URS

SEETO Road Route 4 Investment Plan

Technical Options Report - Final

August 2012

Prepared for: Ministry of Transport & Maritime Affairs, Montenegro

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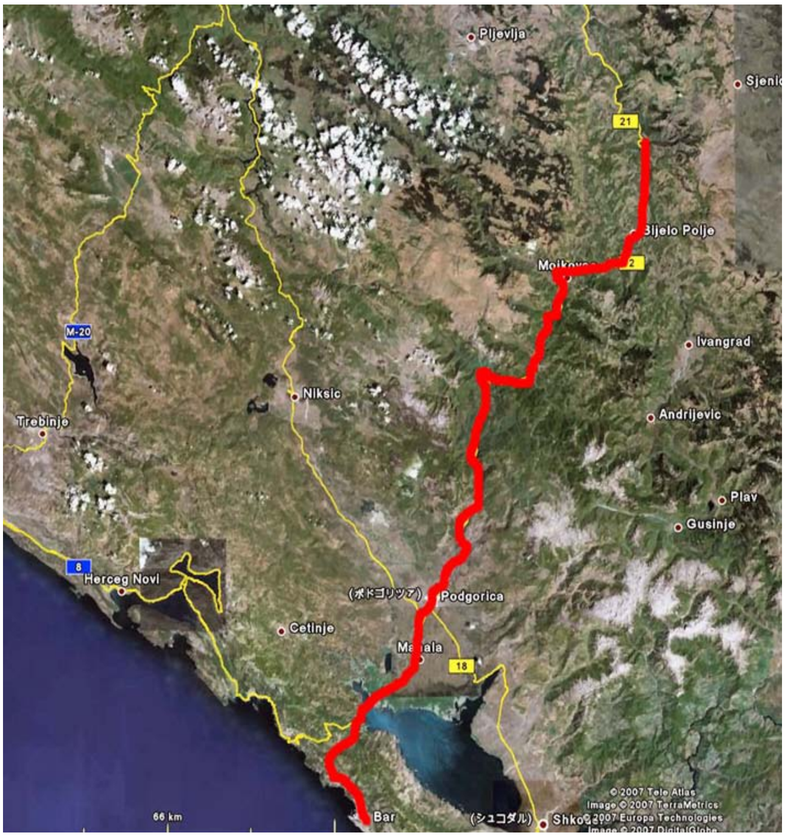

REVISION SCHEDULE					
Rev	**Date**	**Details**	**Prepared by**	**Reviewed by**	**Approved by**
1	July 2012	Draft	George Rutt Project Manager	Martin Edge Project Director	Martin Edge Project Director
2	August 2012	Final	George Rutt Project Manager	Martin Edge Project Director	Martin Edge Project Director

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Acronyms and Abbreviations

SEETO	South East Europe Transport Observatory
AADT	Annual Average Daily Traffic
ATC	Automated Traffic Counts
CAPEX	Capital Expenditure
CEP	Consultation and Engagement Plan
EIA	Environmental Impact Assessment
EIB	European Investment Bank
ESIA	Environmental and Social Impact Assessment
EL	Emergency Lane
ESMP	Environmental and Social Management Plan
EU	European Union
FYROM	Former Yugoslav Republic of Macedonia
GSI	Geological Strength Index
GDP	Gross Domestic Product
HGV	Heavy Goods Vehicle
H&S	Health and Safety
IFC	International Finance Corporation
LGV	Light Goods Vehicle
MoTMA	Ministry of Transport and Maritime Affairs
O&M	Operation and Maintenance
ONR	Old National Road
OPEX	Operational Expenditure
NGO	Non Governmental Organisation
PPP	Public Private Partnership
RSI	Road Side Interviews
SEA	Strategic Environmental Assessment
SIA	Social Impact Assessment
SP	Stated Preference
TEM	Trans European Motorway
TOR	Terms of Reference
VOC	Vehicle Operating Costs
VOT	Value of Time
UNESCO	United Nations Educational, Scientific and Cultural Organisation

