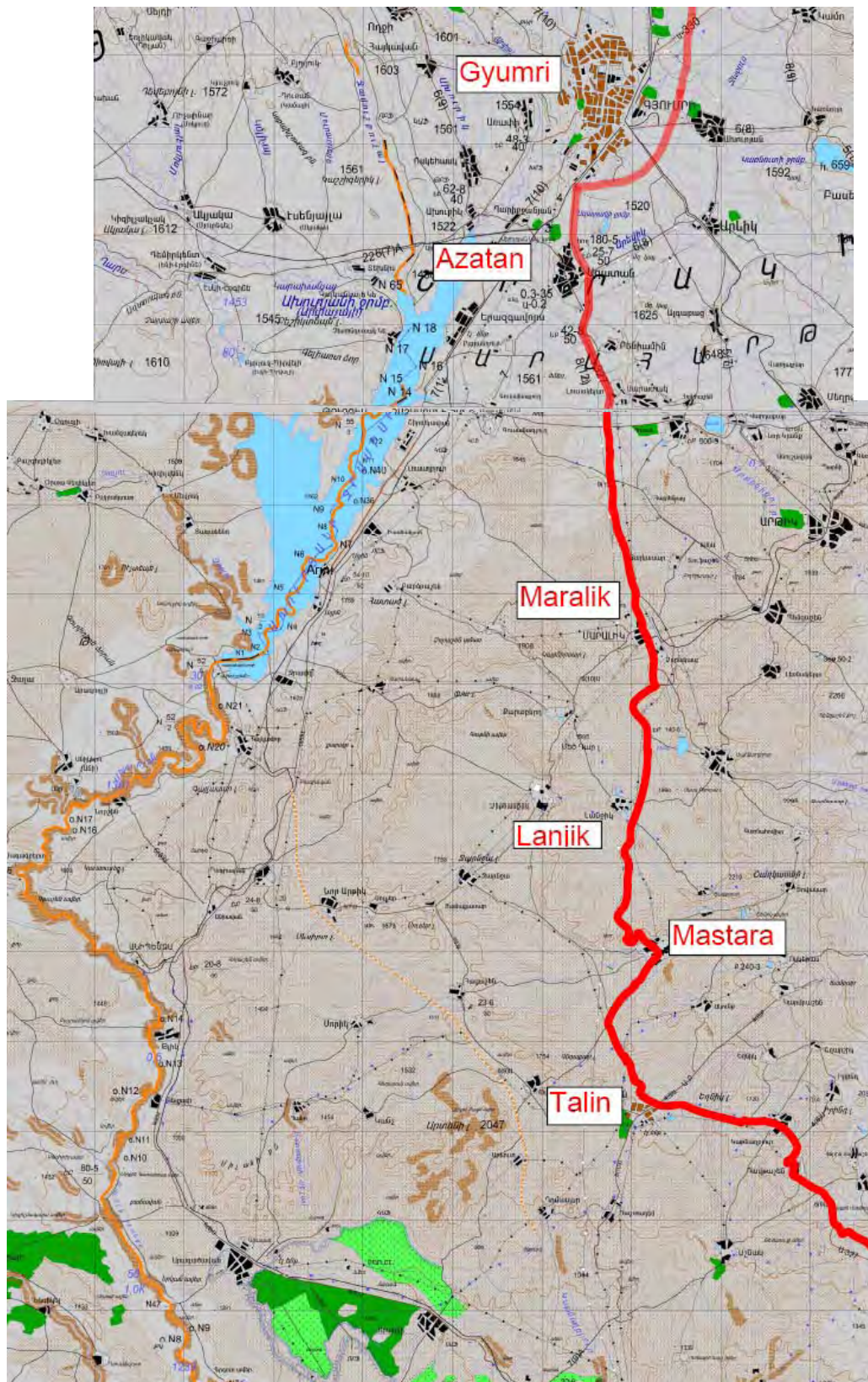
Source: This Study, 2009.

Figure 2-1: Road Condition at Mastara



Source: This Study, 2010.

Figure 2-2: Project Location Ashtarak–Kosh



Source: This Study, 2010.

Figure 2-3: Project Location Talin–Gyumri

6. The lengths of each sub-section from Yerevan to Gyumri are:

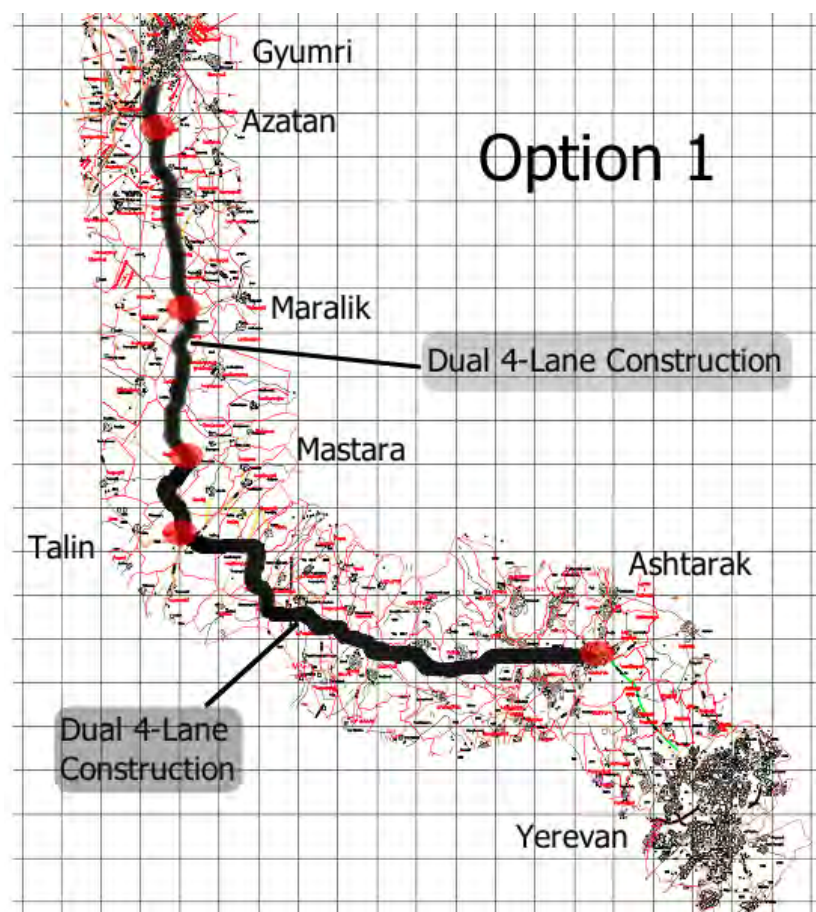
Yerevan-Ashtarak:	18km
Ashtarak-Talin;	40km
Talin-Mastara:	9km
Mastara-Maralik:	16km
Maralik-Azatan:	20km
Azatan-Gyumri:	3km

2.2 Options for Improvement

7. The Consultants conceptualized several options for improving the highway between Ashtarak and Gyumri. In 2008, when the transport sector strategy was prepared, it was envisaged that widening to dual 2-lanes might be feasible in the short to medium term, at least south of Talin.² Due to the economic depression, further investigation and alternative improvement options now need to be considered. Based on engineering considerations there are five options:

2.3 Tranche 2 Option 1

8. Under this option, the existing highway would be widened to dual 2-lanes by constructing a new southbound carriageway and rehabilitating/reconstructing the existing road as a northbound carriageway, as depicted in the Figure below.



Source: This Study, 2010.

Figure 2-4: Tranche 2, Option 1

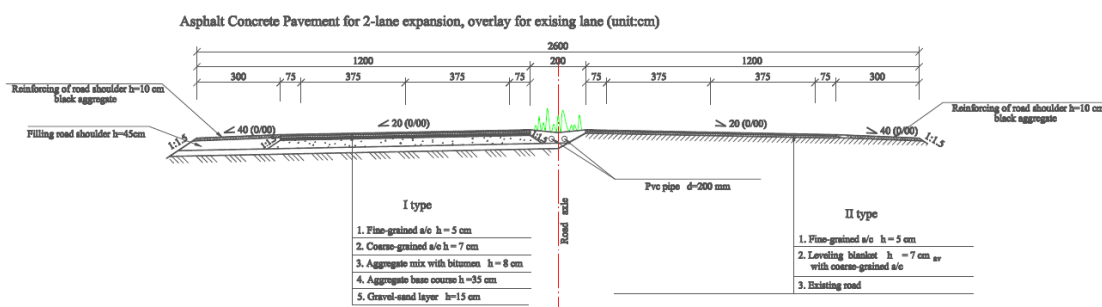
² In July 2009 ADB / MOTC agreed that the consultant would prepare preliminary design and a LARP for this option.

9. **Preliminary Design:** The Option 1 design generally follows the existing alignment. The design was proposed taking into consideration the following factors:

- (i) To accord with Category I geometric standard;
- (ii) to bypass existing residential areas;
- (iii) to separate carriageways in some sections when required by obstacles and topography;
- (iv) to improve the alignment at Mastara – Maralik;
- (v) to mitigate resettlement and environmental impact Agarak–Ujan. In most sections, widening is to either side of the present road (Annex 1 Appendix 7); and
- (vi) to provide grade separation at key intersection points

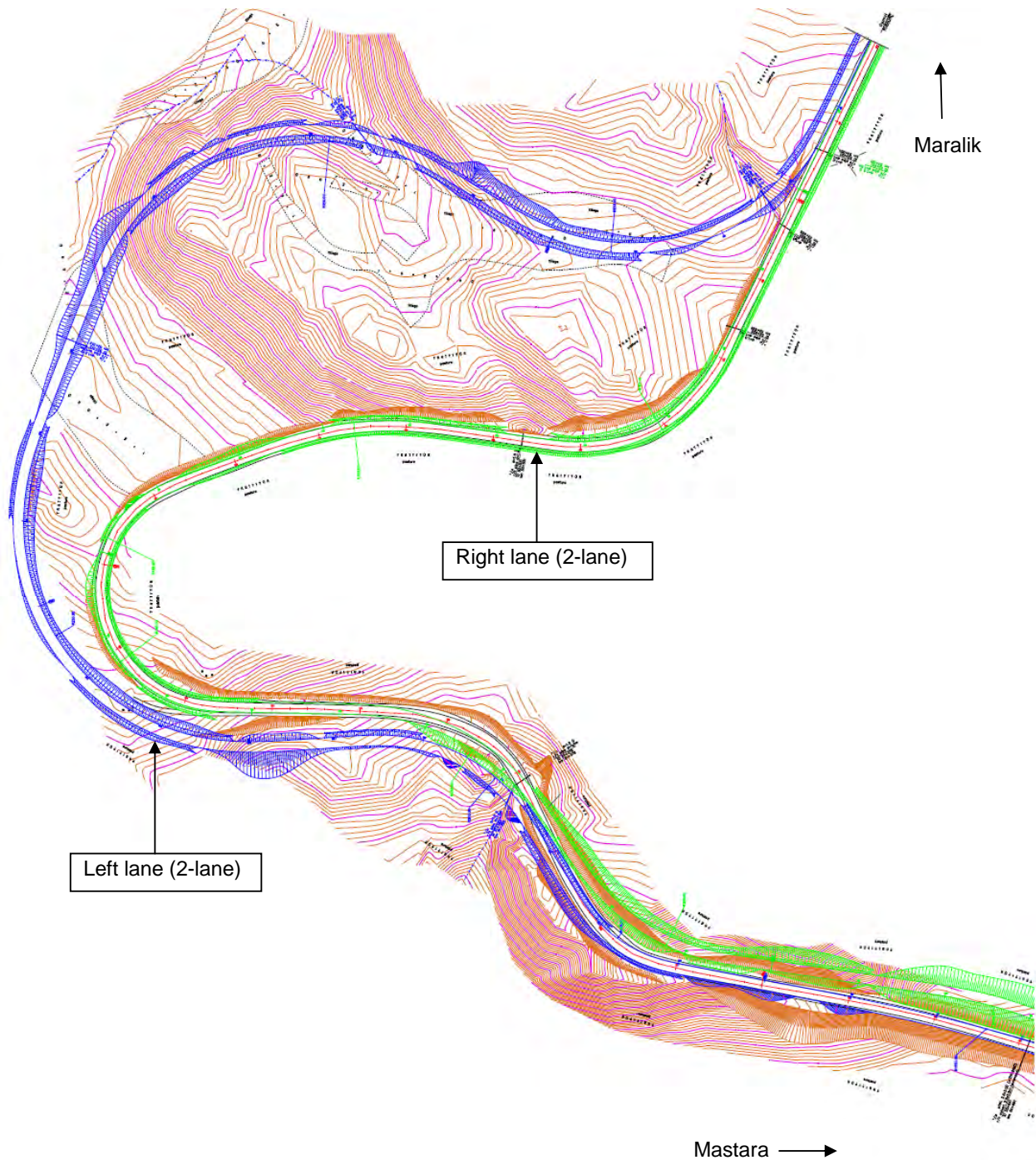
10. The road passes Agarak and Ujan residential areas, where service facilities and vegetation exist along the entire length of this section (within the right of way of the existing road). In such a case, if the existing road were to be widened, there would be encroachment and acquisition of these structures. Therefore, separation of the road by direction was the preferred course of action. The remainder of the section to Mastara residential area is designed by upgrading the existing road through reconstruction to first category road parameters. The section from Mastara to Maralik passes through a high mountainous area and it is not possible to upgrade the existing road to first category road parameters due to the high vertical gradients and small horizontal radii. Therefore the carriageways were split by traffic direction as shown in Figure 2-6 below.

11. The existing carriageway will mainly require rehabilitation to replace failed surfacing and to protect the integrity of the pavement structure. In addition, the soil investigations and pavement design that will be carried out during the Detailed Design shall confirm the need and quantify the extent of replacement of any old structures as required to achieve the desired design life for the road. Figure 2-5 shows the typical road cross section for dual 2-lane. The design average gradient and horizontal curve radius are presented in Annex 1 Appendix 9. Preliminary design drawings, the bill of quantities, and quantity of works are presented in Annex 3.



Source: This Study, 2010.

Figure 2-5: Typical Cross Section for Dual 2-Lane



Source: This Study, 2010.

Figure 2-6: Road Plan (Mastara–Maralik) Dual 2-Lane

12. **Construction cost and packages:** The total cost of Option 1 is US\$232.8m including VAT (or US\$194.2 w/o VAT) assuming an exchange rate of US\$1:ARD390 (full details are in Annex 1 Appendix 11.³) Table 2-1 shows a division of three procurement contract packages.

³ The unit cost of construction works was estimated based on Government instructions. The current price of each material/equipment/labor is published every month by the Ministry of Urban Development, and construction costs

Table 2-1: Option 1 Contract Packages - Work Quantity and Construction Cost (w/o interchanges) (US\$)

Contract Package	1	2	3
Item	Ashtarak-Sasnabard (km29.9–65)	Sasnabard-Lanjik (km65–89)	Lanjik-Gyumri (89–118.3)
Road Length (km)	35.0	24.3	29.4
Excavation (m ³)	1,654,321	1,214,261	947,320
Embankment (m ³)	1,351,010	874,160	590,920
Pavement (m ²)	495,000	364,915	330,219
Earthwork	21.0	14.1	8.5
Road pavement	33.3	23.8	26.5
Road shoulder	3.8	2.8	3.7
Road furniture for traffic safety	5.2	3.8	4.0
Drainage	5.0	3.3	3.1
Structures (Bridges, Culvert)	3.6	0.3	1.6
Construction Cost	71.9	48.1	47.4
Contingencies (10%)	7.2	4.8	4.7
Management/Engineering Fee (5%)	3.6	2.4	2.4
VAT (20%)	16.6	11.1	11.0
Land	0.6	0.4	0.5
Total	100.0	66.8	66.1

Note: estimated at exchange rate of \$1=AMD390 (as of March 2010).

13. The recommended packaging of relatively large contracts considers that there are several disadvantages with smaller contracts. For example, they can be difficult and time-consuming for the EA, they can cause significant work on procurement and supervision, and not be attractive to the larger, high quality contractors. Moreover, small packages invite smaller contractors, which may bid low and compromise quality. Also, the possibility to win several packages tends not to be attractive to large contractors in case one bidder may bid low between the sets. If concrete pavement is preferred, expertise is limited, so larger contractors and packaging is necessary.

14. For civil works contracts with an estimated value of more than \$10million, ADB's *Standard Bidding Document for Large Contracts* shall be used. In preparation for bidding, pre-qualification of contractors should be undertaken, as defined in the *Procurement Guidelines*. The construction period should be determined in with due regard for prevailing climatic conditions, scheduling for completion of work before start of the winter season.

Table 2-2: Option 1 Works Packages

General Description	Estimated Value w/o VAT (\$ million, cumulative)	Estimated Number of Contracts	Procurement Method	Domestic Preference Applicable	Comments
Works					
Civil works contract package for improvement of Ashtarak–Gyumri section (Total 88.4km)	167.4	3	ICB One-envelope single stage with pre-qualification	No	
Consulting Services					
Construction Supervision for Tranche 2 and Detailed Design of Tranche 3	8.4	2 or 3	QCBS with FTP	No	Quality-cost ratio 80/20

Notes: FTP = full technical proposal, ICB = international competitive bidding, QCBS = quality- and cost-based selection.

Source: This Study, 2010.

were calculated by applying the unit prices and efficiency rates provided by the Ministry of Urban Development. Earthworks costs will be lower for the part of the highway that involves rehabilitation of the road.

15. **Land acquisition:** Land acquisition by type of land by community for a 20 m wide COI is summarized in Table 2-3, based on preliminary design and a cadastre map overlay. The official cadastral agricultural land prices are for 1997. However, a valuation survey carried out in 2010 for this TA for the Preliminary LARP provided updated land prices, shown by land type, in Table 2-4 below.

Table 2-3: Option 1 Land Acquisition
(sqm)

Village	Irrig	Non Irrig	Resident	Community	Pasture	Forest	Vineyard	Orchard	Special	Mining	Total m ²
Parpi	6,120	0	1,040	4,000	8,840	0	0	0	0	0	20,000
Agarak	25,162	3,220	2,254	2,254	0	0	0	0	10,396	2,714	46,000
Agtz	12,320	0	0	12,110	36,820	0	6,300	0	0	2,450	70,000
Ujan	36,894	0	4,212	5,460	16,302	0	0	15,132	0	0	78,000
Kosh	7,200	0	360	62,240	5,200	0	5,600	400	0	13,000	94,000
Shamiram	0	0	13,612	31,816	36,572	0	0	0	0	0	82,000
Aruch	8,228	0	0	18,020	13,396	0	0	12,376	15,980	0	68,000
Kakavadzor	0	0	2,520	25,460	0	0	0	0	0	0	27,980
N. Bazmaber	0	5,867	0	3,067	97,067	0	0	0	0	0	106,001
V. ashunashen	0	8,360	0	0	13,640	0	0	0	0	0	22,000
N.Sashunashen	0	0	0	1,600	14,400	0	0	0	0	0	16,000
Davtashen	0	6,080	1,600	6,432	17,888	0	0	0	0	0	32,000
Katnaghbyur	0	10,764	1,950	0	65,286	0	0	0	0	0	78,000
Yeghnik	5,460	0	0	6,708	13,832	0	0	0	0	0	26,000
Talin	14,544	0	4,752	0	124,704	0	0	0	0	0	144,000
Mastara	0	86,072	9,752	0	131,176	0	0	0	0	0	227,000
Lanjik	0	40,400	0	0	14,800	0	0	0	0	0	55,200
Dzorakap	0	16,482	0	0	56,416	0	0	0	0	9,102	82,000
Maralik	298,800	0	50,400	0	199,800	0	0	0	0	0	549,000
Hayrenyats	0	53,136	0	0	28,864	0	0	0	0	0	82,000
Horm	0	37,248	0	5,760	4,992	0	0	0	0	0	48,000
Lusaket	11,300	5,250	11,300	0	22,150	0	0	0	0	0	50,000
Beniamin	8,536	0	12,540	0	16,632	0	0	0	6,292	0	44,000
Azatan	28,208	0	1,476	0	45,264	7,000	0	0	0	0	81,948
Rounded Total	490,000	275,000	120,000	185,000	1,300,000	7,000	12,000	28,000	32,500	27,500	2,477,000

Source: This Study, 2010.

Table 2-4: Tranche 2 Land Losses by Category and Legal Status

Land Type	Legal/titles		Legal Land Unit cost	Legal Land Total	Leases & Non-legal		Leases & Non-legal Land Unit cost	Leases & Non-legal Land Total	Total		
	Plots No	Area(m ²)	AMD/m ²	AMD	Plot No	Area(m ²)	AMD/m ²	AMD	Plots No	Area(ha)	Cost (AMD)
I. Agricultural											
o Arable Irrigable	300	219,972	728.67	160,286,997	11	13,288	497.79	6,614,634	311	233,260	166,901,631
o Arable Non Irrigable	323	207,584	728.67	151,260,233	10	6,744	497.79	3,357,096	333	214,328	154,617,329
o Orchard	29	16,823	2205.34	37,100,435	1	2,445	441	1,078,245	30	19,268	38,178,680
o Vineyards	21	18,650	2671.549	49,824,389	1	235	534	125,490	22	18,885	49,949,879
o Pasture	30	34,471	223.967	7,720,366	9	16,714	37.478	626,407	39	51,185	8,346,774
I. Sub-total	703	497,500	—	406 192 421	32	39,426	—	11 801 872	735	536,926	417 994 292
II. Residential/comm	163	70,263	1916.7	134,673,092	3	637	1127.227	718,044	166	70,900	135,391,136
III. Industrial	4	6,190	1242.0	7,687,980	3	16,283	424.868	6,918,126	7	22,473	14,606,106
V. Community	21	69,629	—	548 553 492*	38	56,346	—	19 438 041*	21	69,629	567 991 535*
Grand Total	891	643,582	—						929	699,928	

*Total sums are rounded.

Source: This Study, 2010.

16. **Utilities:** Aboveground facilities were identified and studied by the Detailed Measurement Survey (DMS) under this TA. However, there are many underground water

distribution mains, gas pipes, telephone cables, and other various cables in the path of the Ashtarak–Gyumri road. The following data on utilities should be surveyed by the detail design consultant for preparation of the bidding documents including existing utility list/plan, the construction cost estimates and specification.

Table 2-5: Utility Information Required for Detailed Design

Utility	Information to be required for Detail Design				
Water Pipeline	Location from existing road center	Depth from existing ground	Size of pipe	Pipe material	Capacity of water
Gas Pipeline	Location from existing road center	Depth or height from existing ground	Size of pipe	Pipe material	Capacity of gas pipe
Electric Cable/Pole	Location from existing road center	Depth or height from existing ground	Size of cable and number of pole	Cable/Pole material	Capacity of cable
Telephone Cable/Pole	Location from existing road center	Depth or height from existing ground	Size of cable and number of pole	Cable/Pole material	Capacity of cable

Source: This Study, 2010.

17. The location of the aboveground utilities should be obtained by the site survey of the detailed design consultant, but the other data should be provided by the government authorities concerned listed in the table below.

Table 2-6: Source of Utility Information

Utility	Government / Organization	
Water Pipeline	Ministry of Territorial Administration, State Committee of the Water Economy	Department of Water and Wastewater Management
Gas Pipeline		RusGasArd
Electric Cable/Pole	Ministry of Transport and Communication	Armentel
Telephone Cable/Pole	Ministry of Energy	Electric Networks CJSC

Source: This Study, 2010.

18. The EA's assistance for getting the data from the government concerned is required, and also need to determined before the tender of the construction works who will shift, remove or relocated these utilities for the Project, whether the EA or the contractor.

19. **Environment:** The consultant carried out an initial environmental assessment for the candidate Tranche 2 Ashtarak-Gyumri 4-lane road. Since the section is considered as environmental category A, a full Environmental Impact Assessment is required, and will be prepared under the Tranche 1 Project. The main environmental features are:

1. The road from Agarak slowly ascends the Yerevan Plateau across Aragatsotn Marz over increasingly higher rolling slopes northwards and crosses into Shirak and the Shirak Plain, on which Gyumri is located. The existing ROW is wide (15–20m) over most of the alignment. It crosses only two small permanent streams, but many irrigation canals and pipes, as well as culverts that are dry for much of the year. There are a number of small villages and small roadside commercial developments along the route.

2. The semi-arid volcanic landscape has no particular qualities of scenic or other importance. It is gently rolling with periodic higher ridges and intervening

shallow valleys. The natural vegetation is mostly dry land species, with shrubs and small trees only around the few permanent and intermittent water courses and moist areas where springs emerge.

3. There are no special reserves or forests nearby, but there is one historic building in the form of a way-side house dating back to the 13th Century.

4. Many small irrigated areas support orchards and cropping, mostly of wheat and potatoes. The non-irrigated dry and gravelly land is used for extensive herding.

5. There appear to be archaeological and cultural heritage sites along the 4 lane improvement option Ashtarak to Gyumri route and these needed to be identified and located. The exact locations and nature of these sites is not fully documented and researchers continue to find new sites. The responsibility for protecting such sites rests with the Department of Historic Monuments in the Ministry of Culture, but the greater knowledge and interest to discover and document such sites rests with researchers in the Institute for Ethnography and Archaeology. The consultant recommended to ADB that supplementary in-depth assessment be undertaken.

20. Key sites are: (i) near historic building km-51; (ii) where new alignments, cuts or embankments may be required; and (iii) the wet soil areas south of Mastara and near Horon and Azatan, and irrigated land.

2.4 Tranche 2 Option 2

21. This option features construction of a new 2-lane road alongside the existing road, which would remain in its current condition. The existing road would operate for local traffic and would not be upgraded. Both new and existing roads would operate with 2-way traffic. The new road could be access-controlled, for through traffic.

22. The advantage of this option is that it provides a new road to higher design standards and operating levels than the existing road. It also represents a less expensive solution than the dual lane option, and yet still provides sufficient capacity for the volume of forecast traffic.

23. The main disadvantage of this option is that the new road would only offer a marginal increase in service level for the level of investment, particularly when compared to the dual lane option. Also, the requirement to physically integrate with the existing road, such as at crossing points will incur costs in structures, which would not be realized if the existing road were fully ‘absorbed’ by a new design. Due to these factors, the main benefit of providing a less expensive option is reduced. Further, the concept of separating through traffic from local traffic to ensure high capacity on the new road is questionable in this case, given the length of road and lack of major towns to bypass, as opposed to a city bypass scheme for example. Another difficulty would be controlling access of the new road. The length and number of accesses has issues of practicality. A buffer area would need to be provided between the existing road and the new road, either to physically separate the two roads, and highlight their different hierarchy, or naturally due to the earthworks (cutting and embankment) created by the new construction.

2.5 Tranche 2 Option 3

24. This option involves widening to dual 2-lanes through staged construction. In Stage 1, the existing road would be reconstructed to the design of the northbound carriageway of a dual carriageway, providing advance earthworks etc. for the southbound carriageway. In

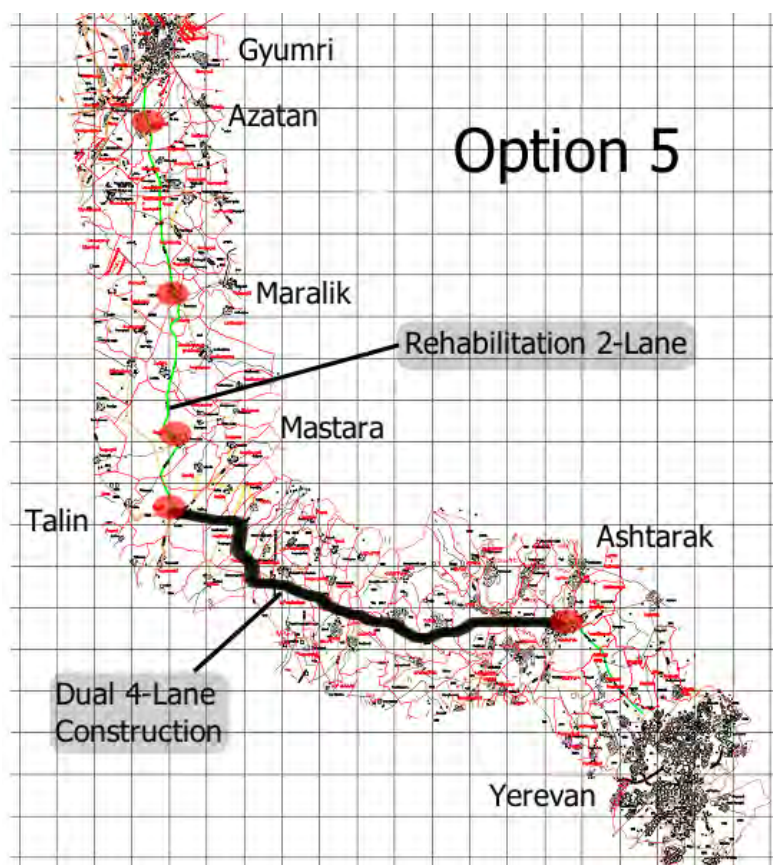
Stage 2, when traffic growth necessitates, complete construction of southbound carriageway would take place. The advantage of this option is that the staged construction allows more timely investment when traffic levels have reached levels that make upgrading more economically viable. However, economic uncertainty remains, so the option contains risks that conditions may not be as viable at a future date e.g. due to interest/inflation/exchange rates. Also, some protection or maintenance of the advance earthworks may be necessary.

2.6 Tranche 2 Option 4

25. This option involves the relatively simple approach of rehabilitating/reconstructing existing road including provision of road shoulder, resurfacing, and safety improvements, with no provision for second carriageway, in order to improve the service level with minimum cost implications. However, rehabilitation does not represent a long-term strategic solution to the corridor and deterioration of the road in future years would offset the costs of improvement. The option also contains the least potential for potential tolling as the public perception of improved service quality would be too low.

2.7 Tranche 2 Option 5

26. This option involves a combination of Options 1 and 4. The section between Ashtarak and Talin would be upgraded to a full 4-lane highway by new construction, whilst the existing 2-lane section between Talin and Gyumri would be rehabilitated to a Class 1, 2-lane highway continuing to operate with two-way traffic. The main works required for the rehabilitated section would be between Mastara and Maralik, approximately 20km in length.



Source: This Study, 2010.

Figure 2-7: Tranche 2, Option 5

2.8 Comparison of Costs

27. **Construction cost:** The construction costs of the five options are compared in Table 2-7. The Option 1 cost is based on preliminary design, while the other options have been estimated by appropriate factoring of Option 1 cost items. Option 4 is the least expensive as it mainly involves rehabilitation of the existing highway. Land costs have been estimated based on the results of the valuation survey carried out in March 2010.

Table 2-7: Cost Comparison of Options

Item	Cost for Option (\$ million)				
	1	2	3	4	5
Earthworks	43.7	24.1	40.2	20.1	26.6
Road Pavement	83.6	66.5	0.0	0.0	27.4
Shoulder	10.4	7.5	7.5	7.5	8.7
Furniture	13.0	9.3	9.3	9.3	9.8
Drainage	12.5	8.3	8.3	8.3	8.6
Structures	5.5	3.9	5.2	3.9	4.1
Construction cost	167.6	120.6	85.7	63.4	97.7
Contingencies @10%	16.8	12.0	8.5	6.4	9.8
Design/Supervision @ 5%	8.4	6.1	4.3	3.1	4.9
Cost before VAT	192.8	138.6	98.4	73.0	112.4
VAT @ 20%	38.5	27.7	19.7	14.6	22.5
Construction Cost Incl. VAT	231.3	166.3	118.2	87.5	134.9
Land Cost	1.5	1.5	1.5	0	0.75
Total	232.8	167.8	119.7	87.5	135.7
Cost/Km	2.6	1.9	1.4	1.0	1.5

Note:

Option 1: widen to dual 2-lanes; new southbound carriageway; existing road northbound.

Option 2: new 2-lane road; new road (through traffic), old road (local traffic) are both 2-way.

Option 3: Stage 1, reconstruct existing road northbound design, plus advance earthworks for southbound; Stage 2, complete construction of southbound according to traffic growth.

Option 4: rehabilitate existing road.

Option 5: widen Ashtarak–Talin and rehabilitate Talin–Gyumri

Source: This Study, 2010.

Table 2-8: Comparison of Tranche 2 Options

	1	2	3	4	5
Alignment:	Follows existing alignment except where necessary to accord with geometric standard; improve alignment Mastara – Maralik; Mitigate resettlement and environmental impact Agaraka – Ujan	Parallel to existing road alignment with minimum gap between roads (for median or intersection requirements)	Same as Option 1 (widening of existing road alignment)	Same alignment as existing	As Option 1 until Talin, then as Option 4 until Gyumri.
Cost:	Highest cost option	Less cost than Option 1 (but savings not proportional to capacity increase)	Similar to Option 1 but staged with lower initial cost (changes in inflation/interest rates could impact on later final cost)	Cheapest option (but marginal service level increase)	Mid level cost with main investment in section with higher traffic demand.
Environmental/ Social Impact:	<ul style="list-style-type: none"> Category A Significant environmental impact Archaeological / cultural heritage sites need identification LARP in progress 	Similar to Option 1	Similar to Option 1	Minor	Similar to Option 1 from Ashtarak to Talin. Minor from Talin to Gyumri.
Advantages:	<ul style="list-style-type: none"> High capacity improvement to strategic route Follows established alignment 	<ul style="list-style-type: none"> New road to higher design standards than existing road Less expensive than Option 1 alignment 	Spreads costs allowing time for traffic demand (and economic situation) to increase/improve	Least cost / least risk	Directs investment to section with highest traffic flow (existing and forecast).
Disadvantages:	Under prevailing conditions , economic benefits expected to be realized later in the 20-year assessment period	<ul style="list-style-type: none"> Marginal increase in service level considering investment level Only minor benefits in separating local and through traffic Service level increase unlikely to 'induce' traffic demand Difficulties in restricting user access 	<ul style="list-style-type: none"> (Minor) expenditure to maintain advance earthwork area Traffic disruption during construction 	<ul style="list-style-type: none"> Traffic disruption during construction Only minor improvement to strategic route Rehabilitation (on Talin–Gyumri section) is not an economical long term strategy solution 	Rehabilitation (on Talin–Gyumri section) is not an economical long term strategy solution
Disruption during construction:	Minor as, in most sections, widening is to either side of the present road.	Minor as 2-way traffic could still use existing road during construction	Major - existing carriageway is reconstructed with no new highway	Major - existing carriageway is reconstructed with no new highway	Traffic disruption on Talin–Gyumri section during construction
PPP Potential	Limited potential for tolling due to traffic volume	<ul style="list-style-type: none"> Provides alternative (local) route, but service level advantage of new road is too low for willingness-to-pay tolling Traffic demand is low for tolling 	Similar to Option 1, but tolling later when new carriageway added (decision can be delayed for review of traffic demand – reduced risk)	Very limited. Unsuitable for tolling (existing route with marginal increase in service level)	Limited potential for tolling due to traffic volume (but Ashtarak–Gyumri section expected to increase traffic demand with recent Georgia–Russia border opening)

Source: This Study, 2010.

SECTION 3 TRAFFIC ANALYSIS

3.1 Traffic Surveys and Base Year Traffic Volume

28. The Consultants May 2009 classified traffic counts are summarized in Table 3-1 (full details are given in Annex 1 Appendix 2). Annual average volume in 2008 from ARD monthly counts was: 5,719 at km34, 3,899 at km71, 2,502 at km100 and 2,480 at km118. The count at km70 may therefore be on the low side. Traffic volume gradually declines north from Ashtarak, with a significant fall at Talin, km69. Considering both traffic count and ARD data, base year 2009 volume, without traffic diverting from Bagratashen to Bavra, is taken as: Ashtarak–Talin 5,400 and Talin–Gyumri 3,000. Including diverting traffic, the volumes are: Ashtarak–Talin 5,820 and Talin–Gyumri 3,420.

Table 3-1: Tranche 2 Traffic Counts

Location	Car	Pickup	Minibus	Bus	Truck			Total	PCUs	Peak H. (% of AADT)
					2-axle	3-axle	>4- axle			
M-1:										
Km30	4,755	493	341	72	351	117	36	6,165	6,749	7.8
Km70	2,215	236	229	26	121	33	31	2,891	3,161	8.3
Bagratashen	527	26	34	3	15	6	145	756	1,004	7.4
Incl. diverted:										
Km30	5,019	506	358	74	359	120	152	6,587	7,360	
Km70	2,479	249	246	28	129	36	147	3,313	3,772	
Composition %										
Km30	77.1	8.0	5.5	1.2	5.7	1.9	0.6	100.0		
Km70	76.6	8.2	7.9	0.9	4.2	1.1	1.1	100.0		
Bagratashen	69.7	3.4	4.5	0.4	2.0	0.8	19.2	100.0		
Incl.diverted:										
Km30	76.2	7.7	5.4	1.1	5.4	1.8	2.3	100.0		
Km70	74.8	7.5	7.4	0.8	3.9	1.1	4.4	100.0		

Source: This Study, 2010.

29. The peak hour volume of an average day is well below that in high season. ARD data shows August to be the peak month, with volume 26% higher than annual average volume. A peak day in August may have volume 10% higher than an average August day. In the peak there would also be a directional split as high as 60:40, for example traffic leaving Yerevan before a holiday weekend. Traffic volume in the peak direction, for peak hour on the peak day in August would then be 66% higher than the average daily peak.

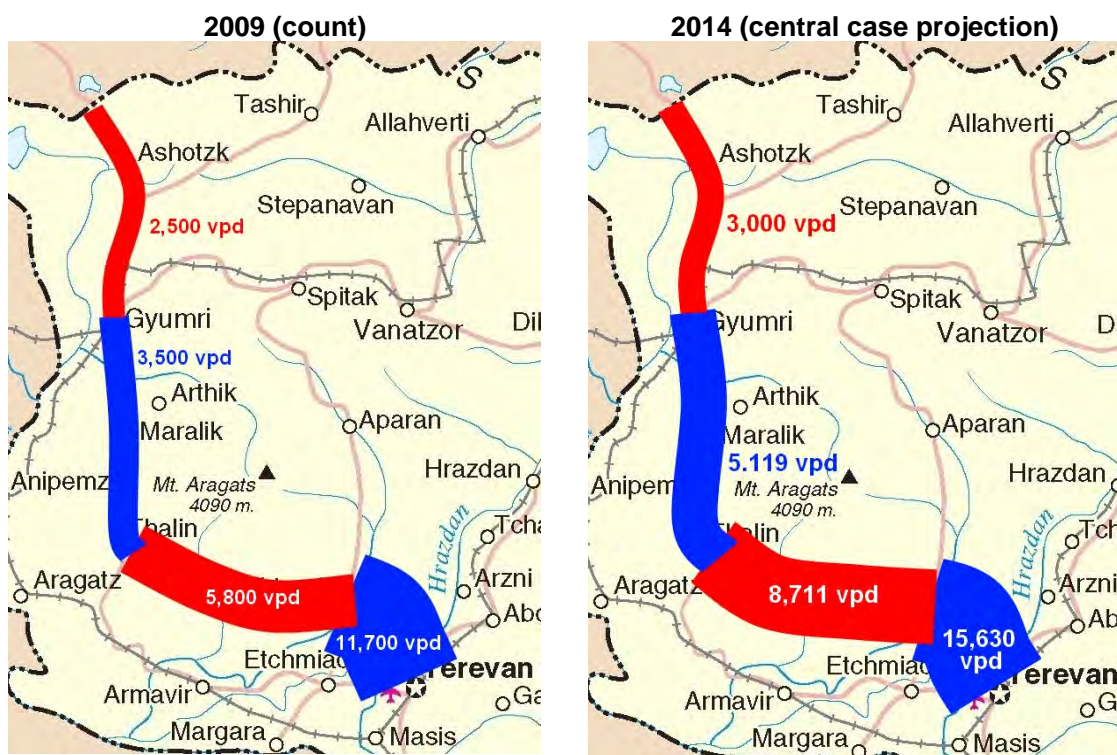
3.2 Traffic Growth

30. Annual traffic growth rates are assumed to be the same as for the adjoining Tranche 1 section assuming three scenarios of low growth (6.6% 2009-2015 and 4.4% 2015+), central growth (8.4% 2009-2015 and 6.0% 2015+), and high growth (9.6% 2009-2015 and 7.2% 2015+). The resulting traffic volumes are given in Table 3-2 and graphically in Figure 3-1. Further analysis of traffic growth is summarized in Table 4-2 of the following Section.

Table 3-2: Traffic Growth Forecasts (annual vehicles)

	Scenario 1 – Low				Scenario 2 – Central				Scenario 3 – High			
	2014	2020	2025	2032	2014	2020	2025	2032	2014	2020	2025	2032
Vehicles:												
Ashtarak–Talin	8,011	10,592	13,136	17,757	8,711	12,637	16,911	25,427	9,204	14,281	20,218	32,893
Talin–Gyumri	4,708	6,224	7,719	10,435	5,119	7,426	9,937	14,942	5,409	8,392	11,881	19,329

Source: This Study, 2010.



Source: This Study, 2010.

Figure 3-1: Traffic Demand on Tranche 2 Corridor

SECTION 4 ECONOMIC AND FINANCIAL ANALYSIS

4.1 Approach

31. The Consultants carried out an economic analysis of the candidate Tranche 2 to determine the Economic Internal Rate of Return (EIRR). The Consultants tested the options under several scenarios of economic conditions due to the uncertainty of various parameters. A financial analysis was then carried out to assess the viability of tolling.

4.2 Traffic and Economic Scenarios

32. The Consultants tested three scenarios with varying traffic and economic growth assumptions, as summarized in the table below and explained in the paragraphs that follow. The traffic demand for the target section in the base year 2009 is: Ashtarak–Talin 5,400 and Talin–Gyumri 3,000. Including diverting traffic, the volumes are: Ashtarak–Talin 5,820 and Talin–Gyumri 3,420.⁴

Table 4-1: Tranche 2 Economic Scenarios

Scenario	Traffic Growth		VOT (\$/hr)	VOT Growth
1 Low Case	6.6% (2009–2015)	4.4% (2015+)	2.00	3.0%–4.5% (2009–2013) 6% (2014–2019) 7% (2020+)
2 Central Case	8.4% (2009–2015)	6.0% (2015+)	2.00	3.0–4.5% (2009–2013) 6% (2014–2019) 7% (2020+)
3 High Case	9.6% (2009–2015)	7.2% (2015+)	2.00	3.0–4.5% (2009–2013) 6% (2014–2019) 7% (2020+)

Note: The low, central, and high scenarios use growth rates from ADB's analysis of Tranche 1 (Sept. 2009), as explained below.

Source: This Study, 2010.

33. **Traffic Growth Assumptions:** For Scenarios 1-3 (the Low, Central, and High cases) traffic growth forecasts are based on the growth assumptions presented in ADB's Report and Recommendation of the President to the Board of Directors – *Proposed Multitranchise Finance Facility and Administration of Cofinancing Republic of Armenia: North South Road Corridor Investment Program, ADB September 2009*⁵, which in turn uses forecasts in car ownership from a Millennium Challenge Corporation Study in 2007 as a proxy for growth.⁶ The aforementioned ADB Report includes economic analysis of the Tranche 1 Project. Traffic growth over the period to 2032 is based on the International Monetary Fund (IMF) June forecast for Armenia of 1.3% in 2010, 3.5% in 2011, and 4.5% per annum in 2012–2014. A GDP growth rate of 6.0% was assumed for 2014–2020 and 7.0% for 2020–2032. The average elasticity of traffic growth to GDP was taken as 1.2.

34. **Economic Assumptions:** Most of the benefits from road widening accrue from time savings. From the surveyed traffic composition on the M-1 section, the average occupancy⁷ per vehicle is 3.4. For Scenario 1 the initial value of time (VOT) is assumed as 1.66 USD per hour with no increase to 2014. For Scenarios 2-4, the VOT is assumed as 2.00 USD per hour, which is equal to the average working wage in 2009. Also, the growth of VOT is

⁴ These figures are based on the Consultants' traffic counts in May-July 2009 and were cross-checked with ARD automatic counts, as stated in Section VI of the DFR.

⁵ <http://www.adb.org/Documents/RRPs/ARM/42145-ARM-RRP.pdf>, p.26 in Appendix 2.

⁶ The MCC Study used gross domestic product (GDP) per capita and income elasticity of demand to forecast growth in car ownership. An elasticity of 1.1-1.2 was assumed and the car ownership of 80 per 1,000 population would increase to 344 by 2026.