1. INTRODUCTION

URS Infrastructure and Environment UK Limited, Systas S.A., TTA S.A. and Omikron Kappa Consulting S.A. were contracted by the Ministry of Transport, Maritime Affairs to develop a route investment plan for the proposed the SEETO Road Route 4. The consultants signed the contract on 5th March with an effective start date of Monday 12th March. An Inception report was delivered on 8th April 2012

In the Inception report the route was assessed and was segmented into sections based on the engineering, traffic, environmental and social importance. For each of these sections the technical options have been studied (including a comprehensive site visit) and a detailed presentation of the thorough screening of these technical options and their relevant merits is presented in detail as text and general design drawings (scale 1:25.000, presented in a separate Appendix) in this Technical Options Report. These options have been carried forward to the Traffic and Economic analysis reports concluding with a tentative investment plan.

Green-field solutions as well improvements to the existing road, where applicable, have been taken into consideration. Every effort has been made to optimise the road alignment with the aim of minimising construction costs and maximizing environmental and social benefits.

The work was carried out by means of desk studies and field visits. Some of the key issues evaluated per road alignment and the basic design process include:

- areas where local improvement of the alignment is feasible and will increase safety
- areas where improvement or widening of the road cross-section is feasible
- deficiencies in works related with signage and safety equipment of the road
- ways to increase safety for traffic passing through settlements or urbanized areas
- problems at intersections or access
- areas where the upgrade of the existing road may or may not be feasible due to technical environmental or social reasons
- the likelihood of phasing of the works, in areas where traffic volumes may dictate it, however considering the constructability at a later stage as well as the need for climbing or overtaking lanes

A detailed presentation of the major geological and geotechnical considerations along the route and their effect on the embankments/cuts of each section and alternative as well as to the major underground structures is also included in this report. The proposed methodology of construction for the major bridges and viaducts along each section and alternative are also part of this report.

The above work yields bill of quantities for all major items of each option that form the basis of the associated cost estimates used in the economic analysis and in the screening process.

1.1. Route segmentation

Further to the proposal of the Inception Report, the segmentation of the route in sections is used as a basis for the generation and assessment of the alternatives. Each section consists of new links as well as links to the existing national road network, which if upgraded/rehabilitated can offer in the short and medium term a more unified and safe road corridor linking the north and south of Montenegro. It is noted that all route alignment alternatives and associated technical options considered are appropriate for a dual carriageway motorway or for the future conversion to a dual carriageway motorway when the traffic needs dictate it.

The segmentation of the route to homogenous sections is shown in Figure 1.1 and has been based on the following classifying attributes:

- terrain morphology of the investigated corridor (various levels; plain, hilly or mountainous conditions)
- present and forecasted traffic demand, as well as various external dependencies (as is the case with sections of the route that are links to new highway projects to neighboring countries)
- type of traffic e.g. using parts of the route as urban by-passes (Podgorica bypass) as well as high percentage of heavy vehicles traffic in certain sections of the route)
- environmental / social restraints which can be more effectively tackled by following alternative route options
- the presence of existing road sections which when properly rehabilitated and upgraded can offer an acceptable single two-way carriageway as a first phase construction of the ultimate dual carriageway motorway

1.2. Existing route

The existing route forms the reference situation or “Do Minimum” alternative in which no investment is made on the road infrastructure other than that necessary to maintain the existing infrastructure to its existing condition. It includes any planned projects of importance to the road network.

In the following sections of this report the Do Minimum alternative, where applicable, is referred to as Alternative 0.

Sections or links to the existing route are included as alternatives in the corridor.

1.3. Alternatives generation

Technical options are generated taking into account the existing alignments or variants of them or new alignments and design standards (cross section, design speed, phasing of the construction), as well as any trade off considerations regarding minor exceptions in the design standards (e.g. longitudinal slope).

1.4. Design Standards

The road alignment design will conform to the standards set down in Annex II of the European Agreement on Main International Traffic Arteries (AGR), of 15 November 1975, these standards were revised and republished under the reference ECE/TRANS/SC.1/384, 14 March 2008.