⁷ Assuming average passenger number as 2.5 for car, 2.5 for pickup, 15 for minibus and 40 for bus.

assumed to increase by 6.0% annually 2014 and 7% 2020–2032.⁸ The operational speed for the existing 2-lane road is assumed at 75 kph due to the mountainous area including mixed traffic. The operational speed will reduce with increasing traffic volume. The operational (design) speed of the new dual-lane road is 90kph.

35. **Traffic Growth Forecasts:** The forecast traffic volumes are given in the table below. This also shows traffic volumes in equivalent passenger car units (PCUs), hourly PCU volume in the peak, and the volume/capacity ratio in the peak hour. For the latter calculation, it is conservatively assumed, given the adverse terrain on some parts, that capacity per lane hour is 750 PCUs or 670 vehicles. This equates to one vehicle per 5.4 seconds, or an average spacing between vehicles of 90 meters, if speed is reduced to 60kph. Such loading would be experienced by moderately heavy traffic, with limited overtaking possibilities.

Table 4-2: Traffic Growth Forecasts (annual vehicles/PCUs)

	Scenario 1 – Low				Scenario 2 – Central				Scenario 3 – High			
	2014	2020	2025	2032	2014	2020	2025	2032	2014	2020	2025	2032
Vehicles:												
Ashtarak–Talin	8,011	10,592	13,136	17,757	8,711	12,637	16,911	25,427	9,204	14,281	20,218	32,893
Talin–Gyumri	4,708	6,224	7,719	10,435	5,119	7,426	9,937	14,942	5,409	8,392	11,881	19,329
PCUs:												
Ashtarak–Talin	9,047	11,961	14,835	20,053	9,837	14,270	19,097	28,715	10,394	16,128	22,832	37,146
Talin–Gyumri	5,316	7,029	8,717	11,784	5,781	8,386	11,222	16,874	6,108	9,477	13,417	21,828
Peak hour PCUs												
Ashtarak–Talin	724	957	1,187	1,604	787	1,142	1,528	2,297	832	1,290	1,827	2,972
Talin–Gyumri	425	562	697	943	462	671	898	1,350	489	758	1,073	1,746
Peak hour V/C ratio %												
Ashtarak–Talin	48	63	78	106	52	75	101	152	55	85	121	196
Talin–Gyumri	28	37	46	62	31	44	59	89	32	50	71	115

Note: PCU peak hour capacity: 750 vehicles per lane. Over-capacity highlighted in bold.

Source: This Study, 2010.

36. **Traffic Volume to Capacity:** The above analysis shows the peak PCU for the Ashtarak–Talin section exceeds the 750 vehicle capacity from 2032 for the Low Case scenario. For the Central and High scenarios the peak hour is exceeded from 2025. For the Talin–Gyumri section, the capacity is only exceeded in 2032 in the High Case scenario.

37. The construction costs for each option are provided in Table 2-8 above. The initial construction cost for the entire length of Option 1 without VAT is taken as USD194.3 million including land costs of USD1.5 million.⁹ This sum was distributed over the first three years of the project period (30% for 2011, 35% for 2012 and 35% for 2013). Overlay is necessary for every 10 years after completion of the construction, which was costed at 15 USD per square meter (the new highway requiring double this due to the increased width). The residual value of the structure is assumed as 30% of the initial value.

4.3 Cost-Benefit Analysis

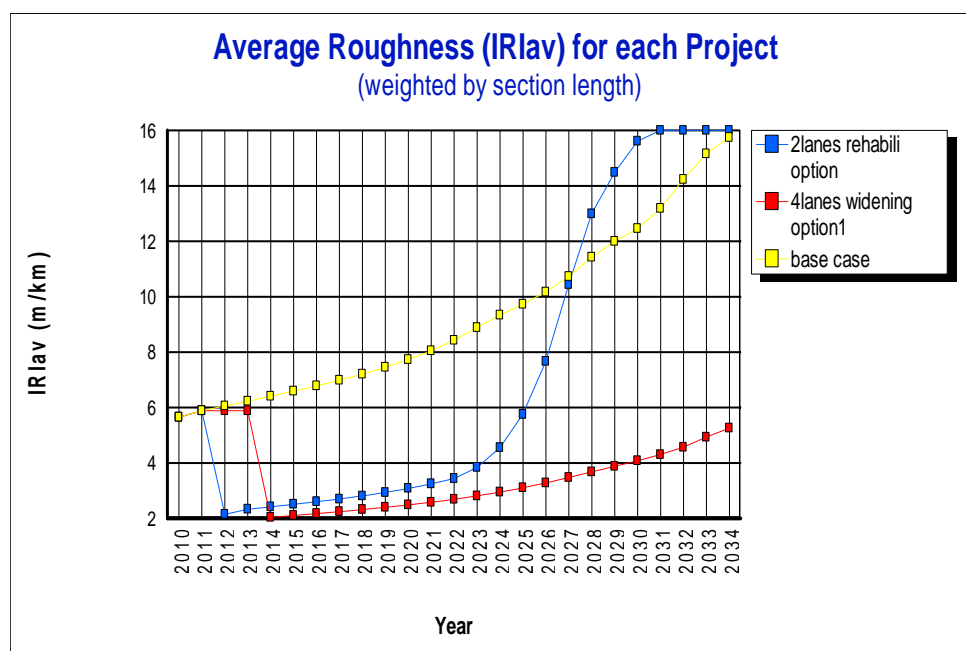
38. **Benefit Analysis Framework and HDM:** Benefits are estimated through comparison of the with and without case. Under this analysis, two types of benefit are expected to be generated; i) travel time saving and ii) reduction of vehicle operating cost (VOC). For (i), this can be estimated based on the difference in travel speed, which is attributed to surface condition, density of traffic, mixture of heavy traffic, etc. The total benefit is the product of travel time difference, number of passengers and value of time. For (ii), this is attributed to

⁸ In line with GDP growth forecast in the ADB Report: *Proposed Multitranchise Finance Facility and Administration of Cofinancing Republic of Armenia: North South Road Corridor Investment Program*, ADB September 2009

⁹ The construction cost assumes an exchange rate at \$1=AMD390. Land price is based on valuation surveys carried out in 2010.

condition of roads, speed, vehicle efficiency, composition of heavy vehicles, etc. Also, both (i) and (ii) are affected by deterioration of pavement throughout the project period. For efficiency in establishing such an analytical framework, the study team utilized the HDM4 model, which was developed by PIARC (World Road Congress) and World Bank, and has been utilized in many road development projects in developing countries. The Consultants referred to the unit cost for users, market, and preference. The specifications of the road improvement, maintenance, cost flow, traffic volume and growth rate, etc., which are necessary input for the HDM4 model, are referred in the description in the previous sections.

39. **Simulation of Deterioration and without case:** The figure below illustrates the simulation of deterioration of the pavement for three cases: i) without case (base case), ii) Option 1 (full improvement) and iii) Option 4 (rehabilitation). The roughness index shows the qualified improvement with a long-term effect for Option 1, slow deterioration due to its operating speed for the base case, and short term improvement, but earlier deterioration due to its weakness and higher damage from the operating speed for Option 4.



Source: This Study, 2010.

Figure 4-1: Deterioration Progress for Option 1, 4 and 5 for Lower Scenario

40. **Analysis of Options:** The 5 options were analyzed. Benefits were estimated based on the following assumptions.

Table 4-3: Summary for Assumption for Options

Option	Brief explanation	Assumption	Assumption in Calculation
1	Full spec four-lane improvement	As described above. Specifications were input into the HDM4 model. IRI will become 2.0 after the improvement.	VOC and Time saving (TS) are estimated by HDM4.
2	Develop new two-lane road and keep the existing road for local traffic	80% of traffic will be diverted to new road. The benefit will be derived from the 80% of traffic only.	Unit benefit is same to the Option 1, but total benefit is proportionally derived to the traffic, therefore, the total benefit is only 80% of Option 1.
3	Staged operation: maintaining two lanes in initial stage, and pavement construction for additional lanes when traffic volume reaches appropriate level	<ul style="list-style-type: none"> The pavement widening will commence when the daily traffic exceeds 10,000, for lower case, which is forecast in 2019 in the southern section (and not happen in the northern section). The additional construction cost for the widening is [difference of initial cost for option 1 and 3] x 1.5 (assumed coefficient for such additional work and price escalation). The staged work will be carried out in two years, 70% for initial and 30% in the second year. 	The improvement effect in the initial stage is same as Option 4 due to its alignment and lanes. After widening, the benefit will be the same as Option 1.
4	Rehabilitation only	Specified "Overlay 50mm" in HDM4. IRI will become 2.0 after the rehabilitation.	VOC and Time saving (TS) are estimated by HDM4.
5	Southern section is improved to dual carriageway and northern is rehabilitation only		Application of Option 1 and 4. The difference in cost was adjusted based on length of the sections.
Base	Minimum maintenance	Pothole patching, etc (common to all options)	VOC and Time saving (TS) are estimated by HDM4.

Source: This Study, 2010.

41. **EIRR Calculation:** The table below summarizes the saving flows and EIRRs for each option under three economic scenarios. The cash flow results are shown in Table 4-5.

Table 4-4: EIRRs for Tranche 2 Options

Option	Cost (\$m) ¹⁰	EIRR		
		Low	Central	High
1	194.23	12.4%	15.5%	17.4%
2	140.11	13.2%	16.3%	18.3%
3	99.98	12.9%	15.5%	17.6%
4	72.96	5.6%	Negative	Negative
5	148.88	13.1%	15.0%	17.1%

Source: This Study, 2010.

42. For most options for each scenario, the figures for EIRR exceed 12%. Regarding Option 4, the EIRR is positive for lower traffic, however, negative figures were estimated for

¹⁰ Including land costs, but not VAT.

the higher scenarios as deterioration progressed to a greater extent than the base case and travel speed and VOC became larger than the base case.

Table 4-5: Estimated Benefits and EIRR for the Target Sections

	Option 1		
	1) low	2) central	3) high
2011	-58.26	-58.26	-58.26
2012	-67.91	-67.81	-67.81
2013	-67.62	-67.59	-67.57
2014	6.83	7.50	7.94
2015	7.82	8.75	9.37
2016	8.90	10.12	10.97
2017	10.19	11.79	12.95
2018	11.78	13.87	15.44
2019	13.76	16.51	18.67
2020	16.35	20.09	23.18
2021	19.72	25.00	29.75
2022	24.23	32.38	37.91
2023	30.65	41.37	47.55
2024	35.25	48.45	57.60
2025	46.24	64.56	79.88
2026	56.35	84.30	104.19
2027	70.07	106.89	132.39
2028	88.64	131.32	181.16
2029	108.55	171.23	254.73
2030	130.30	231.57	321.63
2031	163.26	291.44	380.76
2032	266.22	404.69	516.30
EIRR	12.4%	15.5%	17.4%

	Option 2		
	1) low	2) central	3) high
2011	-42.03	-42.03	-42.03
2012	-48.93	-48.90	-48.90
2013	-48.75	-48.73	-48.71
2014	5.47	6.00	6.35
2015	6.25	7.00	7.50
2016	7.12	8.09	8.78
2017	8.15	9.43	10.36
2018	9.42	11.09	12.35
2019	11.00	13.21	14.94
2020	13.08	16.07	18.54
2021	15.78	20.00	23.80
2022	19.38	25.90	30.33
2023	24.52	33.10	38.04
2024	28.43	38.99	46.31
2025	36.99	51.65	63.90
2026	45.08	67.44	83.35
2027	56.05	85.52	105.91
2028	70.91	105.05	144.93
2029	86.84	136.98	203.78
2030	104.24	185.25	257.30
2031	130.60	233.15	304.61
2032	208.40	319.17	408.46
EIRR	13.2%	16.3%	18.3%

	Option3		
	1) low	2) central	3) high
2011	-69.83	-69.97	-69.97
2012	-29.42	-28.96	-28.93
2013	0.87	1.34	1.39
2014	1.63	1.76	1.86
2015	2.10	2.31	-56.74
2016	2.67	-56.22	-22.14
2017	3.41	-21.50	10.20
2018	4.38	11.00	12.39
2019	5.68	13.34	15.27
2020	-51.74	16.55	19.34
2021	-15.43	21.02	25.42
2022	20.83	27.91	32.99
2023	25.43	34.80	0.67
2024	34.08	45.47	36.88
2025	41.72	57.35	79.88
2026	51.21	41.36	102.88
2027	63.72	84.21	132.39
2028	79.74	124.66	181.16
2029	95.63	160.53	254.73
2030	113.01	216.15	321.63
2031	143.51	272.36	380.76
2032	242.25	396.19	530.43
EIRR	12.9%	15.5%	17.6%

	Option 4		
	1) low	2) central	3) high
2011	-72.96	-72.96	-72.96
2012	0.47	1.04	1.07
2013	0.70	1.36	1.41
2014	1.63	1.79	1.89
2015	2.11	2.34	2.51
2016	2.68	3.03	3.28
2017	3.42	3.94	4.31
2018	4.39	5.16	5.74
2019	5.68	6.83	7.75
2020	7.47	9.25	10.77
2021	9.95	12.83	15.63
2022	12.36	17.61	20.69
2023	18.74	25.82	28.68
2024	24.90	32.84	33.00
2025	30.91	36.07	7.55
2026	35.79	15.40	-39.41
2027	35.79	-31.03	-63.32
2028	24.45	-66.27	-67.20
2029	-8.56	-73.88	-55.98
2030	-40.26	-51.94	-42.25
2031	-43.85	-27.48	-33.69
2032	-12.27	10.69	7.99
EIRR	5.6%	#DIV/0!	#DIV/0!

	Option5		
	1) low	2) central	3) high
2011	-67.54	-67.54	-67.54
2012	-40.58	-40.22	-40.21
2013	-40.32	-39.97	-39.95
2014	5.84	5.61	5.99
2015	6.69	6.64	7.18
2016	7.65	7.81	8.55
2017	8.82	9.25	10.27
2018	10.26	11.08	12.47
2019	12.07	13.45	15.37
2020	14.47	16.69	19.49
2021	17.62	21.22	25.62
2022	21.88	28.19	33.26
2023	28.03	36.67	42.29
2024	33.01	43.77	52.21
2025	42.96	58.09	72.48
2026	52.63	74.55	92.89
2027	65.70	86.12	108.04
2028	82.64	86.78	128.39
2029	97.34	98.46	167.53
2030	106.98	142.23	213.32
2031	119.65	191.15	257.73
2032	190.48	278.49	362.91
EIRR	13.1%	15.0%	17.1%

Source: This Study, 2010.

43. **Conclusion:** Option 4 (rehabilitation) is not a recommended solution for the long term road strategy as benefits are realized relatively quickly and then deteriorate. Options 2 and 5 show the highest EIRR values. Due to economic uncertainty, caution is advised over recommending options based on the higher growth scenarios.

4.4 Financial Analysis

44. In order to assess the viability of tolling the candidate Tranche 2 project, a preliminary financial analysis was undertaken to calculate the Financial Internal Rate of Return (FIRR), with the following assumptions.

- Project period; 20 years following construction
- Financing body; one organization covers the initial construction cost, maintenance cost, and collects the toll
- Traffic volume; three scenarios as in the EIRR estimation
- Toll road sections; analyzed for two sections, i.e. Ashtarak-Talin, and Talin-Gymuri

- Construction option; Tranche 2, Option 1.
- Expenditure includes initial construction cost, maintenance cost as adopted in the EIRR estimation, operation cost, financial charges, and Tax for revenue.
- Operation Cost
 - The operation cost will commence one year before the opening year.
 - The operation cost includes personnel cost, office maintenance, electric fee for lighting/machinery, fuel cost for patrol, etc.
 - The toll collection will be carried out by personnel at several toll barriers/gates on each section. 48 staff (8 gates * 6 shifts) is necessary for toll collection and 20 for management and maintenance. Assuming US\$15,000 per person annually in initial year, and the personnel cost will be increased by 4%.
 - The electric fee, fuel, etc are accounted as 50% of the personnel cost.
- Financial charges
 - The operation body has to pay the interest for the initial cost. The interests' rate is assumed to be 2.0%.
- Tax
 - The operation body needs to pay corporate income tax. The Armenian tax rate for corporations is 20%. The tax payment will be made in the next year.
- Revenue: the toll rate is stipulated at 1.5\$ per use per axle. A 4-axle truck will be charged 6\$, passenger car will be 3\$ for each section.
- Residual value was not considered.
- Tax was not considered.

The FIRR for each scenario and road section are summarized in the table below.

Table 4-6: Financial Internal Rate of Return Base Case

(US\$1.5 per axle)

	Tranche 2	Ashtarak-Talin	Talin-Gymuri
Low Case	1.8%	1.8%	1.9%
Central Case	4.6%	4.6%	4.4%
High Case	6.9%	6.6%	7.4%

Given the relatively low FIRR for the base case as described above, the consultants also calculated FIRR based on the three PPP scenarios outlined in Section 4.13 of Volume 1.

Scenario 1: Capital BOT Support

In Scenario 1, under a Capital BOT support, capital costs would be reduced by 50%. Under this condition, the FIRR would be the following.

Table 4-7: Financial Internal Rate of Return with Capital Support BOT PPP

(US\$1.5 per axle)

	Tranche 2	Ashtarak-Talin	Talin-Gymuri
Low Case	9.3%	9.2%	9.5%
Central Case	12.3%	12.4%	12.2%
High Case	14.8%	14.5%	15.2%

Scenario 2: Annuity-Based Support

Annuity based support is a somewhat attractive option for contractors as it helps to shield them from the variations in traffic volumes. In PPP Scenario 2, the annuity amount is subject to the financial capacity of the GOA to support annuity payments. For a low capacity, and assuming a tolled scenario similar to Table 4-6 above, to achieve an FIRR of around 10% in the central case, the annuity would need to be around US\$6.8 million/year. The FIRR under this scenario is given in Table 4-8 below.

Table 4-8: Financial Internal Rate of Return with Annuity-Based BOT PPP (with tolls and US\$6.8 million annuity)

(US\$1.5 per axle)

	Tranche 2	Ashtarak-Talin	Talin-Gymuri
Low Case	8.2%	7.2%	9.6%
Central Case	10.0%	9.2%	11.2%
High Case	11.8%	10.7%	13.5%

Removing toll income from the calculations would completely shield a contractor from traffic volume variation. To replace this income, an annuity of US\$19 million/year would have to be paid to achieve a mean FIRR of 10.0%. In this case it would be appropriate to package both sections of Tranche 2 into one package given the relatively lower FIRR of Ashtarak-Talin. However, different annuities for each section could also be considered. The FIRR under this no-toll scenario is given in Table 4-9.

Table 4-9: Financial Internal Rate of Return with Annuity-Based BOT PPP (without tolls and US\$19 million annuity)

	Tranche 2	Ashtarak-Talin	Talin-Gymuri
FIRR on constant annuity	10.0%	6.6%	14.4%

Scenario 3: Operating and Maintenance Contract

For Scenario 3, operating costs may be reduced by up to 40% from the base case. The consultants made the following calculations under this assumption. This type of PPP would be especially applicable for Ashtarak-Talin in order to lessen the high maintenance costs in this section.

Table 4-10: Financial Internal Rate of Return with O&M Contract

(US\$1.5 per axle)

	Tranche 2	Ashtarak-Talin	Talin-Gymuri
Low Case	7.9%	8.2%	7.3%
Central Case	10.2%	10.6%	9.5%
High Case	11.6%	12.2%	10.6%

SECTION 5 ENVIRONMENTAL IMPACT AND STRATEGY

5.1 Appraisal of Road Sections on the North–South Road Corridor

45. Environmental assessment needs are proposed on the basis of the environmental complexity and sensitivity on a scale of 1 to 3, where 1 indicates a relatively stable landscape of no particular sensitivity and 3 indicates a sensitive landscape with physical, ecological or other significant attributes. Factors considered included: rock type, slope stability, steepness of slopes, soil type and productivity, water bodies and streams, ecological productivity, forests, protected areas, historical, pre-historical or archeological important areas within the ROW and its close vicinity.

Table 5-1: Road Priority, Approximate Length and Environmental Assessment Category – Ashtarak–Gyumri

Priority	MFF Tranche	Road Section	Approx. Length (km)	Recommended Environmental Assessment Category	Reason for Consultant Recommendation
1	2 nd Tranche	Ashtarak to Gyumri	88	A	ADB designation—corroborated

Source: *This Study, 2010.*

46. **North of Yerevan (Ashtarak to Bavra):** The entire area north of Yerevan lies within a semi-arid zone in different altitude zones and with an annual precipitation of 450–500mm and similar landscape and environmental features throughout. There are no unique or sensitive areas, no forests, and no protected areas within 1km of the alignment.

5.2 Main Environmental Features

47. The main environmental features of the environmental zone through which the road passes or may pass are summarized below.

Table 5-2: Environmental Features: Ashtarak to Gyumri

Road Section: Ashtarak to Gyumri (Km 29–118 from Yerevan)	
Main Environmental Features	Eco-sensitivity (1 to 3) and EA Required
<p>a. The road from Ashtarak gently ascends the Yerevan Plateau across Aragatsotn Marz (province) over increasingly higher rolling slopes as it progresses north and crosses into Shirak and the Shirak Plain on which Gyumri is located. The ROW is wide (15–20m) over most of the alignment. It crosses only two small permanent streams but many irrigation canals and pipes as well as culverts that are dry over much of the year. There are a number of small villages and small roadside commercial developments along the route.</p> <p>b. The semi-arid volcanic landscape has no particular qualities of scenic or other importance. It is gently rolling with periodic higher ridges and intervening shallow valleys. The natural vegetation is mostly dryland species with shrubs and small trees only around the few permanent and intermittent water courses and moist areas where springs emerge.</p>	<p>1, Category A EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ Streams. ➤ Near the historical building at Km-51. ➤ Where new alignments, cuts or embankments may be required. ➤ The wet soil areas south of Mastara and near Horon and Azatan, and irrigated land.

<p>c. There are no special reserves or forests nearby but there is one historic building in the form of a way-side house dating back to the 13thC.</p> <p>d. Many small irrigated areas support orchards and cropping, mostly of wheat and potatoes. The non-irrigated dry and gravelly land is used for extensive herding.</p> <p>e. There are a number of archaeological and cultural heritage sites along the Ashtarak to Gyumri route and researchers continue to find new sites.</p>	
--	--

Source: *This Study, 2010.*

48. Three different sections of road are proposed to be upgraded and/or upgraded and expanded along the N–S roads corridor to the north of Yerevan:

- i. Ashtarak to Gyumri
- ii. Gyumri to Bavra – border with Georgia
- iii. Gyumri Bypass

5.3 Ashtarak to Gyumri

49. The Ashtarak to Gyumri road section was classified by the ADB as a Category A project. Category A projects have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works, necessitating an EIA. In addition to the widening of the current M1 section to 4-lanes, in the course of conducting the Draft IEE Report, it was found that there are potentially many heritage and cultural sites located close to the existing road, within its ROW or within 100m of it. The exact locations and nature of these sites is not fully documented and researchers continue to find new sites.

50. The responsibility for protecting such sites rests with the Department of Historic Monuments in the Ministry of Culture, but the greater knowledge and interest to discover and document such sites rests with researchers in the Institute for Ethnography and Archaeology. The Consultants recommended to ADB that supplementary in-depth assessment be undertaken.¹¹

¹¹ In meetings between the consultant and ADB on the 8th and 9th October 2009 it was agreed that ADB would complete any necessary EIA work for Tranche 2. In conducting environmental assessments, the requirements of ADB's latest Safeguard Policy Statement (2009) should be considered.

SECTION 6 LAND ACQUISITION AND RESETTLEMENT (LAR)

6.1 Preliminary LARP for Tranche 2

51. Under this TA an impact and socioeconomic survey was conducted along the road section to update the draft preliminary LARP prepared earlier for this TA in July 2009. This LARP has been further updated through the ongoing revisions of the LARF. The updated LARF is presently under Government review.

52. Although the LARP for the candidate Tranche 2 will need to be finalized after Detailed Design (DD), the TA conducted DMS and SES and prepared a preliminary LARP based on the preliminary design for Option 1 between Ashtarak and Gyumri. The DMS and SES were carried out by two Armenian firms engaged for this purpose. These surveys were carried out in coordination with Social and Resettlement Specialists (SRS) in the EA/IA where possible/appropriate. To complete the preliminary LARP, cadastral maps were obtained and over-laid with the preliminary design to determine land acquisition impacts, and three real estate assessors provided detailed bids, including assessment methodologies to be employed, to make price assessments of both land and structures for inclusion in the LARP.

53. Annex 1 Appendix 14 presents the preliminary LARP. The final LARP should be completed by the EA, once a notification decree is passed (expected in April 2010) and the Tranche 1 supervising consultants who will, among other tasks outlined in an updated Tranche 2 LARF presently under Government review, carry out with the EA the legal DMS, based on the accepted DD.

**Asian Development Bank TA7208-ARM
Ministry of Transport and Communication
Republic of Armenia**

**Preparing the North-South Road Corridor
Development Project**

VOLUME IV

Further Tranches

**FINAL REPORT
May 2010**



VOLUME IV FURTHER TRANCHES

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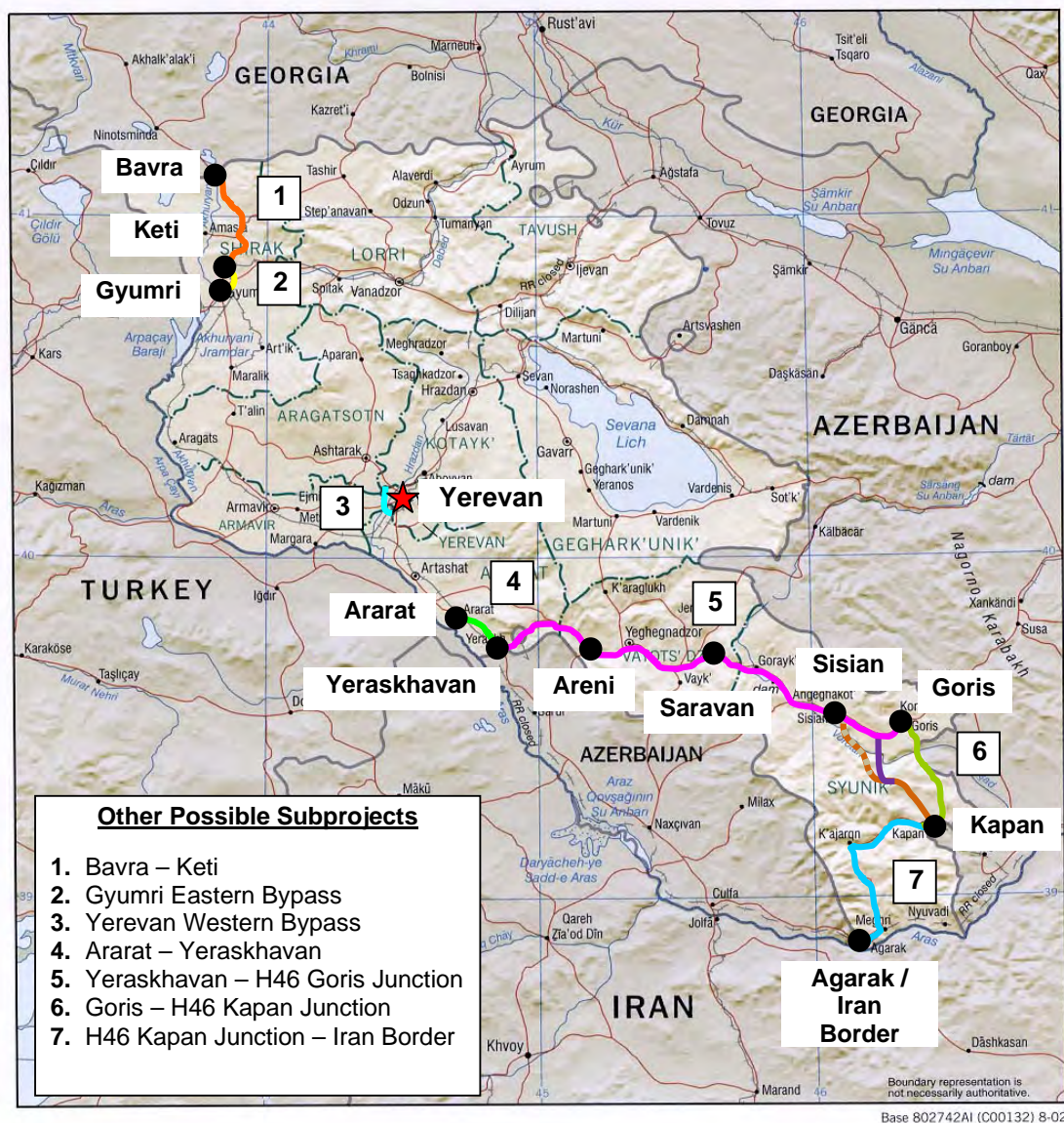
ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
AC	Asphalt Concrete
ADB	Asian Development Bank
AGR	European Agreement on Main International Traffic Arteries
AMD	Armenian Dram
AP	Affected People
AR	Armenian Railways
ARD	Armenia Roads Directorate
ASIF	Armenia Social Investment Fund
BOQ	Bill of Quantities
DMS	Detailed Measurement Survey
EA	Executing Agency
EBRD	European Bank for Reconstruction and Development
ECRP	Emergency Contingency Response Plan
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EM	Environmental Manager
EMA	Emergency Management Agency
EMOP	Environmental Monitoring Plan
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
EO	Environmental Officer
ERT	Emergency Response Team
EU	European Union
GEF	Global Environment Facility
GDP	Gross Domestic Product
GoA	Government of Armenia
HDM	Highway Design Model
HH	Household
IDA	International Development Association
IDPR	Internally Displaced Persons and Refugees
IDPRDF	The Internally Displaced Persons and Refugees Development Framework
IDPRDP	Internally Displaced Persons and Refugees Development Plan
IDPRSA	Internally Displaced Persons and Refugees Specific Action
IEE	Initial Environmental Examination
IES	International Environmental Specialist
IFI	International Financial Institutions
IMF	International Monetary Fund
IRI	International Roughness Index
IRR	Internal Rate of Return
IT	Information Technology
IUCN	International Union for the Conservation of Nature
ILCS	Integrated Living Condition Survey
km	kilometer
kph	kilometer per hour
marz(es)	administrative region(s)
marzpet	Marz Governor
MCA	Millennium Challenge Account - Armenia
MCC	Millennium Challenge Corporation (USA)
MHPI	Modified Human Poverty Index
MDG	Millennium Development Goals

MFF	Multitranche Financing Facility
MM	Mitigation Measure
MNP	Ministry of Nature Protection
MOFE	Ministry of Finance and Economy
MOTC	Ministry of Transport and Communications
MTA	Ministry of Territorial Administration
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organization
NPE	Nature Protection Expertise
NRSC	National Road Safety Council
NSS RA	National Statistical Service of Republic of Armenia
OECD	Organization for Economic Co-operation and Development
PA	Protected Area
PIU	Project Implementation Unit
PMU	Project Management Unit
PPP	Public-Private Partnership
PPTA	Project Preparatory Technical Assistance
PRSP	Poverty Reduction Strategy Paper
RA	Armenian Government
RoA	Republic of Armenia
REC	Regional Environmental Centre (for Central and Eastern Europe)
ROW	Right-of-Way
RP	Resettlement Plans
RPF	Resettlement Policy Framework
RRC	Regional Resettlement Committee
RRSL	Rural Roads Sector Loan
RRSP	Rural Roads Sector Project
SE	Senior Engineer
SEEC	Department of State Environmental Expertise Commission
SEI	State Environmental Inspectorate
SIEE	Summary Initial Environmental Examination
SME	Small and Medium-sized Enterprise
SNCO	State Non-commercial Organization
SNP	Sevan National Park
SR	State Reservation
SSTA	Small Scale Technical Assistance
TA	Technical Assistance
TRACECA	Transport Corridor Europe Caucasus Asia
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCBD	United Nations Convention on Biological Diversity
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics (former)
WUA	Water Users' Association

SECTION 1 INTRODUCTION

1. Highway sub projects that may be included in further possible tranches for the North–South corridor are shown in Figure 1-1 below. The Consultants carried out an overview of these sub projects to assess their existing situation, the conceptual strategy of their development, and the costs. Details of the sub projects are summarised in the following sections.



Source: This Study, 2010.

Figure 1-1: Other Possible Sub Projects

2. Table 1-1 summarises the main features of each sub project in terms of scheme length, cost, social impact, and environmental impact.

Table 1-1: Possible Sub Projects

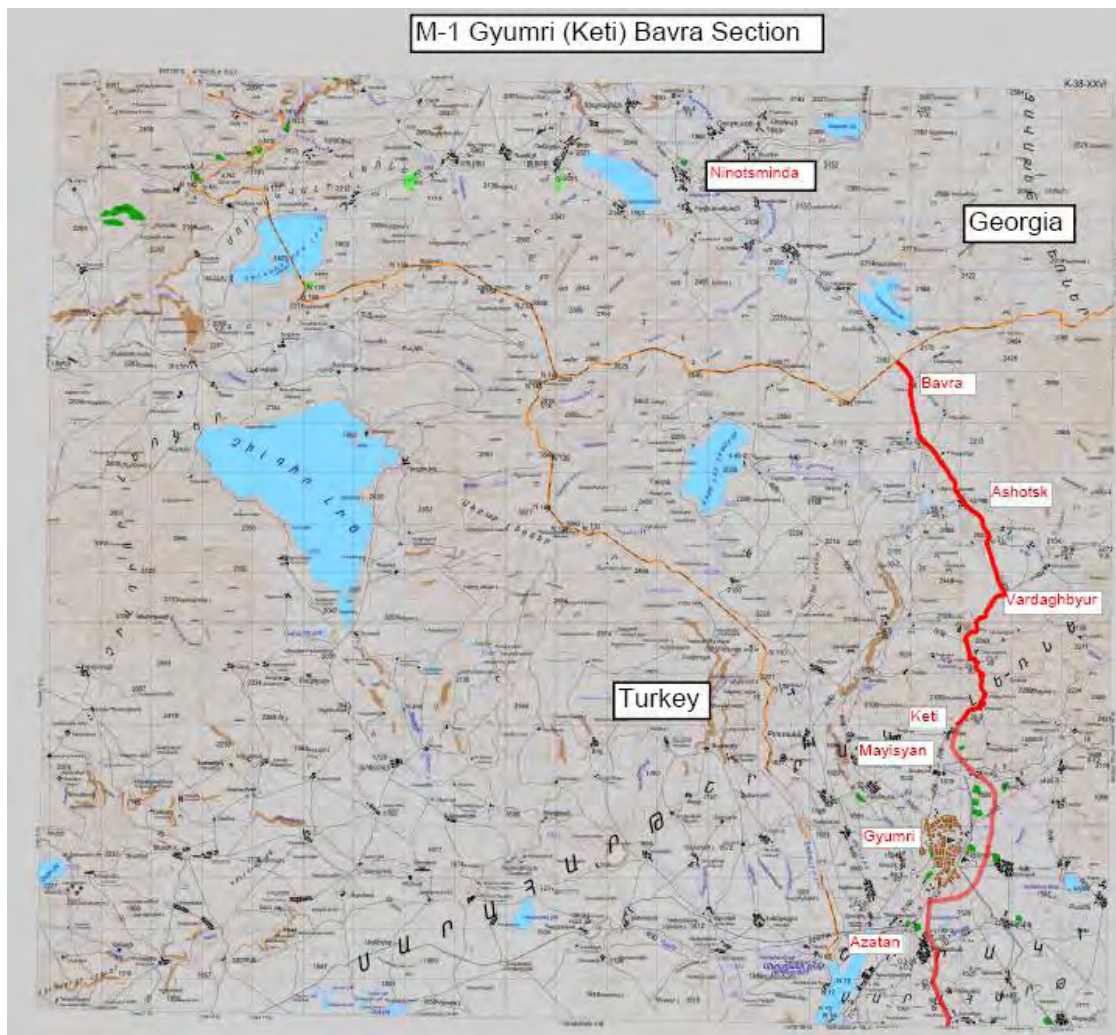
	Possible Subproject	Length (km)	Cost (\$ mil.)	Social Impact	Env. Imp.
1	Bavra–Keti	38	63–103	Medium – Low	B
2	Gyumri Eastern Bypass	19.5 (recommended option)	64–93	High	A
3	Yerevan Western Bypass	19.5	108	Very High	A
4	Ararat–Yeraskhavan	19.5	65	High	B
5	Yeraskhavan–H46 Goris Junction*	92	65	Varies by section	B/A
6	Goris–H46 Kapan Junction (alternative to M-2)	64	213	Varies by section	A
7	H46 Kapan Junction–Iran Border	87	200	Varies by section	A

Source: This Study, 2010

SECTION 2 BAVRA–KETI SUB PROJECT

2.1 Description

3. The M-1 starts at the Georgian border at Bavra, then passes through Ashotsk, Between Vardaghvyur and the Ketí Pass there are some 15km of hairpin bends. The section ends at Ketí, the starting point for the proposed Gyumri Bypass, which is 5km north of Gyumri. The terrain is mostly mountainous to rolling, with elevation of 2000m at the Ketí pass and 1,750m at Ketí. The road surface is in moderate condition (IRI 2009 of 5.7).



Source: This Study, 2010

Figure 2-1: Location of M-1 Gyumri–Bavra



Source: This Study, 2010

Figure 2-2: Ketik Pass



Source: This Study, 2010

Figure 2-3: Ashotsk

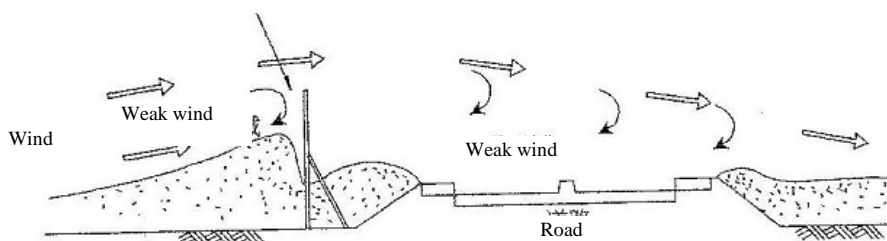
2.2 Development Strategy

4. Currently there is little, mostly local area, cross-border traffic at Bavra (Table 2-1). Completion of road improvements on the Georgian side of the border by October 2010 will lead to a diversion of traffic from the crossing at Bagratashen, an estimated 423 vehicles per day in 2009, increasing cross-border volume by 143% to 718 vehicles. However, should the Turkish border open, most of this traffic would transfer to the border crossing at Gyumri. Thus future traffic volume is highly uncertain. From a capacity standpoint, the existing road will provide for long term needs. The section could be improved on the existing alignment, with realignment only where necessary to: (i) achieve category I geometry, (ii) improve the geometry through the Ketik pass, and (iii) mitigate resettlement and environmental impacts. Some sections require rehabilitation to replace failed surface and protect the integrity of the pavement structure.

5. There is heavy winter snowfall and travel is often disrupted through drifting snow. Additional winter maintenance would reduce snow delays. Snow fences are recommended. An upwind fence of 4–5m, without openings at its base, but with voids above, will control wind action. The angled fence blows off snow, typically carrying it six times its height (Figure 2-4).



Collector Upwind Snow Fence



Source: This Study, 2010

Figure 2-4: Snow Fence

2.3 Cost Estimate

6. The estimated work quantity and cost is given in Table 2-1 (details are in Appendix 11).

Table 2-1: Estimated Work Quantity and Construction Cost

	Case: Expanding to 2-lane dual carriageway (category I)					Case: 2-lane improvement to category I
Section	Section I	Section II	Section III	Section IV	Total	
Location	Keti– Pokrashen– Vardaghbyur	Vardaghbyu– Ashotsk	Ashotsk	Ashotsk– Bavra		
Major Work Quantity						
Road Length (km)	15.85	7.50	1.90	12.68	37.93	37.93
Excavation (m³)	1,663,500	105,000	26,600	177,520	1,972,620	487.363
Embankment (m³)	297,188	210,000	53,200	355,040	915,428	699.391
Pavement (m²)	213,975	101,250	25,650	171,180	512,055	259,200
Construction Cost (excluding VAT and Contingency)						\$ million
Earth Work	14	2	1	4	21	8
Road Pavement	13	6	2	10	31	19
Road Shoulder					5	3
Road Furniture for Traffic Safety					6	6
Drainage					5	4
Structures (Bridge, Culvert)					11	9
Total Construction Cost					79	48

Source: This Study, 2010

2.4 Environmental Appraisal

7. Future sub-projects selected for financing under the MFF shall:
 - i. Be for the upgrading, rehabilitation and/or expansion of existing national roads forming part of the North–South Roads Corridor
 - ii. Avoid passing through any RA designated wildlife sanctuaries, national parks, other sanctuaries, or areas of international significance
 - iii. Avoid passing through any RA designated cultural heritage site or site known to exist by the RA Institute of Ethnography and Archaeology.
8. Three different sections of road are proposed to be upgraded and/or upgraded and expanded along the N–S road corridor to the north of Yerevan:
 - i. Ashtarak to Gyumri (Priority 1 and candidate Tranche 2)
 - ii. Bavra–Keti (Priority 2)
 - iii. Gyumri Bypass (Priority 2)
9. The environmental assessment needs are proposed on the basis of the environmental complexity and sensitivity on a scale of 1 to 3, where 1 indicates a relatively stable landscape of no particular sensitivity and 3 indicates a sensitive landscape with physical, ecological or other significant attributes. Factors considered included: rock type, slope stability, steepness of slopes, soil type and productivity, water bodies and streams, ecological productivity, forests, protected areas, historical, pre-historical or archeological important areas within the ROW and its close vicinity.

Table 2-2: Road Priority, Approximate Length and Environmental Assessment Category – Bavra–Keti

Priority	MFF Tranche	Road Section	Approx. Length (km)	Recommended Environmental Assessment Category	Reason for Consultant Recommendation
2	Future Candidate Tranches	Bavra–Keti	38	B	Less Significant. Standard Impacts

Source: This Study, 2010

10. The Bavra–Keti Road Section has been designated to be a Priority 2 project. The environmental assessment impact requirements are similar to the Priority 1 project. Category B and IEE recommended.

Table 2-3: Environmental Features: Bavra to Ket

Road Section: Bavra–Ket	
Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. After Gyumri the road climbs a shallow valley as it ascends the north slopes of the Shirak Plain to the top of a plateau or mountain steppe stretching to Bavra at the border and across it into Georgia. The wide ROW crosses several streams and bridges. Buildings of three villages stand close by the road (see: Gyumri Bypass, above) where a bypass or resettlement will be required.</p> <p>b. The landscape is gently rolling mountain steppe, particularly north of Ket (after about Km-140). The natural steppe vegetation has a variety of grasses and fleshy as well as woody ground plants.</p> <p>c. The new national park (Arpi Lich) stretches in a strip approximately 12km wide from the border with Turkey to 10km east of Bavra. The alignment passes through the economic use zone and of the Park and several small villages, rather than the protection zone of the Park.</p> <p>d. There are no other special reserves, forests, historical buildings or cultural sites nearby.</p> <p>e. There are no crop or wheat areas north of Gyumri.</p>	<p>1-2, Category B</p> <p>IEE</p> <p><u>Key Sites on this road section:</u></p> <p>Streams. Through the national park area where the natural landscape may be affected. Where new alignments, cuts or embankments may be required.</p>

Source: This Study, 2010

SECTION 3 GYUMRI EASTERN BYPASS SUB PROJECT

3.1 Description

11. The Armenia National Strategy (2008) states that a program of bypass construction should start by 2020. Bypasses are environmentally sound, reduce traffic accidents and greatly improve quality of life in affected towns. The Gyumri Eastern Bypass is listed as a priority as part of the north–south corridor upgrade.

12. Construction of an eastern Gyumri bypass was started soon after the 1988 Spitak earthquake. The project was about 45% complete when it was abandoned in 1991, following independence. There are three development options: (i) improve the existing M-1 route through Gyumri; (ii) construct an eastern bypass on the 1991 alignment; and (iii) extend the eastern bypass north to Ketik. Alternative alignments for the bypass are also possible.



Source: This Study, 2010

Figure 3-1: Gyumri Eastern Bypass

3.2 Development Strategy

13. The key issue is the extent of diversion to a bypass. Most M-1 traffic north and south of Gyumri is Gyumri-related. As noted for the Bavra–Gyumri section, there is considerable uncertainty concerning the volume of through and cross-border traffic, until the Turkish border issue is resolved. NSRC cross-border traffic is evenly distributed through the day and its diversion from city streets would only reduce intra-city volume marginally. Thus, improving the city route, which also benefits local traffic, is clearly the better option for the city. Delays to through traffic in Gyumri are not currently long. With light traffic and low benefits from diversion, the economic case for early construction of a bypass is slight. Of immediate concern is the deteriorated surface of the M-1 through the city. This needs to be rehabilitated/reconstructed for both local and through traffic.