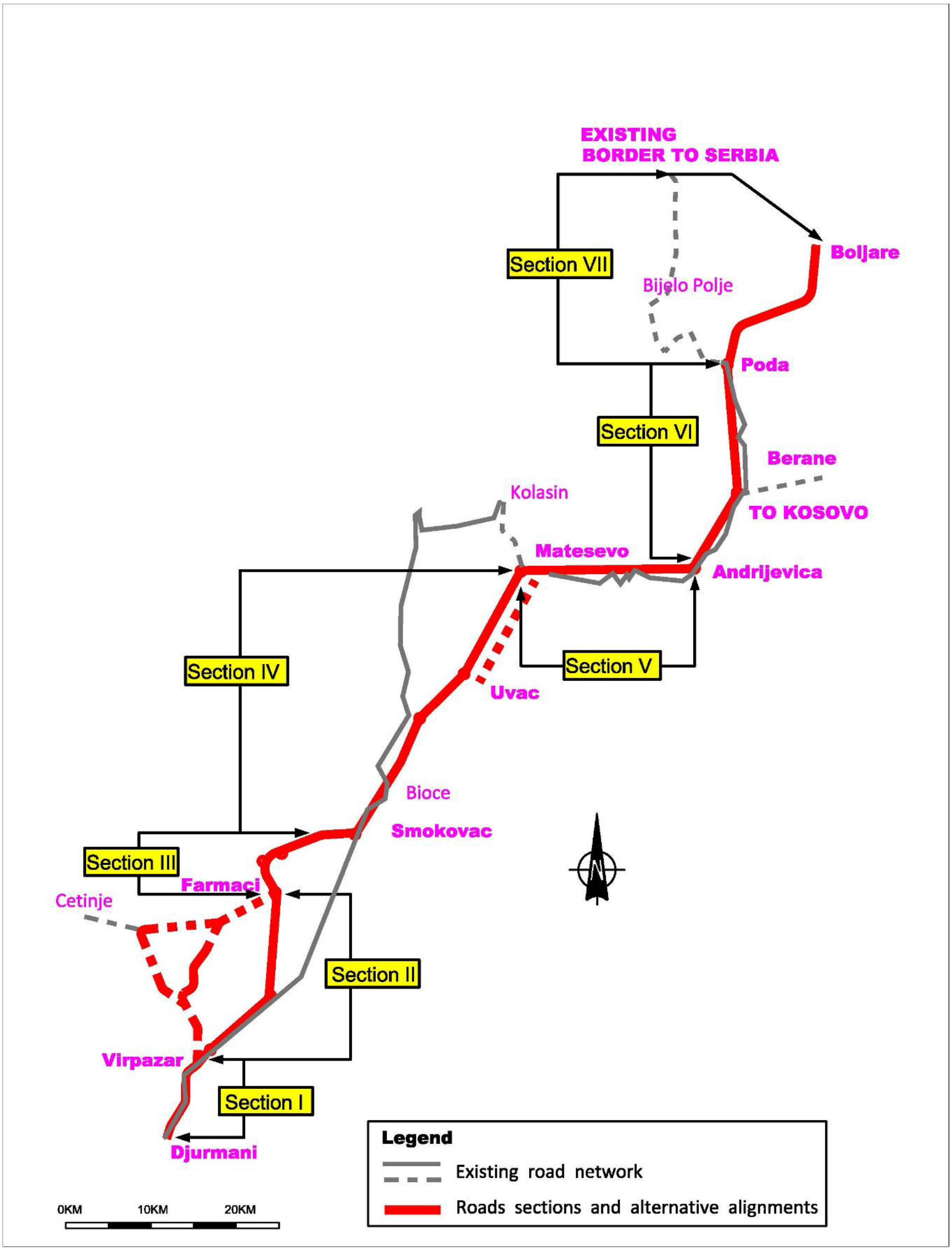

Figure 1.1.: Route segmentation

These standards are best reflected in the published 3rd Edition Standards and Recommended Practice for the UNECE-sponsored Trans-European North-South Motorway (TEM) Project. These standards are commonly used in most countries of Central Europe and the Balkans for the design of new motorways and have incorporated the latest experience, research and development achievements in the field of motorway design, construction and operation as well as newly required safety measures in relation to motorway tunnels.

TEM standards provide the possibility to apply a different design speed to various parts of the road according to terrain configuration. This flexibility permits reduced design parameters where needed to minimize the investment costs.