14. Opening of the Turkish border would generate east–west traffic from the border to the M-1 (requiring construction of a new 7km link). If the Azerbaijan border opens, the Turkish border to M-1 to M-7 section would become part of the main Euro–Asia highway and a Gyumri bypass would be necessary as far as the M-7.

15. The elevation of the bypass route is 1550m at the southern end (M-1 km118+350), gradually ascending to 1750m at Ketı. The initial 9.5 km to the M-7 intersection follows an existing track (missing at Akhuryan). The subsequent 10 km to Ketı (M-1 km135+750) is a new alignment. Most of the section will be on embankment, to provide a suitable vertical profile to cross two railways, three roads and five rivers. A feasibility study should consider whether to provide dual 2-lane in the long term, with initial operation as single 2-lane. A typical embankment section for dual 2-lane is illustrated in Figure 3-3. There are resettlement and land acquisition issues for the section through Akhuryan.

16. The features of the alternative alignments are given in Table 3-1 and Figure 3-4.

Table 3-1: Gyumri Bypass Alignment Alternatives

Alternative	Start Point	Centre	End Point	Length km	Function
1 (Proposed)	M-1 km118+350 (crossroad to Airport)	West of Akhuryan	M-1 km135+750 (End of Ketı)	19.5	Bypass for M-1
2	M-1 km118+350 (crossroad to Airport)	West of Akhuryan	M-1 km130+100 (End of Gyumri)	15.0	Gyumri eastern bypass, passes through Mayisyan and Ketı for M-1
3	M-1 km118+350 (crossroad to Airport)	West of Arevik East of Akhuryan	M-1 km135+750 (End of Ketı)	22.0	Bypass for M-1
4	M-1 km115+030 (Azatan)	East of Akhuryan	M-1 km135+750 (End of Ketı)	23.0	Bypass for M-1
5	M-1 km119+000 (Start of Gyumri)	Gyumri Town Area	M-1 km130+100 (End of Gyumri)	11.5	City road

Source: This Study, 2010



M-1 Km 118+350 (left), Existing track (right)



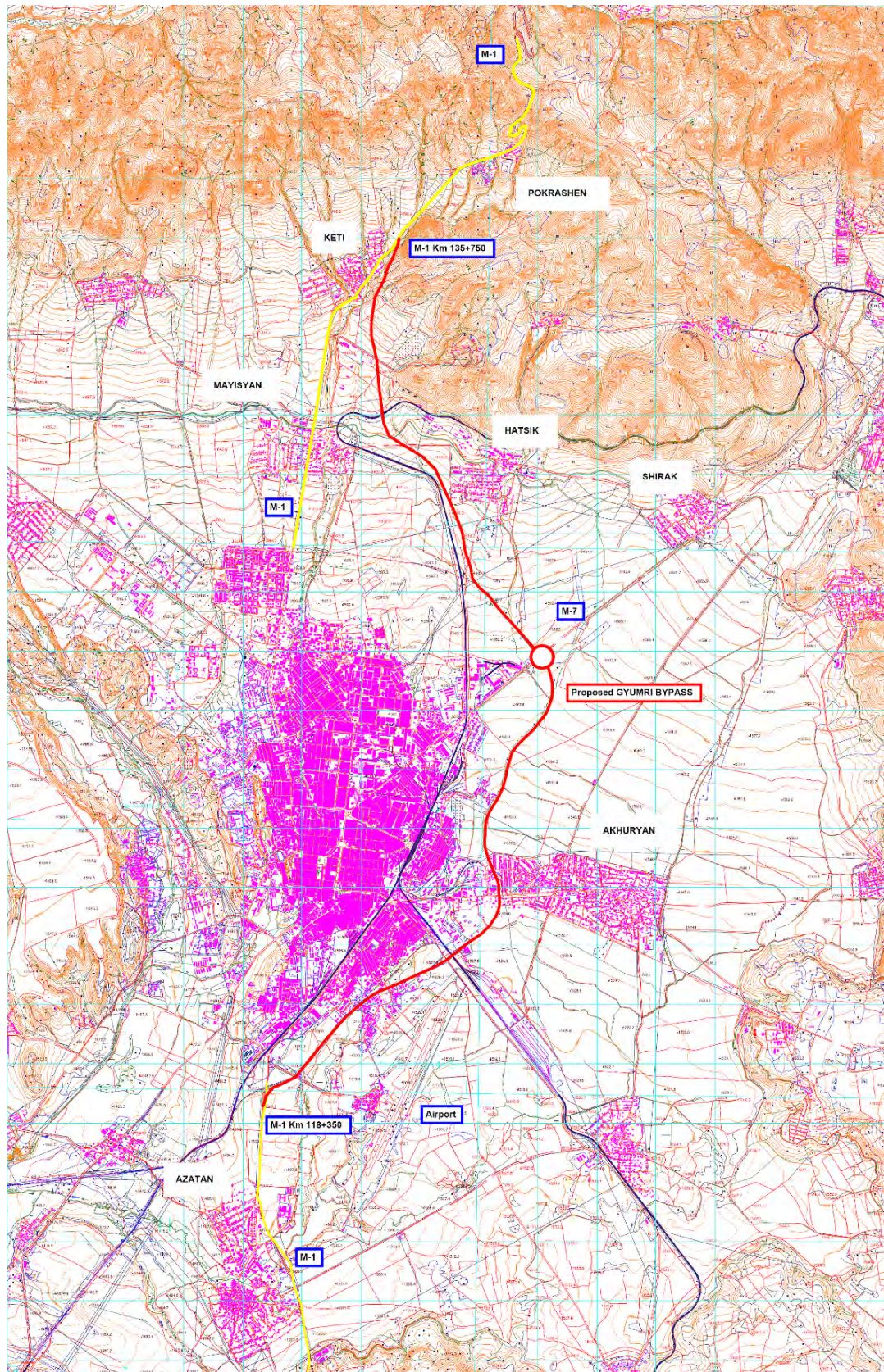
Missing Track in Akhuryan



Existing track on Embankment



Meeting Point with M-1 (left) at Ketı



Source: This Study, 2010

Figure 3-2: Location of Gyumri Bypass

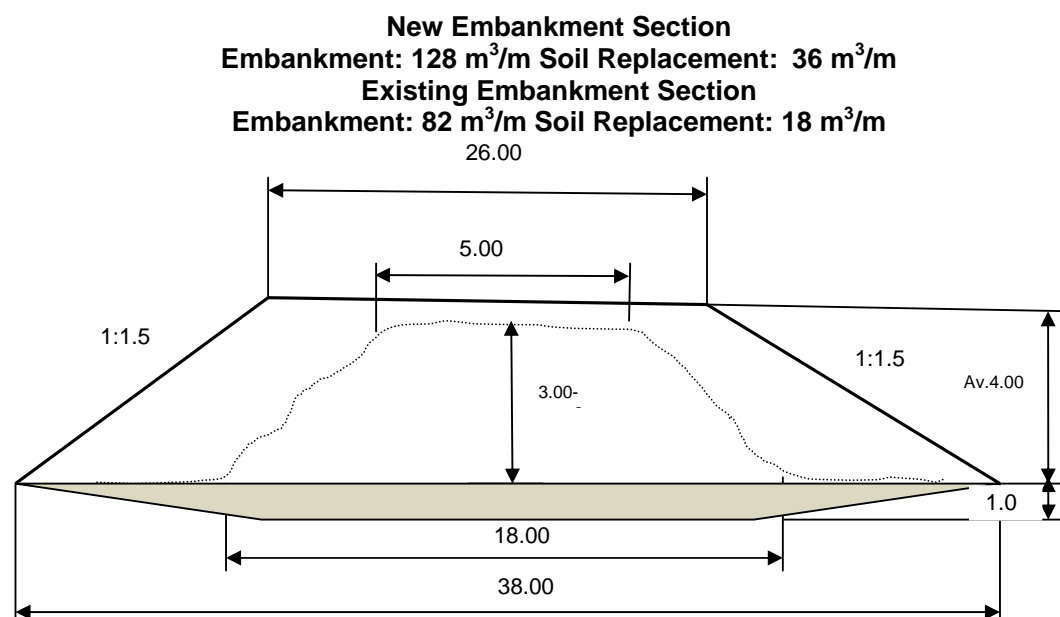


Figure 3-3: Typical Embankment Cross Section

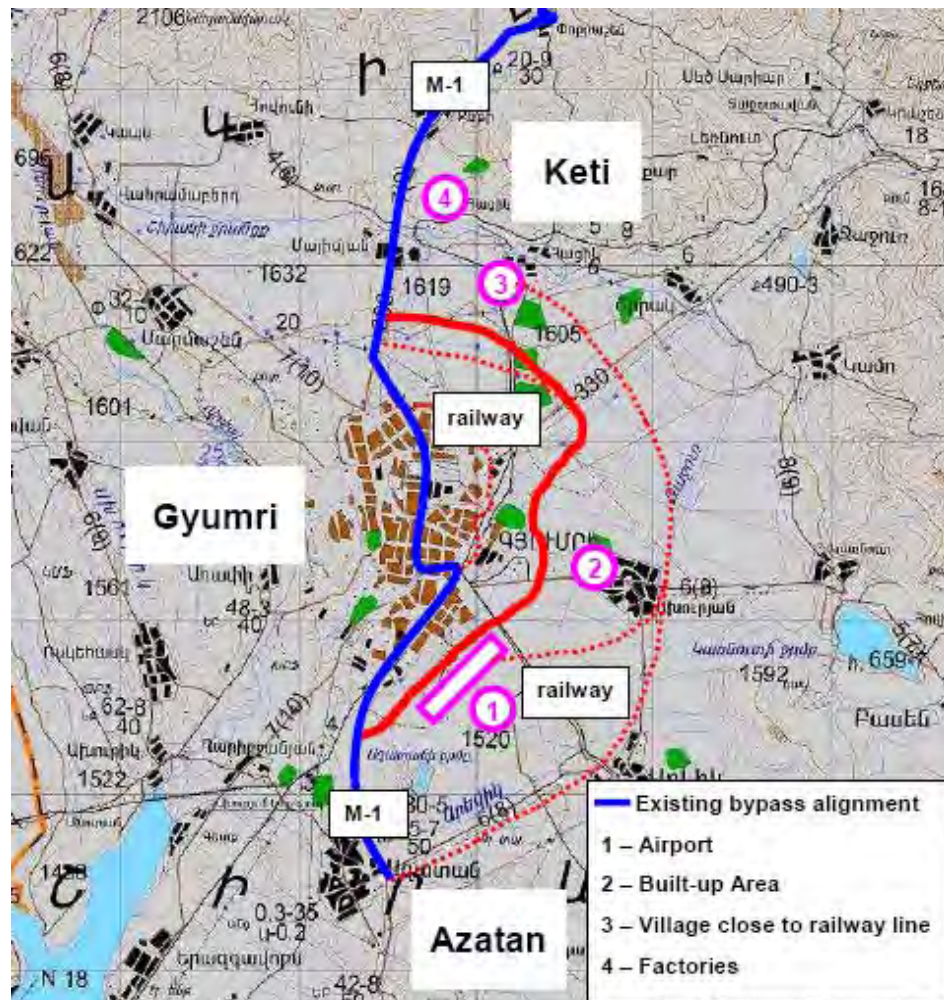
3.3 Cost Estimate

17. The estimated work quantity and cost for dual 2-lane are given in Table 3-2 (details are in Appendix 11).

Table 3-2: Gyumri Bypass Work Quantity and Construction Cost

Section	Case: 2-lane dual carriageway (category I)			Case: 2-lane construction for pavement (category I)
	Section I M-1 Km118+350– Akhuryan–M-7	Section II M-7–Keti–M1– Kma135+750	Total	
Location				
Major Work Quantity				
Road Length (km)	9.5	10.0	19.5	19.5
Excavation (m ³)	147,000	360,000	507,000	507,000
Embankment (m ³)	646,000	1,640,000	2,286,000	2,286,000
Pavement (m ²)	171,000	180,000	351,000	16,600
Construction Cost (excluding VAT and Contingency)				\$ million
Earth Work	6	17	20	20
Road Pavement	10	11	22	10
Road Shoulder			2	2
Road Furniture for Traffic Safety			2	2
Drainage			1	1
Structures (Bridge, Culvert)			26	14
Total Construction Cost			72	49

Source: This Study, 2010



Source: This Study, 2010

Figure 3-4: Gyumri Bypass Location of Alternatives

3.4 Environmental Appraisal

18. The entire area north of Yerevan lies within a semi-arid zone in different altitude zones and with an annual precipitation of 450–500mm and similar landscape and environmental features throughout. There are no unique or sensitive areas, no forests, and no protected areas within 1km of the alignment.

Table 3-3: Road Priority, Approximate Length and Environmental Assessment Category – Gyumri Bypass

Priority	MFF Tranche	Road Section	Approx. Length (km)	Recommended Environmental Assessment Category	Reason for Consultant Recommendation
2	Future Tranches	Gyumri Bypass (2 options)	19.5	A	Complex Mitigation

Source: This Study, 2010

19. The Gyumri Bypass requires in-depth environmental assessment. One of the options for the bypass would be through urban land on the periphery of the City of Gyumri. It may involve the demolition of several buildings including high-rise residential apartments and the resettlement of the affected households and businesses operating close to the present right-of-way (ROW) of existing urban roads. A second option would be across very productive cropland on wet carbonate soils and involve the purchase of some 140ha. (There is only very limited rich cropland in Armenia.) The wet soils may also require additional engineering attention to drainage and the base course. In either case there would be significant environmental impact on households and landscapes. Category A and EIA recommended.

Table 3-4: Environmental Features: Gyumri Bypass

Road Section: Gyumri Bypass – Options A and B	
Option A: Through the City—Main Environmental Features	Eco-sensitivity Category (1 to 3) And EA Required
<p>a. Option A: The City Bypass Option would be through urban land on the eastern periphery of Gyumri. The existing ROW is wide over most of the alignment but narrows in the northern section. It crosses two small streams (one twice) the main railway line and two disused railway side-lines. The route is through an existing urban area of mixed use and vacant land on the outer fringe of Gyumri.</p> <p>b. The landscape along the road is urban industrial, vacant, and rail transport land uses, with limited commercial uses along the road but with several apartment buildings close to it north of the railway station. There is a public square in front of the railway station. Demolition of several buildings including 5-storey residential apartments and the resettlement of the affected households and businesses operating close to the present ROW may be required.</p> <p>c. The area is subject to earthquakes, most recently in 1988 before the Soviets left Armenia. Much of the debris from collapsed buildings remains.</p> <p>d. There are some urban trees and the banks of the small stream support a variety of plants and provide an opportunity for a decorative landscaped strip.</p> <p>e. There are no special reserves, forests or historical buildings nearby.</p>	<p>3 A, EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ Bridging across streams and the main railway line. ➤ The public square in front of the railway station (where it may be better for the town if a bypass was sunk below a new square). ➤ Where buildings may have to be removed.
Option B: East of Gyumri City—Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. Option B: The Eastern Bypass Option would cross very productive cropland on wet carbonate soils south and east of the City. These soils may also require additional engineering attention to drainage and the base course. The proposed bypass would join the M-1 near Azatan with the M-1 north of Gyumri. The final alignment, yet to be decided, would follow an essentially flat to gently rising route just beyond the city fringe. Depending on the alignment north of the City, one to three small villages may be impacted. Sufficient ROW for a 4-lane dual carriageway would involve either the resettlement of village households and businesses or the construction of bypasses to their east.</p> <p>b. The landscape along this alignment is flat, rich cropland growing wheat, potatoes and market garden produce. There is little natural vegetation except to the north of the City to the east of the three villages mentioned above.</p> <p>c. To make way for the bypass some 100–120 ha of land would need to be purchased and it is worth noting that there is only very limited rich cropland in Armenia.</p> <p>d. As for Option A, the area is subject to earthquakes. There are no special reserves, forests or historical buildings nearby.</p>	<p>3 A, EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ The wet soil. ➤ Bridging across streams and the main railway line. ➤ Where buildings may have to be removed or demolished or villages bypassed.

Source: This Study, 2010

SECTION 4 YEREVAN WESTERN BYPASSES SUB PROJECT

4.1 Description

20. Through traffic from the M-1 to the M-2 passes through Yerevan. A PPTA for the *Yerevan Sustainable Urban Transport Project* will evaluate missing links which would complete a Western Inner Bypass, for financing under a proposed ADB MFF. The missing sections are: (i) Davitashen Bridge–Halabyan St.–Ashtarak (3.1km); (ii) Argavand Intersection–Shirak St. (1.5km); and (iii) Shirak St.–Artashat and St. Tamanciner–Arshakunyan St. (2.8km). The estimated construction cost is \$47 million. A missing link eastwards from the end of the 4-lane section of the M-1 to north Yerevan is also to be considered. These projects would provide a more coherent road network for the whole of western and northern Yerevan and improve NSRC connectivity.

21. The Inner Bypass will cater for NSRC traffic for the medium to long term. In the very long term, a Yerevan Western Outer Bypass may be needed from the M-1 at Proshian to the M-2 at Ayntap. The 19.5km would be new construction, with interchanges at the M-1, M-2, and M-5, a railway crossing, a river crossing and two other road crossings. The elevation Agravand–Ayntap is 870m, gradually ascending Agravand–Proshian to 1180m. The central section Geghapnya–Merdzavan is heavily populated.

4.2 Cost Estimate

22. The estimated work quantity and cost of a dual 2-lane Outer Bypass are given in Table 4-1 (details in Appendix 11).

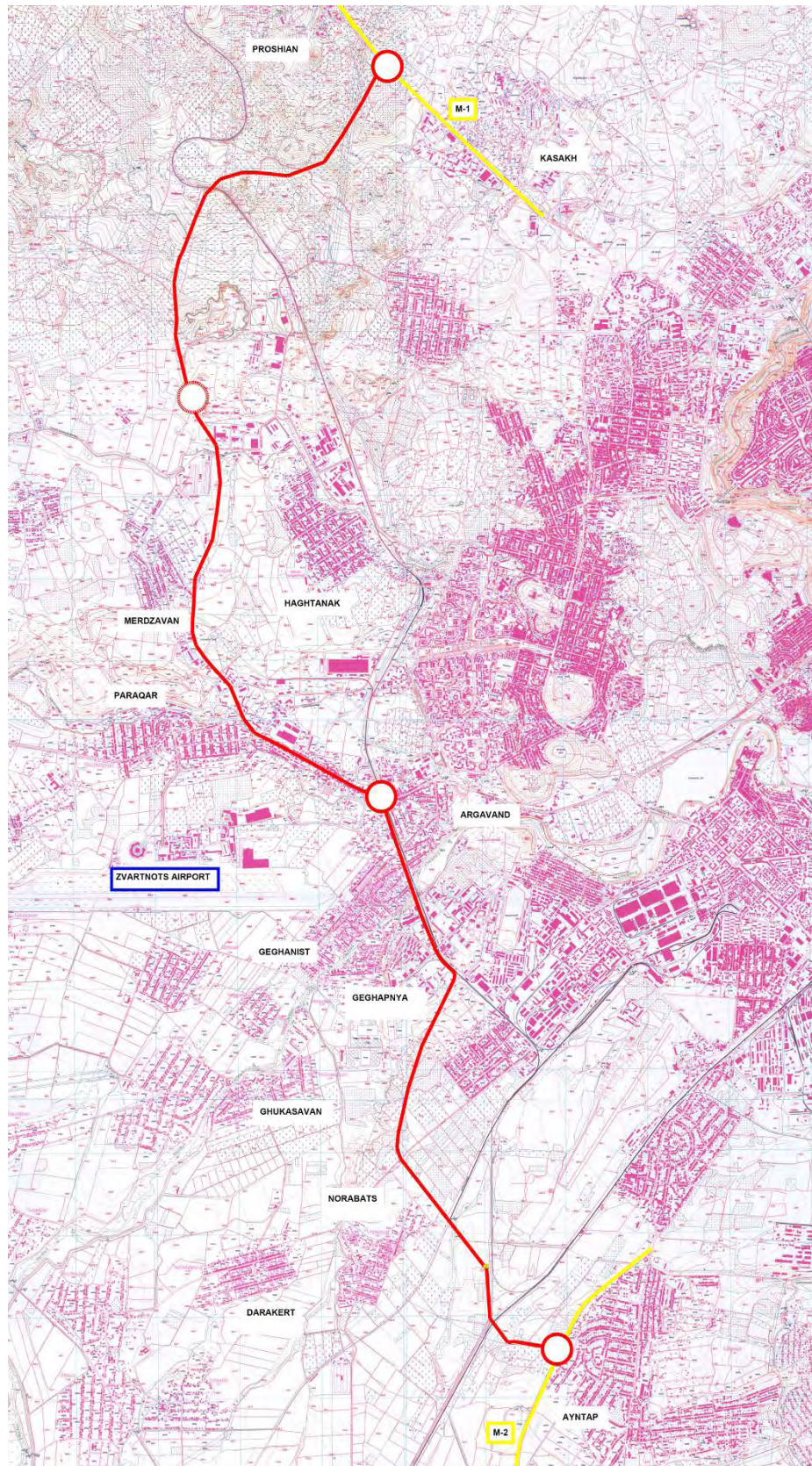
Table 4-1: Yerevan Western Bypass Work Quantity and Construction Cost

	M-1 Proshian	Merdzayan	Paraqar Argavand	M-2 Ayntap	Total
Major Work Quantity:					
Length (km)	4	5	5	5.5	19.5
Excavation (m ³)	159,000	270,000	222,000	297,000	948,000
Embankment (m ³)	30,000	910,000	666,000	1,001,000	2,607,000
Pavement (m ²)	72,000	90,000	90,000	99,000	351,000
Construction Cost (excluding VAT and Contingency):					
					\$ million
Earthwork	1	8	6	9	25
Road Pavement	4	5	5	6	21
Road Shoulder					2
Road Furniture for Traffic Safety					3
Drainage					3
Structures (Bridge, Culvert)					28
Total Construction Cost					83

Source: This Study, 2010

4.3 Development Strategy

23. The Western Outer Bypass is a high cost project, which is unlikely to be needed for many years, once the Western Inner Bypass is completed. Its development would also have a high social and resettlement impact. No immediate action is required, other than possibly protecting the alignment.



Source: This Study, 2010

Figure 4-1: Location of the Proposed Yerevan Bypass

SECTION 5 ARARAT–YERASKHAVAN SUB PROJECT

5.1 Description

24. The 19.5km is mainly flat, an area of irrigated agriculture at an elevation of 800m. Ararat itself is a center of building industry. However, there is a heavy concentration of high-value vineyards and orchards all along M-2 from Ararat until after the border town of Yeraskhavan.

5.2 Development Strategy

25. Widening of this section, which begins at the end of the dual carriageway, would complete a dual carriageway to within 1km of the Azerbaijan border. The initial 4.5km to a railway overpass can be widened on the existing alignment. The remaining 15km is through the heavily built-up area of Surenavan and Armash, where widening is impractical. It would require a new northbound carriageway bypassing the built-up area, with the existing road becoming the southbound carriageway (Figure 5-1).

26. The new carriageway would run through an arid, hilly area, requiring cuts and embankments. It is not ecologically sensitive and negative environmental impacts can be expected to be minor, standard and readily prevented or mitigated.

27. Widening is likely to be justified on capacity grounds at some stage during the 2020s. As the section is largely through an urban area, which restricts operating speed, benefits are lower than for an inter-urban section, although users of the northbound carriageway would gain the full benefits, if the carriageway is protected from frontage development.

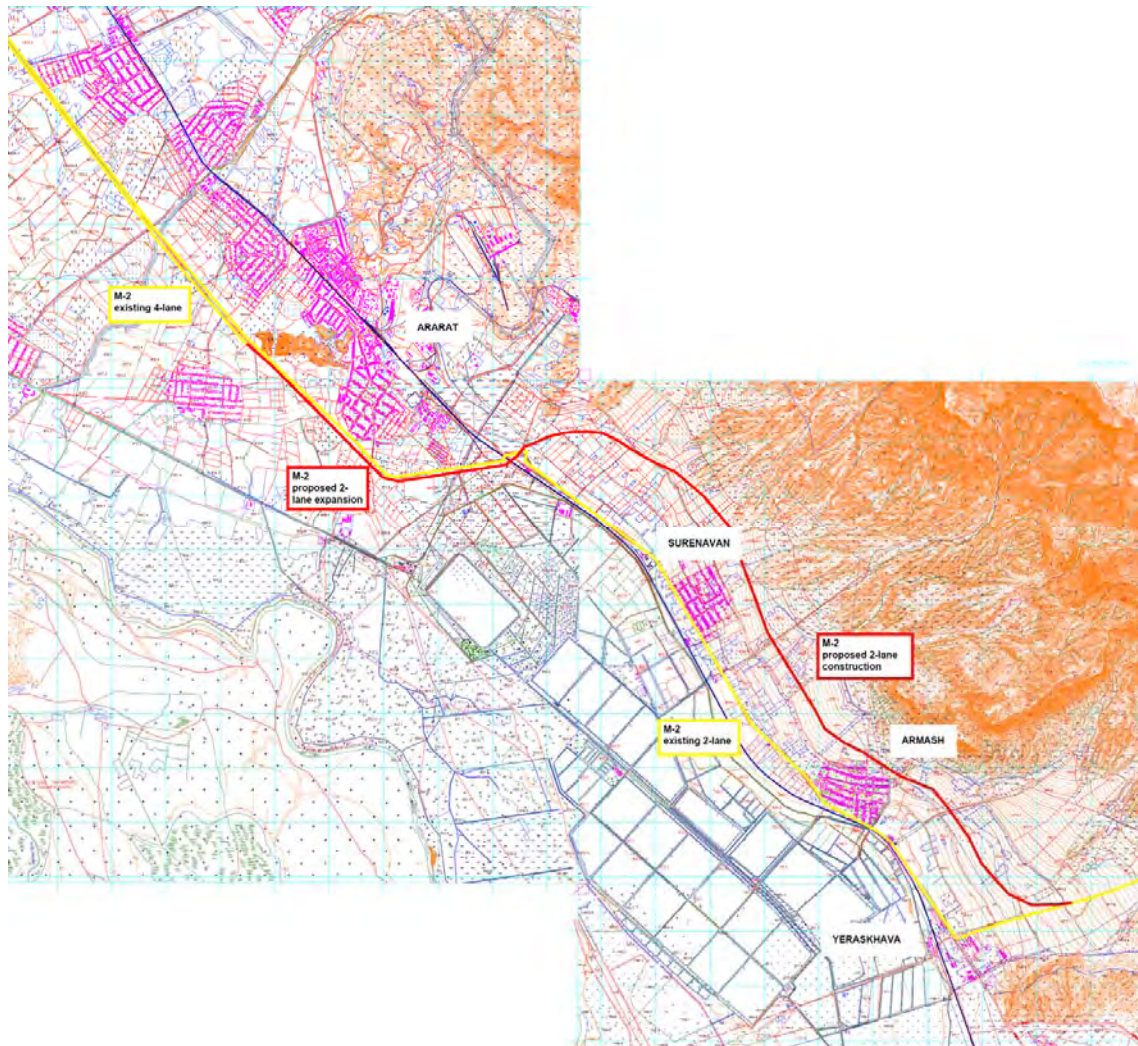
5.3 Cost Estimate

28. The estimated work quantity and cost of widening to dual 2-lane are given in Table 5-1 (details are in Appendix 11).

Table 5-1: Ararat–Yeraskhavan Estimated Work Quantity and Construction Cost

I	4-lane end to Railway Overpass	Railway Overpass– Yeraskhavan	Total
Major Work Quantity			
Road Length (km)	5.5	14	19.5
Excavation (m ³)	70,670	1,341,886	1,412,556
Embankment (m ³)	101,415	1,189,148	1,290,561
Pavement (m ²)	112,147	288,009	401,156
Construction Cost (excluding VAT and Contingency)			\$ million
Earth Work	1	18	19
Road Pavement	6	15	20
Road Shoulder			2
Road Furniture for Traffic Safety			3
Drainage			3
Structures (Bridge, Culvert)			3
Total Construction Cost			50

Source: This Study, 2010



Source: This Study, 2010

Figure 5-1: Location of Ararat–Yeraskhavan



Ararat-Railway Overpass



Thickly Settled Community



Proposed Bypass Location

Source: This Study, 2010

Figure 5-2: Ararat–Yeraskhavan Existing Condition

5.4 Environmental Appraisal¹

29. Several sections of road are proposed to be upgraded or upgraded and expanded along the N–S road corridor to the south of Yerevan. Here, the alignment is broken down into five different road sections reflecting the different environmental settings and sensitivities through which the road passes as follows:

- i. Ararat to Areni (Priority 3)
- ii. Areni to Saravan (Priority 3)
- iii. Saravan to Goris (Priority 3)
- iv. Goris to Kapan (Priority 2)
- v. Kapan to Agarak (Priority 3)

30. The environmental setting south of Yerevan, particularly south of Goris but also along the Arpa River, is environmentally very rich and diverse: physically (diverse geology, diverse landscapes, diverse micro-climates), biologically (diverse plant and animal species), via human use of resources and historically. Old and immensely mixed geological structures and landscapes are complemented by archaeological, historical and cultural richness going back thousands of years and only marred recently by the poverty and isolation brought about by the political events of last century and the poor road maintenance since the Soviets left 20-years ago.

Table 5-2: Road Priority, Approximate Length and Environmental Assessment Category – Ararat to Areni

Priority	MFF Tranche	Road Section	Approx. Length (km)	Recommended Environmental Assessment Category	Reason for Consultant Recommendation
2	Future Candidate Tranches	Ararat to Areni	60	B	Less Significant, Standard Impacts

Source: This Study, 2010

31. The Ararat to Areni Road Section crosses two landscapes. The first part (Ararat to Yeraskhavan) is an essentially flat area of irrigated agriculture and dry, non-irrigated land but either a bypass or resettlement of households and businesses in three villages may be required. The second part (Yeraskhavan to Areni) is through an arid to semi-arid hilly area that will require new cuts and embankments to accommodate a new vertical and horizontal road alignment. The corridor is not ecologically sensitive and potential impacts can be expected to be minor, standard and readily prevented or mitigated. Category B and IEE recommended.

¹ This sub section includes the Ararat–Yeraskhavan sub project, as well as a small portion of the Yeraskhavan–H46-Goris Junction sub project (Yeraskhavan–Areni).

Table 5-3: Environmental Features: Ararat to Areni

Road Section: Ararat–Areni	
Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. The ROW initially follows an essentially flat alignment and then climbs, crossing steep-faced dry hillsides via many cuts and embankments. The ROW is wide (20–30m) but there are many tight turns as it climbs up and down hill slopes. It crosses no significant streams or water bodies.</p> <p>b. The geomorphology is shingle fans and an old flood plain. The landscape is flat to gently sloping. The climate is semi-arid.</p> <p>c. The land has many bare gravelly and saline patches where sage predominates. All slopes above irrigation canals are very dry, bare and gravelly.</p> <p>d. There are no special sites (reserves, forests, historical etc.) within 200m of the road.</p> <p>e. Crops, mostly wheat, vineyards and orchards occupy irrigated land.</p>	<p>1-2, Category B IEE</p> <hr/> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ Where re-alignments, large cuts, or large embankments may be required. ➤ Where irrigated land may be affected.

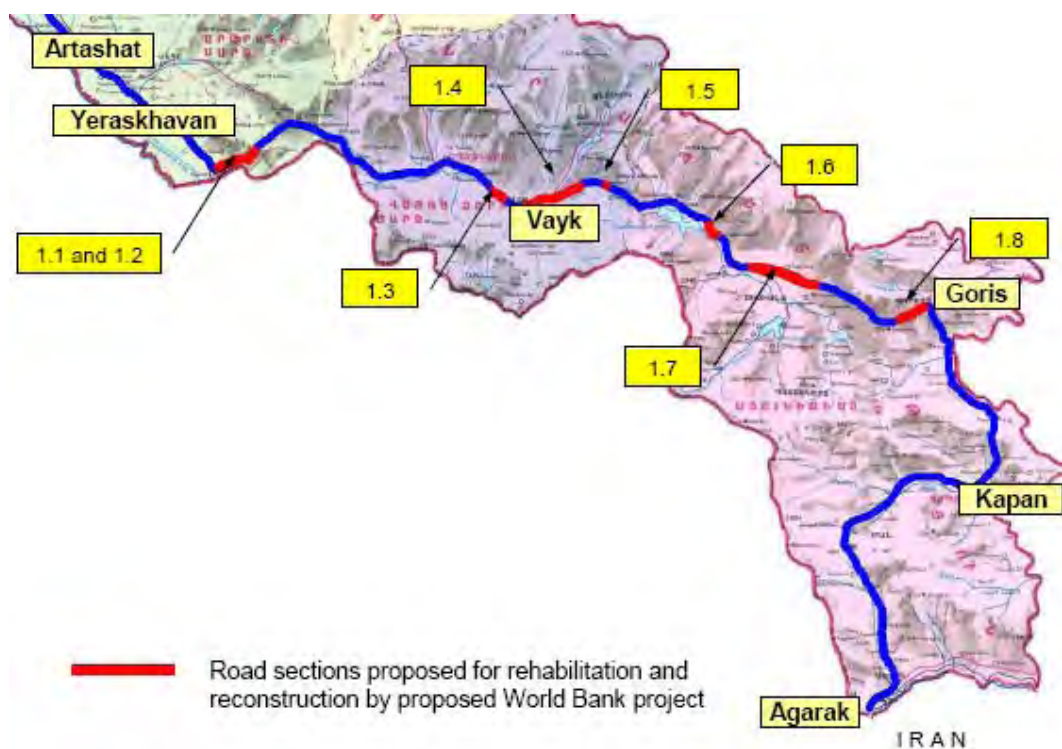
Source: *This Study*, 2010

SECTION 6 YERASKHAVAN–H46 GORIS JUNCTION SUB PROJECT

6.1 Description

32. This section runs east from the junction with the north–south route through Nakhijevan, 1km from the Azerbaijan border. The first 25km is a continuous climb from 800m to the Tukh Manuk Pass 1795m. The road then continues east south–east through the important wine-growing town of Areni. The M-10 to Lake Sevan and the north starts at km120. The 24km local road to Jermuk runs north from km147. Continuing south–eastwards, Sisian is bypassed to the north. This section ends at the H-46 intersection to Tatev. Most of the route is rolling to hilly terrain, with short sections of hairpin bends. There are long stretches of wide 2-lane/3-lane Yeraskhavan–Areni.

6.2 Development Strategy



Source: This Study, 2010

Figure 6-1: Road Sections Addressed by Proposed World Bank Project

33. Surface condition is mainly moderate, with average IRIs in 2008 of: 5.45 km65–120, 6.07 km120–147 and 5.51 km147–end. The northbound, loaded truck direction is more worn than the southbound side, with some rutting. Some stretches are in poor condition and were identified for priority improvement under a proposed World Bank project: km65–77, km132–136, km140–156, km165, km167, km182–191, km196–216 and km224–235. The World Bank project is unconfirmed and may also be considered for implementation under the MFF.

6.3 Cost Estimate

34. The cost for rehabilitation of the 92 kilometers of road between Yeraskhavan and H-46 Goris Junction not covered by the proposed World Bank project is roughly estimated at \$65 million.²

6.4 Environmental Appraisal

Table 6-1: Road Priority, Approximate Length and Environmental Assessment Category – Ararat–Goris

Priority	MFF Tranche	Road Section	Approx. Length (km)	Recommended Environmental Assessment Category	Reason for Consultant Recommendation
2	Future Candidate Tranches	Ararat to Areni	50	B	Less Significant, Standard Impacts
		Areni to Saravan	22	A	Narrow Gorge. Road next to a river. Protected Area across river
		Saravan to Goris	112	B	Less Significant. Standard Impacts

Source: This Study, 2010

35. The Areni to Saravan Road Section follows a narrow valley floor interrupted by short very narrow gorges with solid rock sheer cliffs 40m high confining the road to a narrow strip between the cliffs and the Arpa River. There is insufficient horizontal space to accommodate road expansion and tunnels may be required. To the south, across the river (5–10m wide) lies a reserve to be designated shortly as Gnishik National Park. Category A and EIA recommended.

36. The Saravan to Goris Road Section climbs across the faces of slopes as it ascends the Sisian Plateau of mountain steppe but otherwise the landscape is not environmentally sensitive and there are no protected areas, archaeological sites or important cultural sites within the road corridor. Category B and IEE recommended.

Table 6-2: Environmental Features: Areni to Goris

Road Section: Areni to Saravan	
Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. The road enters a short narrow gorge immediately after Areni and follows a confined strip between the Arpa River and a high rock face. After the first Gorge, the road ascends the floor of the narrow Arpa Valley and goes through several other short gorges. The ROW follows close to the river in the gorges and never far from it throughout the valley. It passes through most villages.</p> <p>b. Basalt intrusions on both sides of the river are separated by gravel slopes.</p> <p>c. The natural land above the narrow valley floor is bare on the rock faces with bushes and a variety of short plants on the gravel slopes. The bushes give way to a stunted Juniper open forest from about</p>	<p>2-3, Category A EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ The gorge sections. ➤ Where new cuts, tunnels, or embankments may be required. ➤ Where irrigated land may be affected.

² Based on the \$50 million allotted by the World Bank for the rehabilitation of the sections identified above.

<p>Km-137 to Km-148.</p> <p>d. The gorges are special sites in their own right and provide habitats and route-ways for a variety of species. There are no special areas nearby along the north bank of the Arpa River but south of the river Gnishik National Park is proposed to stretch from the river to the Azerbaijan border and westeast approximately from Areni to Malishka (Km-130).</p> <p>e. The gorges are too narrow for agriculture but a number of small hotels and restaurants sit on the strip between road and river in the gorge east of Vayk. Outside the gorges, the pattern of irrigated agriculture on valley floors repeats.</p>	
Road Section: Saravan to Goris	
Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. The road crosses the faces of modestly steep slopes via cuts and embankments as it rises to Voratan pass (2,300m) to the top of a plateau some 2000m in elevation. The ROW is relatively wide but has many tight turns as it traverses hill slopes. It crosses no significant streams or water bodies and passes above most villages.</p> <p>b. The rock type is very mixed with outcrops of fractured basalt interspersed with sedimentary deposits (of mixed eroded sedimentary material, basalt rocks and gravel and volcanic ash).</p> <p>c. The plateau is moister than previously. The landscape, sprinkled with basalt rocks, is gently rolling cut periodically by small valleys and covered in steppe vegetation. Wheat is grown on the flatter areas. There are no trees.</p> <p>d. There are no special sites nearby (reserves, forests, historical etc.).</p> <p>e. The mountain steppe and patches of wheat on the gentle slopes of the high rolling country with no trees continues to the edge of the plateau (about 5km south of Sisian, 2km south of Norovan and the top of the Goris ramp).Bring this up to avoid splitting this and the following table-page</p>	<p>1-2, Category B IEE</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ Where re-alignments, cuts or embankments may be needed. ➤ Where irrigated land may be affected.

Source: This Study, 2010

SECTION 7 GORIS–H46 KAPAN JUNCTION

7.1 Description

37. This section starts 10km from Goris. It is the only north–south route (H-46 provides an alternative, but in its current condition – IRI>15, it is unsuitable for use by through traffic). Winter storms can close the road. It has a high landslide incidence and accidents on the mountainous sections can close the route. Provision of an alternative is desirable on strategic grounds: (i) the M-2 route is in places very close to the border with Azerbaijan; and (ii) it is essential to maintain access to the far south and Iran. However, the topography in the area is difficult and to develop other than an emergency alternative would be very expensive. The additional route could either (i) provide an emergency use only route for through traffic, when the M-2 is closed; or (ii) be designed to replace the M-2 as the main north–south through route. In case (ii), it would need to be of a similar or higher standard than the M-2, which is challenging.

7.2 Development Strategy

38. There are four development options: (i) improve the M-2 route, with H-46 rehabilitated primarily for tourist use, but also as an emergency alternative to M-2; (ii) upgrade H-46 to form the NSRC; (iii) as (ii) south of Tatev, with a new tunnel route Sisian–Tatev; and (iv) as (ii) south of Tatev, with a new non-tunnel route Sisian–Tatev. These options are summarized in Table 7-1.

Table 7-1: Improvement Options Goris–Kapan

Option	Route	Improved Length Km		Distance Sisian (km210+800)–Kapan (km296+290)	Geographic Feature/Improvement	Estimated Construction Cost (Excluding VAT/Contingencies \$ Million)
1. Improve M-2	Existing km237-297	60		85	UN ESCAP pre-feasibility study 2007.	12*
2. Improve H-46	M-2 (km227+790) Halidzor–Tatev	18	64	81	Need to cross gorge (500m deep)	164
	Tatev–Kapan M-2 (km 296+290)	46			Improve	
3. New Sisian Route	M-2 (km210+800)–Noravan–Lor–Tatev	33	78	78	Cross 2,400m mountain (height difference 600m) by tunnel -21km M-2-Lor to be improved, 12km Lor -Tatev new construction	283
	Tatev–(H46)–Kapan M-2 (km 296+290)	45			As Option 2	
4. New Sisian Route	M-2 (km206+95)–Noravan–Ltsen–Tatev	32	77	77	M-2-Ltsen 19km to be improved, 13km Ltsen-Tatev new construction	187
	Tatev–Kapan M-2 (km 296+290)	45			As Option 2	

Note: * UNESCAP 2007 prices.

Source: This Study, 2010

Option 1: Improve M-2/Rehabilitate H-46

39. Goris–Kapan was rehabilitated in 1997–1998 under the World Bank *Armenia Highway Rehabilitation Project*. The average IRI in 2008 was 4.95. UNESCAP undertook a *Prefeasibility Study of AH82: Goris Kapan Road in Armenia* in March 2007, under its initiative to promote and develop Asian Highway priority routes. Five alternative improvement levels were considered, with costs ranging from \$1.6 to \$20.3 million. Alternative 4, at a cost

of \$12.1 million, was recommended as feasible (EIRR of 13.4%). This comprises: (i) pavement rehabilitation km237–267; (ii) pavement reconstruction and widening km267–297; (iii) realignment and bridge reconstruction at Vorotan km243 and at km252; and (iv) installation of guardrail on mountainous sections and replacement of cross drainage.

40. Some of this work was done during pavement repairs to the mountainous section in 2008. Also, 3km through Goris were reconstructed in 2009. There is a local initiative to construct a 6.5km northwest bypass of Goris, as heavy vehicles on the upgrade through the city cause noise and other pollution. In 2009, there were serious landslides at km243, 5km south of Goris, which closed the road for a few days. Repairs were still in progress in September. A long term solution is problematic due to geological conditions above the road. One option, suggested by ARD, would be to relocate the M-2 to the east of the river. The alternative is to remove a large section of hillside and install protective barriers.

41. The most difficult stretches are immediately north and south of km270, the crest at 1820m. There are many hairpin bends in this area, with that at km266.5 a particular problem, reportedly the site of many accidents in winter. A winter maintenance center needs to be established (km270 would provide a suitable location), equipped with snow clearing equipment and rescue vehicles.

42. Although the M-2 route should be improved in line with the UNESCAP recommendation, it will always remain vulnerable to temporary closure. H-46 is in very poor condition and urgently needs to be rehabilitated to serve tourist traffic. This rehabilitation should be combined with easing of curves to enable emergency use of the route by through traffic, when the M-2 is impassable. The most difficult sections may be designed to operate as alternating one-way in such circumstances for passage of heavy vehicles.

Option 2: Improve H-46 to Class II

43. H-46 runs parallel and to the west of the M-2. It starts at the Shinuhayr–Tatev intersection M-2 km227+790 (5km north of Goris) and ends at the Aghvani–Ujanis M-2 intersection km296+290. At 70km, it is 1.5km longer than the M-2 route. It passes through Shinuhayr, Halidzor, Devil's Bridge, Tatev, Aghvani, Tandzver, Shrvnants, ending at Sznak, close to Kapan. Between Halidzor and Tatev, the road descends 500m into the Halidzor Gorge, through 10km of hairpin bends and steep gradients.

44. H-46 provides the only access to Tatev Monastery, which is of great historic importance and a major tourist attraction. It sits at the edge of a sheer rock face, virtually inaccessible on three sides. The church dates from the 4th century and the monastery from the 9th century. A large-scale tourist development is proposed in the area comprising: (i) a 5.8km cablecar from Halidzor across the Halidzor Gorge to the monastery; and (ii) two hotel and resort areas, one in the Gorge below Devil's Bridge and one in Halidzor.