Table 1.1 on the next pages summarises the values for the various design elements (road geometric characteristics) according to design speeds of 80, 100 and 120 km/hr.

At the present general design stage, the application of standards and the relevant guidelines aims at confirming the project corridor alternatives and the reliability of the estimation of the roadworks quantities. Minor geometric issues such as separation of the carriageway in areas of tunnels and bridges, good range for the ratio of consecutive curves, minimum longitudinal slope for drainage, design consistency for two lane road etc, will be addressed at the next design stage. These issues have been discussed with the Montenegrin design institutes to reassure that there is insignificant impact on the decision making process for the Project Investment Plan as long as the options proposals are technically feasible and the bills of quantity estimates are reliable to the degree that will not obscure the alternatives compared and identification of the preferred option.

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Table1.1 : Motorway Geometric Design Standards (TEM Standards and Recommended Practice, 3rd Edition)

Design Element	Standards	Comments	Standards	Comments	Standards	Comments
Design speed	**80 km/h**		**100 km/h**		**120 km/h**	
Minimum horizontal radius	240 m		450 m		650 m	
Maximum longitudinal gradient	6% absolute max.	6% should be desirable maximum overall wherever possible 1.5% max. for tunnels / bridges longer than 3500 m. 3.0% max. for tunnels / bridges 1000-3500m in length 4.0% max. for tunnels / bridges 500-1000m in length 5.0% max. for tunnels / bridges less than 500m in length	5% absolute max.	5% should be desirable maximum overall wherever possible 1.5% max. for tunnels/bridges longer than 3500 m. 3.0% max. for tunnels/bridges 1000 – 3500 m. in length 4.0% max. for tunnels/bridges 500 – 1000 m. in length 5.0% max. for tunnels/bridges less than 500 m. in length	4% absolute max.	4% should be desirable maximum overall wherever possible 1.5% max. for tunnels/bridges longer than 3500 m. 3.0% max. for tunnels/bridges 1000 – 3500 m. in length 4.0% max. for tunnels/bridges 500 – 1000 m. in length 5.0% max. for tunnels/bridges less than 500 m. in length
Minimum longitudinal gradient	0.3% absolute	0.5% desirable [In excavation cuts and on fill embankments]	0.3% absolute	0.5% desirable [In excavation cuts and on fill embankments]	0.3% absolute	0.5% desirable [In excavation cuts and on fill embankments]
Minimum vertical crest curve	3,000 m absolute	4,500 m. for two-way carriageway [if construction is phased]	6,000 m absolute	10,000 m. for two-way carriageway [if construction is phased]	12,000 m absolute	
Minimum vertical sag curve	2,000 m absolute		3,000 m absolute		4,200 m absolute	
Minimum stopping sight distance	100 m absolute	125 m. preferable wherever possible	150 m absolute	175 m. preferable wherever possible	200 m absolute	250 m. preferable wherever possible
Minimum sight distance for overtaking for two-way carriageway	325 m absolute	475 m desirable	400 m absolute	600 m desirable		

Design Element	Standards	Comments	Standards	Comments	Standards	Comments
Design speed	**80 km/h**		**100 km/h**		**120 km/h**	
Minimum length of climbing lane	800 m. absolute	1,000 m. preferable wherever possible	800 m. absolute	1,000 m. preferable wherever possible	800 m. absolute	1,000 m. preferable wherever possible
Traffic lane width	3.50m. (3.75m.)	par. 1.2.2.9.2. difficult terrain	3.75m. (3.50m.)		3.75m. (3.50m.)	
Climbing lane width	3.50 m.	Also to be provided in tunnels less than 500 m. and on bridges less than 700 m.	3.50 m.	Also to be provided in tunnels less than 500m in length, and on bridges less than 700m in length.	3.50 m.	Also to be provided in tunnels less than 500m in length, and on bridges less than 700m in length
Shoulder (Emergency/ stopping lane) width	See Note 1	See Note 2	See Note 1	See Note 2	See Note 1	See Note 2
Central reserve*	3.00 m. absolute	4.00 m. desirable	3.00 m. absolute	4.00 m. desirable	3.00 m. absolute	4.00 m. desirable
Verge width**	0.5m. min		0.5m. min		0.5m. min	
Outer [right] edge marking line width	0.25 m.		0.25 m.		0.25 m.	
Inner [left] edge marking line width	0.25 m.		0.25 m.		0.25 m.	
Minimum crossfall – traffic lanes	2.5%		2.5%		2.5%	
Maximum crossfall – traffic lanes	7.0%		7.0%		7.0%	