45. Diversion to an improved H-46 is difficult to estimate, as the route would not be markedly superior to the M-2, although some 4km shorter. Most traffic on the M-2 near to Goris and Kapan is local (Table 7-1 counts at km228 and 296, compared with count at km270, mid-section representing through traffic). If 80% of km270 traffic diverts, this is some 660 vehicles per day at 2009 levels (October volume is factored by 0.9 to convert to AADT). Existing traffic on H-46 is low, but a large growth in tourist traffic is in prospect, given road improvement. This could add perhaps 500 vehicles per day as far south as Tatev. Low traffic volume and the relatively minor benefits of diversion, make the economic case for investment of \$164 million unsustainable. This Option should be considered on the basis of whether it is desirable for strategic purposes.

46. Table 7-2 and Figure 7-1 detail the existing condition and improvement to Category II. It is not considered practicable to improve to a higher standard. There are four subsections, corresponding to pavement condition and terrain.

Table 7-2: Option 2 Improvement of H-46

No.	Subsection	Existing		Improvement to Category II	
		Length Km	Condition	Length Km	Plan
I	M-2 Km227+790-before Shinuhayr	4	Flat/hilly terrain, paved with asphalt but the surface is largely deteriorated.	4	Follows existing alignment, rehabilitation to replace failed surfacing and protect integrity of pavement structure.
II	Shinuhayr–Tatev	20	The first 10km runs through hilly area and two villages, Shinuhayr and Halidzor. After Halidzor descends over 500m to gorge through a series of hair-pin bends for 10km. Pavement is heavily damaged or missing.	14	New alignment to the north of Shinuhayr and Halidzor through flat terrain, mostly pasture. New alignment to the north of Devil's Bridge crossing gorge on a 300m bridge.
III	Tatev–Shrvenants	34	Mountainous terrain, highest altitude about 2,000m north of Aghvani. The paved surface varies from damaged to missing to relatively well preserved. Very narrow passing through Verin Khotanan and Nerkin Khotatan.	34	Major rehabilitation or reconstruction for much of length. New alignment to the east of Verin Khotanan and Nerkin Khotatan as planned previously.
IV	Shrvenants-M-2 km296+290	12	Hilly terrain, adequate for local traffic, paved surface.	12	Follows existing alignment, requires rehabilitation to replace failed surface and protect integrity of pavement structure.
Total		70		64	

Source: This Study, 2010

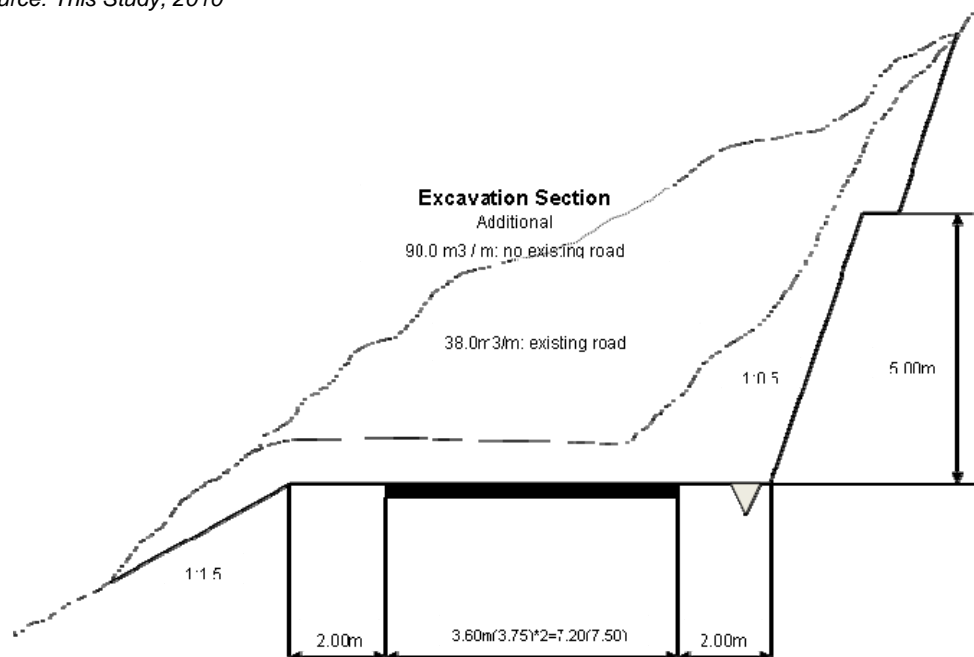


Figure 7-1: Typical Road Cross Section (Category II)

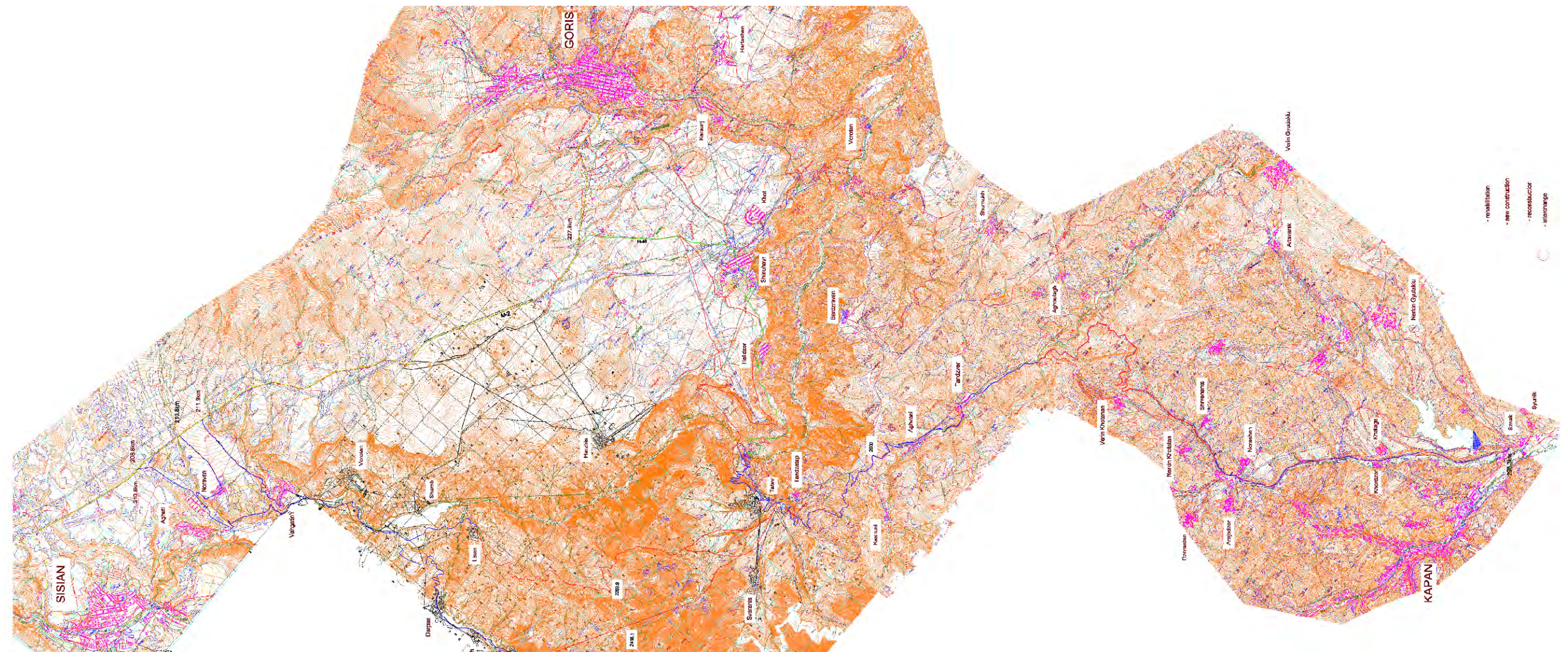
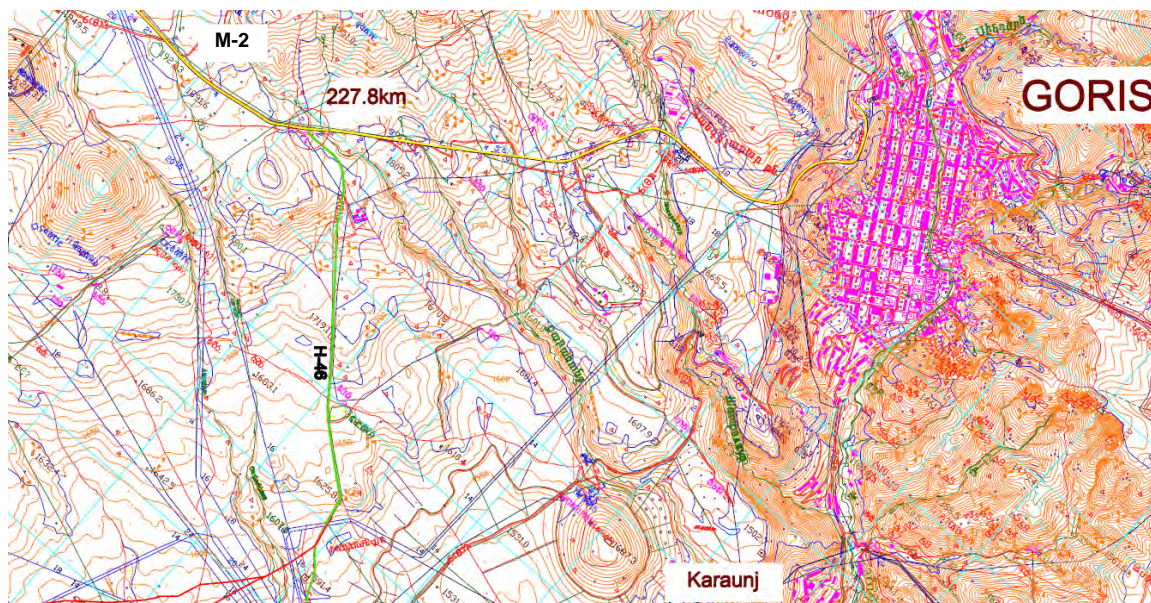


Figure 7-2: Location of the Proposed Goris–Kapan Alternative Route

47. **H-46 M-2 km227+290–Shinuhayr:** The start point on the M-2 is 5km northwest of Goris. The improvement would be to the existing road, which is almost straight for 4km through flat to hilly terrain. Elevation at the start is around 1,850m, gradually descending to 1,650m. The asphalt surface is heavily deteriorated. Land use is for pasture and agriculture. This section requires rehabilitation to replace the failed surface and protect the integrity of the pavement structure.



Existing road to be rehabilitated: —
Proposed road to be constructed: —

Figure 7-3: Section I M-2 Km227+790—before Shinuhayr

48. **H-46 Shinuhayr–Tatev:** Mostly mountainous terrain, with the initial 10km relatively hilly. From Halidzor the road descends from 1,500m to a low point of 1,000m at Devil's Bridge, then climbs to 1,650m at Tatev. There are about 10km of about 20 hair-pin bends (Figure 7-4). The pavement is largely deteriorated or missing.



Figure 7-4: Shinuhayr–Tatev Road Condition

49. To avoid Shinuhayr and Halidzor and to cross the deep gorge, several alternatives would need to be considered during preliminary and detailed design (Figure 7-6). A new alignment which runs through pasture and forest is recommended. Figure 7-7 illustrates the bridge over the Halidzor Gorge.

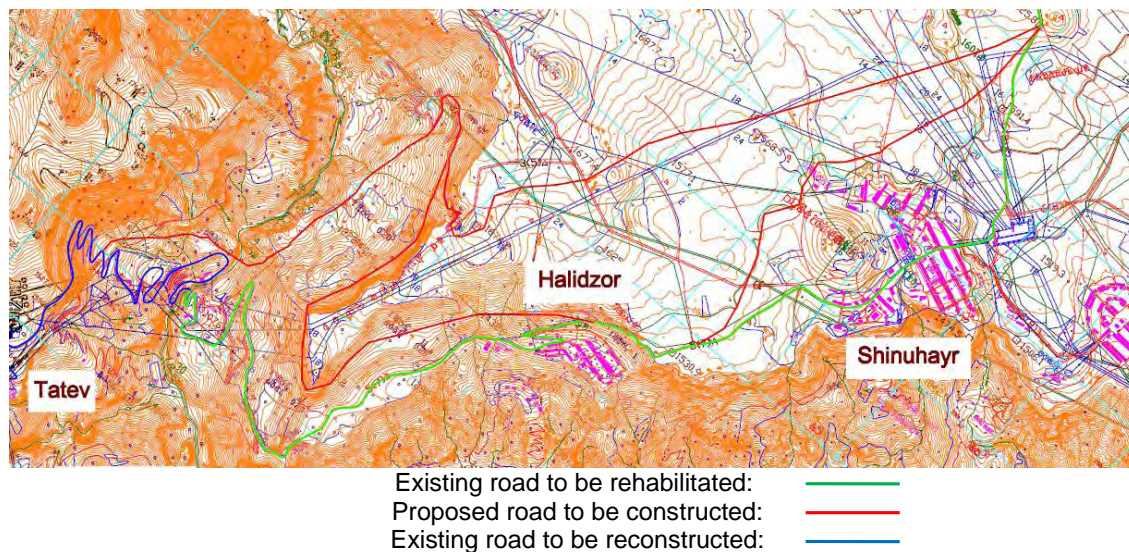


Figure 7-5: Section II Shinuhayr–Tatev

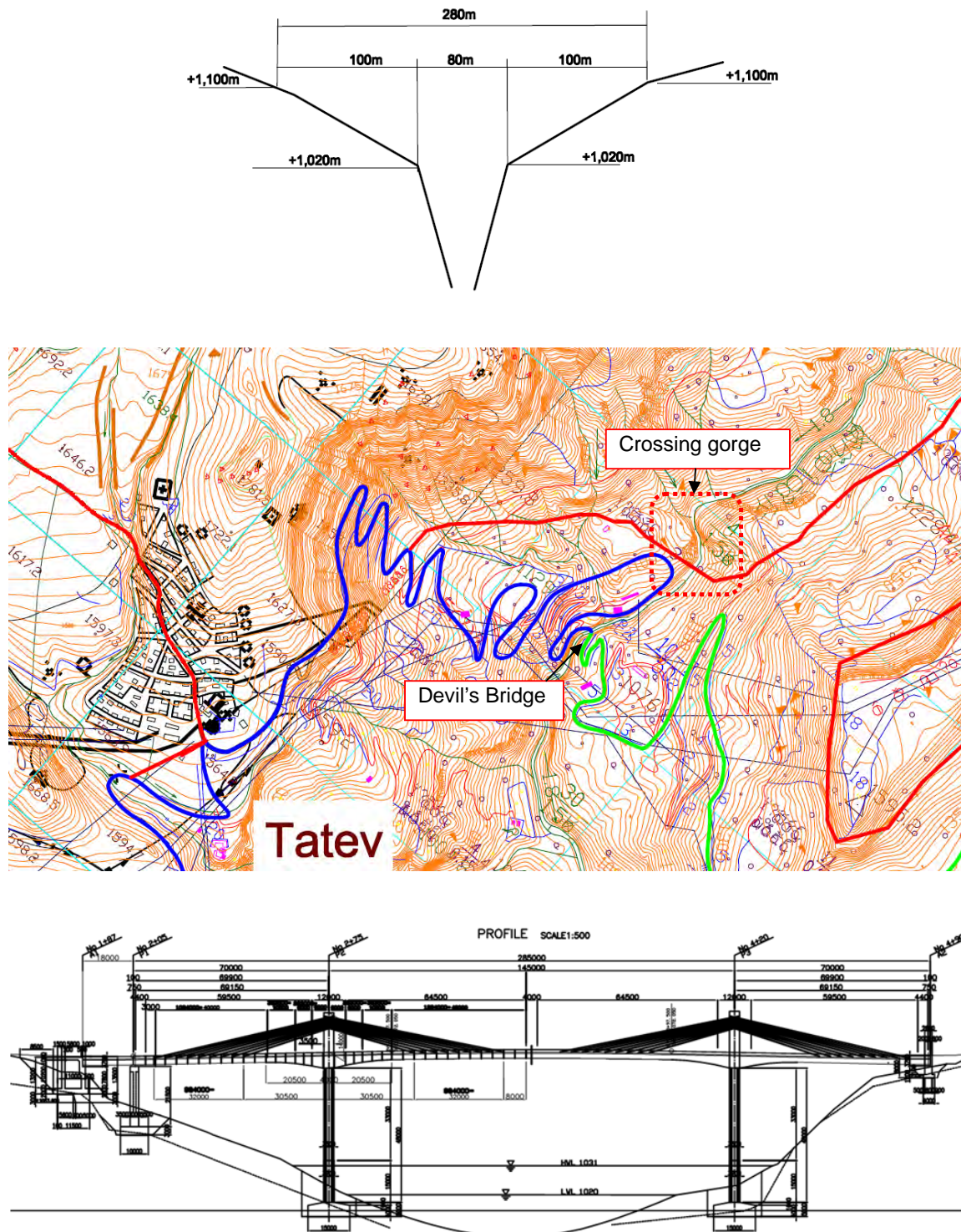


Figure 7-6: Schematic Bridge Crossing Gorge



Figure 7-7: Illustration of Halidzor Gorge Bridge (upstream from Devil's Bridge)

50. **H-46 Tatev–Shrvenants:** The road runs through mostly mountainous terrain and forested area, ascending from 1,650m to 2,000m north of Aghvani, then descending to 1,000m. The paved surface varies from damaged to missing to relatively well preserved. The road is very narrow through Verin Khotanan and Nerkin Khotatan. This section requires major rehabilitation or reconstruction over much of its length. A new alignment is recommended east of Verin Khotanan and Nerkin Khotatan, following that started in Soviet times and still in existence. The new alignment would avoid some particularly severe curves and limit the amount of forest impacted.

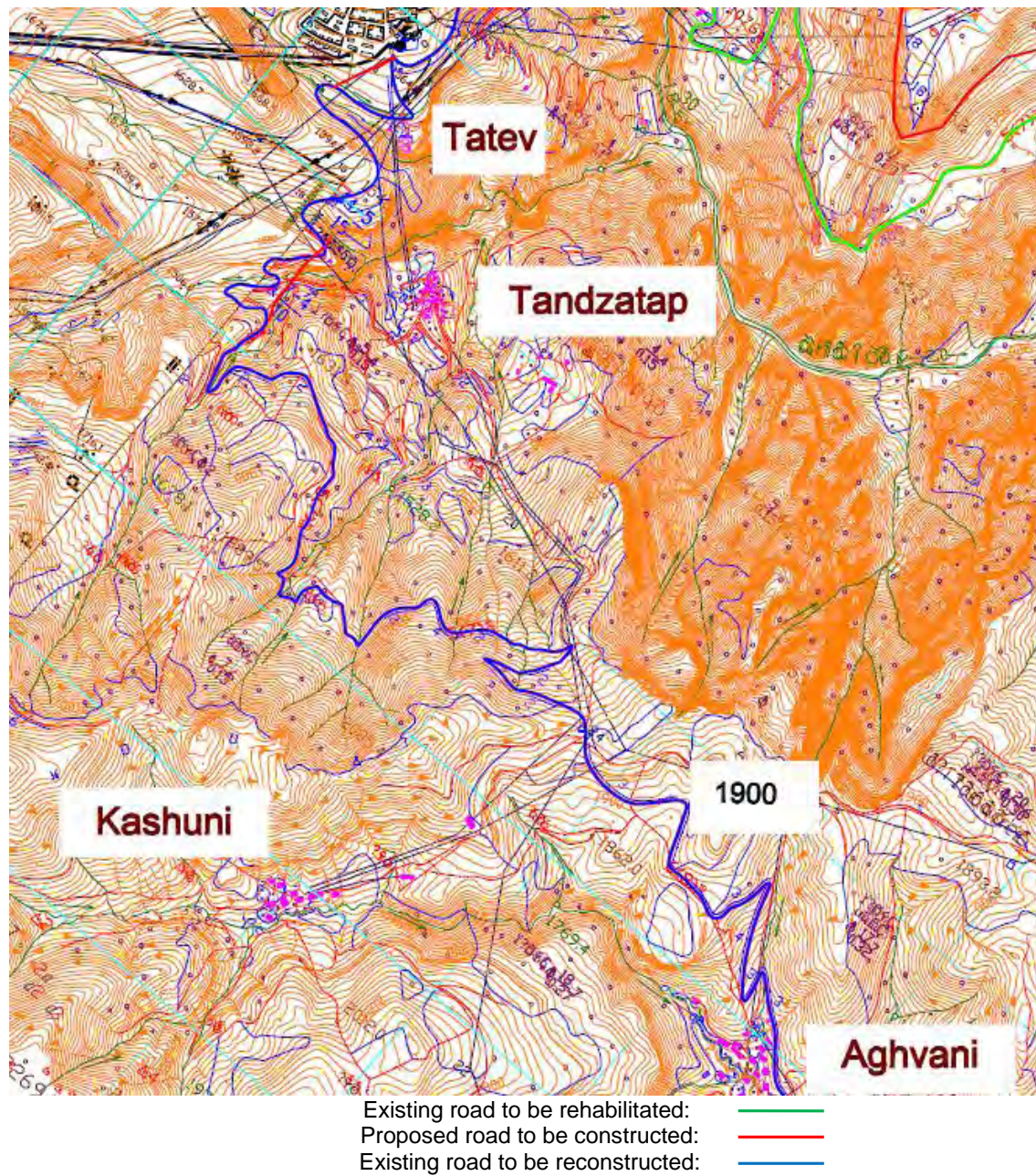
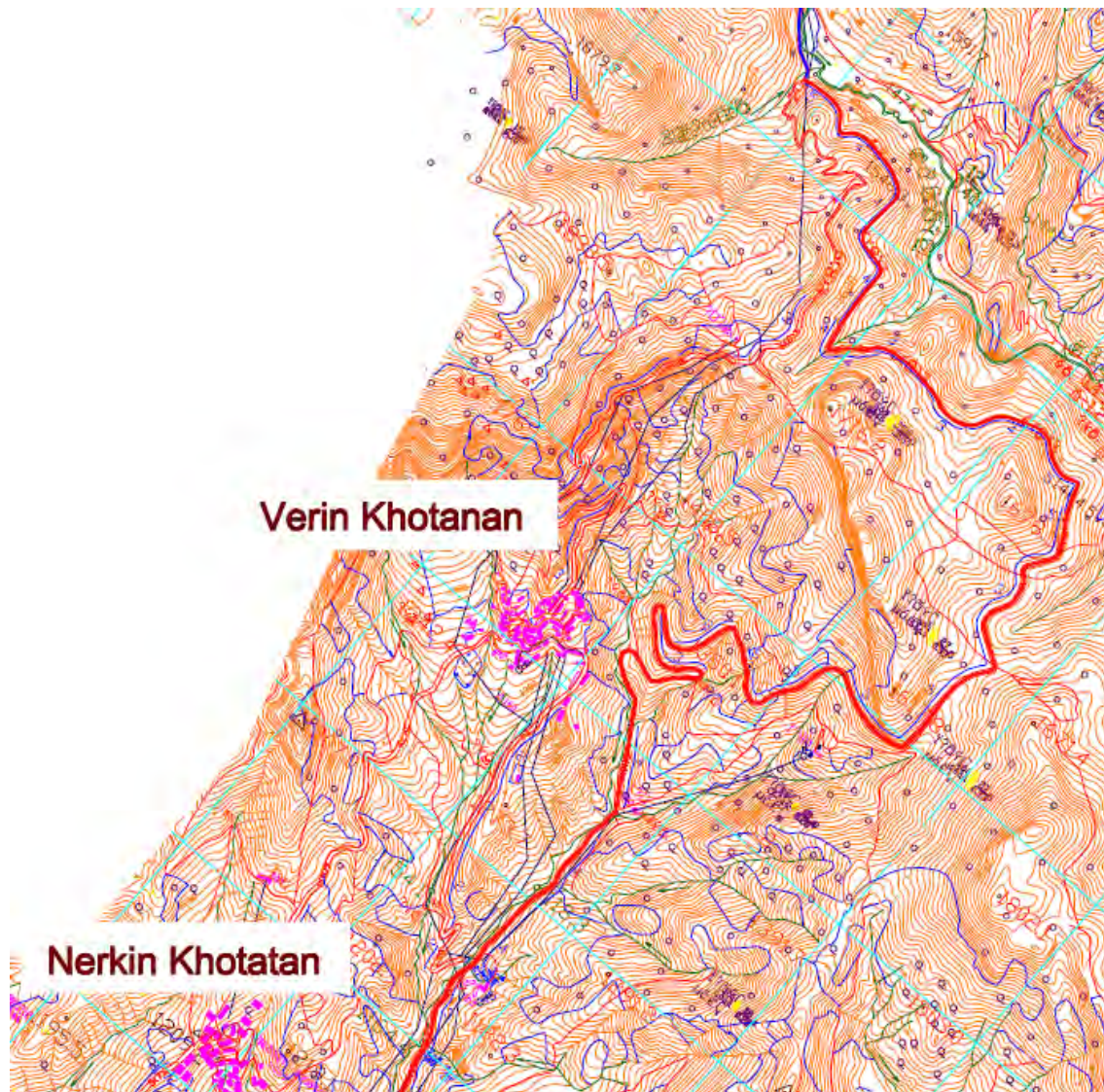


Figure 7-8: Section III Project Road, Shinuhayrd–Tatev



Existing road to be rehabilitated: ————
Proposed road to be constructed: ————
Existing road to be reconstructed: ————

Figure 7-8: Section III Project Road, Shinuhayrd–Tatev (continued)

51. **H-46 Shrevenants–M-2 km296+290:** This section is hilly. The paved road descends from 1,100 to 700m, and its condition is adequate for local traffic. The proposed improvement follows the existing alignment, with reconstruction or partial rehabilitation to replace failed surface and protect the integrity of pavement structure.

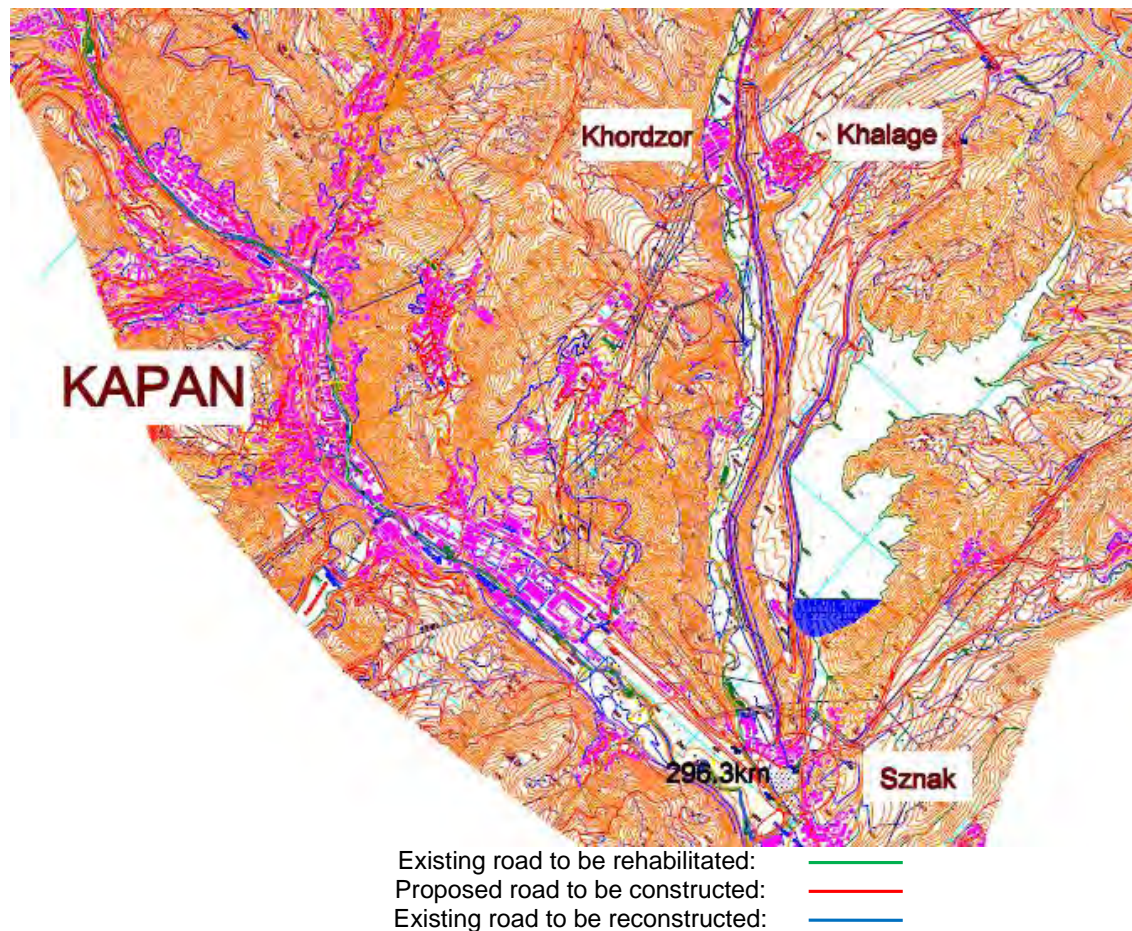


Figure 7-9: Section IV The Project Road, Shinuhayrd–Tatev

52. **Cost estimate:** The estimated work quantity and cost for improvement of H-46 to Category II are given in Table 7-3 (details are in Appendix 11).

Table 7-3: H-46 Improvement Estimated Work Quantity and Construction Cost

	Section I	Section II	Section III	Section IV	Total
Major Work Quantity					
Road Length (km)	4	14	34	12	64
Excavation (m3)	48,000	1,168,000	2,552,000	182,000	3,950,000
Embankment (m3)	96,000	216,000	852,000	288,000	1,452,000
Pavement (m2)	36,000	126,000	306,000	108,000	576,000
Construction Cost (excluding VAT and Contingency)					\$ million
Earth Work	1	18	24	3	46
Road Pavement	2	8	19	6	35
Road Shoulder					5
Road Furniture for Traffic Safety					10
Drainage					6
Structures (Bridge, Culvert)					62
Total Construction Cost					164

Option 3: Improve H-46 Tatev–Kapan/Tunnel Route Sisian–Tatev

53. An alternative to the use of H-46 north of Tatev is to develop a new route Sisian–Tatev (Figure 7-10). This would require an expensive tunnel through the mountains and costs 73% more than Option 2. In addition, there would be recurrent maintenance and operating costs for the tunnel (Figure 7-11).

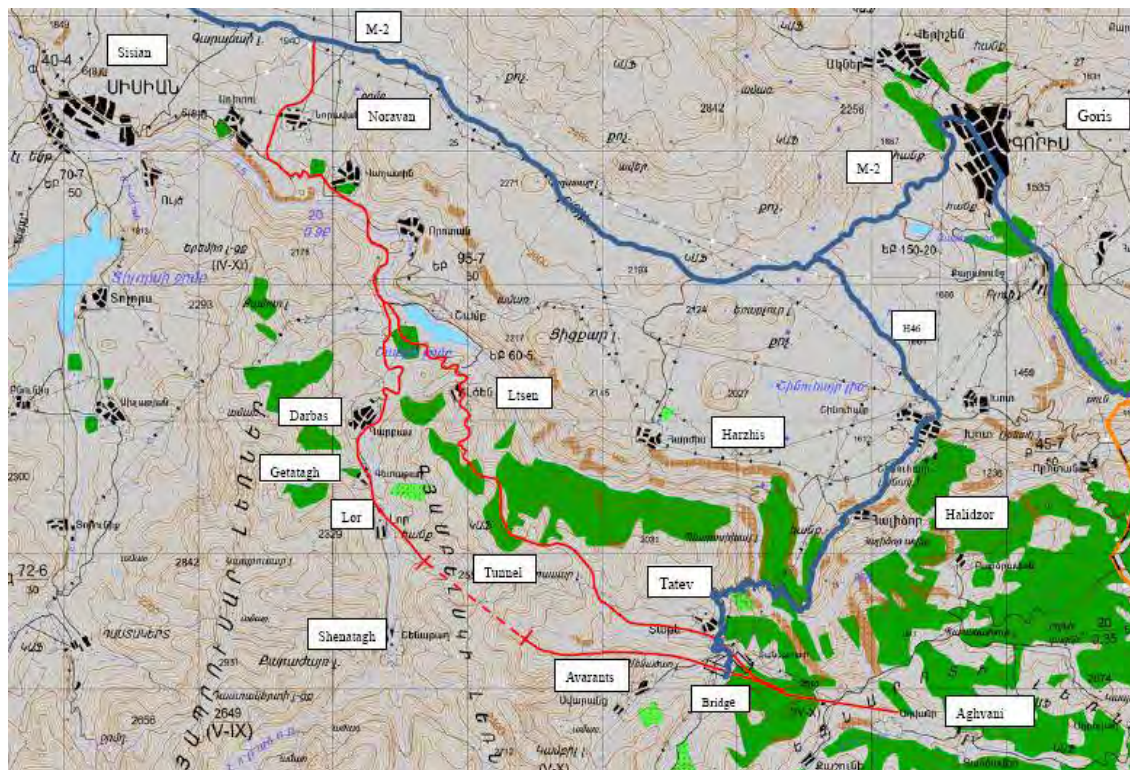


Figure 7-10: Alternative Routes between Tatev and M-2 (Sisian)

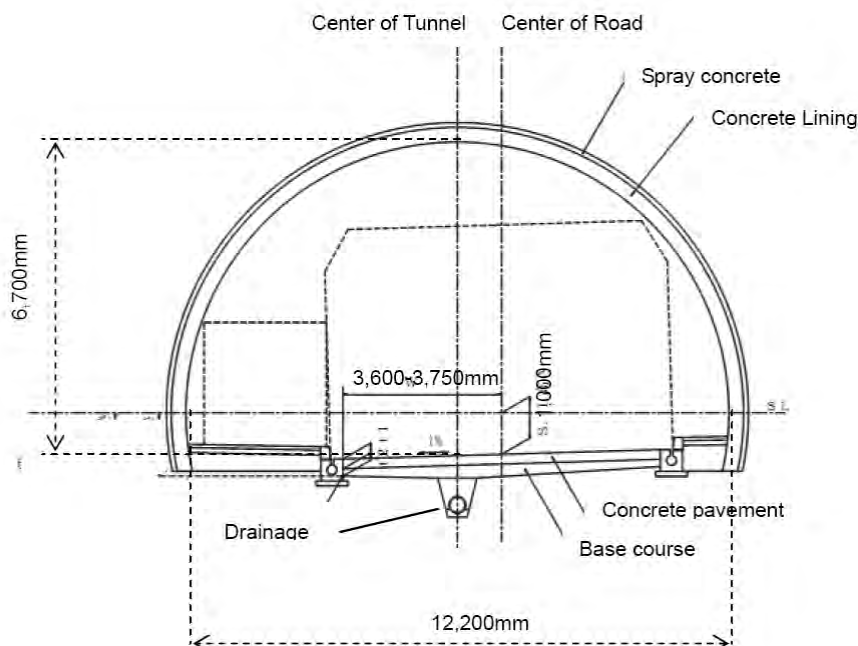


Figure 7-11: Tunnel Cross Section for 2-Lane Carriageway

Option 4: Improve H-46 Tatev/Kapan/Alternative Route Sisian–Tatev

54. This alternative is nearly \$100 million cheaper than the tunnel route, although the alignment is not as good.

7.3 Cost Estimate

55. The cost of the sub project is estimated at \$213 million.

7.4 Environmental Appraisal

Table 7-4: Road Priority, Approximate Length and Environmental Assessment Category – Goris–Kapan

Priority	MFF Tranche	Road Section	Approx. Length (km)	Recommended Environmental Assessment Category	Reason for Consultant Recommendation
3	Future Candidate Tranches	Goris to Kapan	64	A	Biodiverse and Ecologically Sensitive area, plus Forest Reserve

56. The Goris to Kapan Road Section requires in-depth environmental assessment. One of the options for this route is to expand the existing alignment. A second option is to construct a new alignment in the general location of Sisian (3km south of M-2) through Tatev to Kapan. Both options would be through areas rich in biodiversity, rich in cultural history, forest reserves, wildlife reserves, steep hills and rivers but low population density. Under both options, the works would involve many cuts through rock or tunnels, cuts across the faces of hillsides and a number of large and small bridges across pristine streams. Category A and EIA recommended.

Table 7-5: Environmental Features: Goris to Kapan

Road Section: Goris to Kapan Options A and B (A: From Goris South. B: From Sisian South)	
A: From Goris to Kapan (existing route)—Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. From Voratan Plateau the road descends steeply down the face of the plateau to Goris. From Goris South, after passing through its narrow streets, the road continues down the steep valley across small side-streams en-route to the valley floor. It then climbs steep dry hills before descending again to the Voghji River and Kapan.</p> <p>b. The rock type is very mixed with solid rock basalt intrusions and fractured outcrops interspersed with sedimentary deposits and unstable gravel slopes in the north to uplifted sedimentary rock in the south.</p> <p>c. The moist micro-climate in the valleys supports a mixed forest of wide biodiversity and patches of open land covered in vascular flowering plants with small gardens cleared from the surrounding vegetation. Goris Sanctuary located just east and south of the city will soon be incorporated into the much larger planned Voratan National Park. A number of the mammal, fish, amphibian and plant species are rare and threatened; some red-listed.</p> <p>d. The landscape ranges from vertical rock cliffs in the narrow, moist valley to narrow, flat valley floors and steep dry hillsides as one</p>	<p>3, Category A EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ Near streams, rivers and forests. ➤ Where new alignments, cuts or embankments may be required. ➤ Where natural landscapes may be affected. ➤ Near old buildings and historical sites.

proceeds south. e. The valley floors and the lower slopes are used for mixed cropping.	
B: From Sisian to Kapan (alternative route)—Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. South from Sisian, the road descends from the plateau down steep valley sides about 400m to the valley floor and climbs and falls again before reaching Lor at the base of a mountain between it and Tatev (at the same elevation).</p> <p>b. North and south of Tatev, the ROW is narrow with many tight turns as it traverses many steep, unstable sides of valleys. The road runs close to the old stone buildings in all villages that it goes through.</p> <p>c. North of Tatev, the rock type is very mixed with outcrops of fractured basalt interspersed with volcanic tuff and sedimentary deposits. The natural vegetation changes from steppe grassland on the upper slopes to bushes and a large variety of flowering plants along the lower slopes and valley floors.</p> <p>d. South of Tatev, rolling hills are covered in forest and/or grassland.</p> <p>e. North of Tatev there are no special reserves or forests but Vaghatin monastery (11thC), a protected historical site and building sits just 50m from the road. Old villages date back hundreds of years (one small church has 1666 carved into its stone lintel). Human occupancy dates from the pre-historic.</p> <p>f. At Tatev, the monastery dating from the 4thC is the main attraction and nearby there are natural protected areas and monuments.</p> <p>g. Re-alignments will be required at many locations.</p>	<p>3, Category A EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ All villages and historical buildings and their immediate surrounds. ➤ Where new alignments, cuts or embankments may be required. ➤ Where natural landscapes may be affected. ➤ Where irrigated land may be affected.

SECTION 8 H46 KAPAN JUNCTION–IRAN BORDER

8.1 Description

57. This section passes through Kapan and runs west to Kajaran, before turning south across the Kajaran Pass, through Meghri to the Iranian border at Agarak. The average IRI in 2008 was 4.69. An alternative to the M-2 route was provided for strategic reasons with the completion under the Government budget in 2008 of the 91km M-17, Kapan–Tsav–Shranidzor. This is 14km longer than via the M-2. The M-17 average IRI in 2008 was 3.52. Truck drivers advised that it was a more difficult route to drive than the M-2 and it is little used by through traffic. Its ruling gradient is lower than that on the M-2. It crosses the Gomaran Pass 2362m, 127m lower than the M-2 Kajaran Pass.

8.2 Development Strategy

58. Having built an alternative route, it is appropriate to make use of it. This can best be accomplished by routing northbound through traffic (the loaded direction for trucks) onto the new route, with southbound traffic remaining on the M-2. Although both routes would need to function as 2-way, to maintain local access, the split of traffic would improve safety and driving conditions.

8.3 Cost Estimate

59. The cost of the sub project is estimated at \$200 million.

8.4 Environmental Appraisal

Table 8-1: Road Priority, Approximate Length and Environmental Assessment Category – Kapan–Agarak

Priority	MFF Tranche	Road Section	Approx. Length (km)	Recommended Environmental Assessment Category	Reason for Consultant Recommendation
3	Future Candidate Tranches	Kapan to Agarak	87	A	Biodiverse and Ecologically Sensitive area, Plus Forest Reserve

60. The Kapan to Agarak Road Section follows two existing alternative alignments. One alignment was constructed in 2006 through protected forest reserve. When the road was built the MNP obtained a Government Decree instructing road re-alignment but the MOTC obtained a second Decree nullifying the first. The new road section was financed internally under a limited budget. Now it is hardly used because potential road users consider it to be unsafe. The alternative alignment passes up a confined valley, up steep-sided hills and over a high pass before descending. Both options are through areas rich in biodiversity, forest reserves, wildlife reserves, steep hills and rivers but with low population density. Under both options, the works would involve many cuts through rock or tunnels, cuts across the faces of hillsides and a number of large and small bridges across pristine streams. Category A and EIA recommended.

Table 8-2: Environmental Features: Kapan to Agarak

Road Section: Kapan to Agarak (Km 307— 394 from Yerevan) – Two Routes: A and B	
A: Kapan to Meghri via Kajaran—Main Environmental Features	Eco-sensitivity Category (1 to 3) and EA Required
<p>a. Route A (the M-2) ascends 20km up the Kapan Valley to Kajaran and then climbs a steep hill to about 1,800m over Tashtun Pass before descending to the Meghri river at Km-350 and following it to Meghri. The ROW has many tight turns across unstable slopes as it climbs and descends the main ridge. It runs close to buildings in Kapan and Kajaran.</p> <p>b. The climate is arid. The rock type is sedimentary and hill slopes unstable.</p> <p>c. The natural vegetation changes from sparse grassland on the west side of the steep hills to bare upper slopes and sparsely forested lower slopes, particularly on the east facing slopes. The area hosts rich biodiversity and forms part of a trans-national wildlife corridor linking conservation areas in Armenia with those in Iran and Azerbaijan (e.g., the conservations areas: Meghri and Zangezur in Armenia with Marakam–Kiamaki and Arasbaran in Iran).</p> <p>d. Along either route, the road cannot avoid crossing at least one national park or protected area. Three national parks are located across the bottom, or southern 15km of Armenia: Boghakar, Shikagogh and Arevik National Parks. There is also the small, protected area: Planetree Grove.</p> <p>e. South of Meghri to Agarak, the valley floors and irrigated areas along lower slopes are used for intense mixed cropping and orchards on the rich soils.</p>	<p>3, Category A EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ Where new alignments, cuts or embankments may be required. ➤ Where irrigated land may be affected. ➤ Through or near protected forest and national parks. ➤ Where natural landscapes or natural habitat areas may be affected.
B: Kapan to Meghri via Shikagogh Forest—Main Environmental Features	Eco-sensitivity (1 to 3) And EA Required
<p>a. Route B (the M-17) follows a new alignment (2006) south from Kapan. It passes through Shikagogh Forest National Park. The road was poorly designed and built. Its construction caused many landslides and the noise from explosions caused threatened leopards and other mammals to vacate the area. The finished road is little used because the curves are tight and the ROW is narrow. Drivers feel unsafe and use the pre-existing and very inconvenient road rather than the new road which goes south to the Araks River and then turns west to Agarak.</p> <p>b. The natural vegetation is sparse forest on the valley floor and lower slopes, particularly on the east and south-facing slopes. An area of rich biodiversity, it forms part of a trans-national conservation corridor linking conservation areas in Armenia with those in Iran and Azerbaijan (e.g., the conservations areas: Meghri and Zangezur in Armenia with Marakam–Kiamaki and Arasbaran in Iran).</p> <p>c. The road along either route cannot avoid crossing at least one national park.</p> <p>d. Along the Araks River (the border with Iran) the irrigated areas support intense mixed cropping and orchards.</p>	<p>3, Category A EIA</p> <p><u>Key Sites on this road section:</u></p> <ul style="list-style-type: none"> ➤ Where new alignments, cuts or embankments may be required. ➤ Where irrigated land may be affected. ➤ Through or near protected forest, national parks or natural habitat areas.