* Central Reservation Area width includes for edge lines of 0.25m each

** A single verge shall be provided on the outer edge of each carriageway.

Note 1:

Shoulder width: 3 m

Emergency Lane (EL): 2.5 m paved plus 0.5 m unpaved

As indicated to TEM cl. 3.2.4 and Fig.3a

Note 2:

In exceptional cases when lay-bys are used instead of EL, the shoulder width must be at least 0.5 m.(TEM cl. 3.2.4)

2. DEFINITION OF ALTERNATIVE ALIGNMENTS

It is apparent through the review of the available data and previous studies on this route that from 2003 a number of alignment alternatives have been considered by consultants and university professionals. The aim was always, irrespective of the justification from the traffic data in the short and medium terms, the construction of a new dual carriageway motorway all along the corridor. It is also evident from the review of the data provided to the Consultant that cost optimisation techniques were not used for the majority of the sections of the route.

This study has paid close attention to the following areas:

- review of various alignments and design standards
- proposition of construction sequences which aim to balance as far as possible the mass haul diagram by optimizing the cut/fill process, reducing the percentage/cost of tunnels and bridges/viaducts and utilizing design standards applicable to the terrain and the expected traffic along the various sections of the route.

For each section the following types of investment alternatives have been taken into consideration:

- upgrade of the existing 2-lane road (with climbing/overtaking lanes and with new 2-lane road improvement, where appropriate)
- widening the existing 2-lane road to 4 lanes (with new 2-lane road improvements, where appropriate)
- a 2-lane road capable of being upgraded to a 4-lane motorway on a new alignment
- a 4-lane motorway on a new alignment

The alternative alignments are described sequentially in the following pages.

2.1. Section I: Djurmani - Virpazar

Alternative I-0: Do minimum alternative

This reference alternative relates to the use of the existing single two-way carriageway as it is (taking into account the necessary maintenance works)

Alternative I-1: Upgrade of the existing single two-way carriageway, including:

- Extra lay-by provision at appropriate places (due to the lack currently of Emergency Lane).
- Lateral configuration and drainage network maintenance works
- Cut slopes repair works where necessary
- Upgrade of the existing Toll Station
- Reconstruction where needed of the surface layer
- Maintenance works to the existing bridges and tunnels where necessary.

Alternative I-2: Construction of the second 2-lane carriageway, as proposed in the Existing Final Study, for the conversion to a full 2x2 lane motorway

Alternative I-3: Construction of the second 2-lane carriageway with a variation of the alignment (compared to Alternative I-2) from Ch 6+079 to Ch 9+321. Alternative I-3 aims to:

- reduce the length of the RAS tunnel at Ch 8+500 by 110 m
- eliminate the need of the two bridges before the RAS tunnel

It should be noted that construction of the second bore of the Sozina tunnel does not necessarily have to coincide with the construction of the “open” 2-lane carriageway of the above Alternatives I-2 and I-3.

Also the implementation of the full 2x2 lane motorway has to take into account the progress of the Adriatic coastal highway.

2.2. Section II: Virpazar - Farmaci

The following alternatives were selected for study.

Alternative II-0: Maintaining the present 2-lane road as it is.

Alternative II-1: Construction of a new 2-lane road (Alt. II-1-a) in a new alignment according to existing preliminary design (east route). The new 2-lane road could be prepared for 4 lanes.(Alt. II-1-b).

Alternative II-2: Construction of: a) a new 2-lane road on a new alignment following the route northwest of Skadar Lake, b) upgrading of existing 2-lane road Farmaci-Cetinje for a length of 8.2km approximately.

The new and the existing 2-lane roads could be prepared for 4 lanes (II-2-b).

An alternative alignment to the west of the Alternative II-2 has been examined; this uses a section of the Farmaci-Cetinje road further to the west. This variant has not been selected for detailed assessment due to the following:

- It is 7 km longer than the previous Alt. II-2
- Existing road to Cetinje has geometrical characteristics that correspond to a design speed less than 80 km/hr
- Interventions and improvement of the existing road will have to tackle serious traffic management problems and risks.
- Realignment or widening of the existing road, due to the difficult terrain morphology, will demand very expensive works and structures

2.3. Section III: Farmaci - Smokovac

Alternatives options for this section took into consideration:

- Alternative alignments examined in the General Design of the section Farmaci-Smokovac (LB and Simm Ing., 2008)
- This section functions as the Podgorica west bypass
- The Adriatic-Ionic highway, that has a common section of ~12 Km with Route 4 (Durmani-Boljare)
- The different views -to some extent- of the Podgorica Municipality and GRD.
- Traffic demand data for the section that justify the need of a 2x2 lane motorway
- The alignment of the variants of the next section Smokovac-Matesevo and the reduction of the length and height of the major bridge that was proposed for the crossing of the Moraca river
- Terms of Reference (TOR) requirements for the Podgorica bypass (single alternative beyond Zelenika hill) and 2x2 lane

According to the above, the following alternatives were selected for further study.

Alternative III-1: Construction of a new 4-lane road in a new alignment and connection with motorway Adriatic-Ionic with I/C at Strganica.

Alternative III-2: Construction of a new 4-lane road in a new alignment and connection with motorway Adriatic-Ionic with I/C at Smokovac.

2.4. Section IV: Smokovac - Matesevo

The reference situation, Alternative IV-0, maintains the present 2-lane road (Smokovac-Kolasin-Matesevo) as it is.

The existing road cannot form part of the upgraded axis, due to its:

- Difficult terrain
- Large number of accesses
- Insufficient geometrical characteristics
- Difficulty in undertaking traffic management during construction

In addition the existing road that will be utilised by local traffic would need to be upgraded in terms of traffic safety equipment (signage and markings).

The following alternatives were selected for further study.

Alternative IV-1: Construction of a new 2-lane road (IV-1-a) on a new alignment The new 2-lane road could be prepared for 4 lanes (IV-1-b). This alternative is compatible with an interchange connecting the two motorways at Smokovac.

Alternative IV-2: Construction of a new 2-lane road (Alt. IV-2-a) on a new alignment. The new 2-lane road could be prepared for 4 lanes (Alt. IV-2-b). This alternative, with the connecting I/C at Strganica, includes an eastern branch (2-lane road) to link the I/C with the existing road and the Podgorica road network at the Smokovac area.

Alternatives IV-1-a and IV-2-b refer to 2-lane roads, this will be examined for the inclusion of “open” 2x2 sections of reasonable cost, that will be proposed for construction from the initial stage and will enhance the safety characteristics.

2.5. Section V: Matesevo – Andrijevica

The reference situation (Alternative V-0) maintains the existing 2-lane road as is.

The existing road, due to its poor geometrical characteristics, cannot form even temporarily a part of the axis. In addition, the existing road that will be used by the local traffic requires upgrading in terms of traffic safety equipment (signing and markings).

The following alternatives were selected for study.

Alternative V-1: Construction of a new 2-lane road (V-1-a) in a new alignment according to existing Design. The new 2-lane road could be prepared for 4 lanes (V-1-b).

Alternative V-2: Variation of the new 2-lane road of Alternative V-1, that will have reduced construction cost.

2.6. Section VI: Andrijevica-Berane-Poda

The following alternatives were selected for study:

Alternative VI-0: Upgrading of the existing 2-lane road including:

- Provision of lay-bys appropriately placed or local widening for the provision of even a rudimentary Emergency Lane
- Junctions improvement
- Asphalt layer reconstruction
- Upgrade of the signage and safety equipment

Alternative VI-1: Construction of a new 2-lane road (VI-1-a) in a new alignment according to an existing design. The new 2-lane road will be prepared for 4 lanes (VI-1-b).

Alternative VI-2: Variation of the new 2-lane road of Alternative VI-1 that will have reduced construction cost. The new 2-lane road could be prepared for 4-lane road (VI-2-b).

Alternative VI-3: Variation of new alignment of the Alternative VI-2 from Ch.3+800 until Ch.6+713.

Alternative VI-4: Variation of new alignment of the Alternative VI-2 from Ch.13+200 until Ch.17+500.

The main issue to tackle in this section is the urban development along the corridor of Berane.

2.7. Section VII Poda - Boljare and Poda - Bijelo Polje - Existing Serbian Borders

The section of motorway inside Serbia has not been finalised yet. To reach the border from Poda, either a new road will be constructed **(Alternatives VII-1, 2 and 3**), or the existing road towards the current Serbian Border (to the north of Bijelo Polje) must continue to serve traffic with best possible road safety conditions and to meet the capacity demands **(Alternatives VII-4)**.

The following alternatives were selected for study.

Alternative VII-1: Construction of a new 2-lane road in a new alignment according to an existing design that will have reduced construction cost. The new 2-lane road could be prepared for 4 lanes (VII-2-b).

Alternative VII-2: Variation of alignment of Alternative VII-1 from Ch.34+000 until Ch.47+000.

Alternative VIII-3: Variation of alignment of Alternative VII-1 from Ch.27+500 until Ch.47+000.

Alternative VII-4-0: Upgrading of existing 2-lane road to the current Serbian Border, including:

- Provision of lay-bys appropriately placed or local widening for the provision of even a rudimentary Emergency Lane
- Junctions improvement
- Asphalt layer reconstruction
- Upgrade of the signage and safety equipment
- Installation of electric lighting wherever required
- Provision, where possible, of an overtaking lane
- Local re-alignment (where this is feasible)
- Slope repair works wherever required
- Provision of works for rock fall protection or avalanche protection

Alternative VII-4-0 includes the already constructed (Stage A') By-pass of Bijelo Polje.

Alternatives VII-4-1 and VII-4-2:

These are variations of a possible new alignment of Alternative VII-4-0 between Ch.6+419 and Ch.32+645 (existing Serbian Border): these alternatives are selected and examined for the case that the construction of the new motorway Poda-Boljare will be delayed.

Alternative VII-4-2 comprises a new alignment of length 5.64km between the 2 sections of existing road. With this alternative (a) the total length of route is reduced by 8.26km and (b) the traffic will no longer pass through Bijelo Polje. This alternative alignment starts at Ch.7+102 of the existing road, ends at Ch.21+000 (end of the recently constructed Bypass of Bijelo Polje) and it requires the construction of a tunnel of length about 2000m.

In order to minimize the tunnel length, it was decided to also examine **Alternative VII-4-1**, which starts at Ch.6+419 of existing road and ends at Ch.12+516 where it links with an existing road. Thereafter this existing road links at about Ch.21+000 of Bijelo Polje Bypass. With this alignment, the resulting new tunnel is about 1200m long, i.e. 800m shorter than Alternative VII-4-2.

3. SCREENING OF ALTERNATIVE ALIGNMENTS

3.1. Introduction

In this section of the Technical Options report the alignment issues of the various alternatives studied and analysed for each Section of the route are presented. The comparison among alternatives focuses on qualitative issues of road characteristics (e.g. speed, gradient, percentage in open road and major structures, disturbance to urban areas, land expropriation and surplus material dumping issues). In addition, the screening takes into consideration route and structural characteristics in terms of:

- length,
- new highway (single 2-lane or dual 2-lane) or widening of existing road,
- characteristics of structural elements (major bridges/viaducts, bridges, overpasses, underpasses, reinforced and/or high embankments, tunnels, culverts) and:
- number of interchanges.

This comparative data are further evaluated and form the basic input to the Cost-Benefit Analysis and prioritization plan.

Cost estimates have been generated for the various alternatives to assist with the screening process, and these are presented in Section 7.

3.2. Section I: Djurmani - Virpazar

The Project starts from the southern entry portal of the already-constructed right branch of the Sozina Tunnel, which is about 4.19km long. After the tunnel exit, a 2-lane road of length about 5km has been constructed and it is now in operation. This road will become the left carriageway of the future 2x2 lane motorway. Today traffic from Podgorica to Bar on this 2 lane road is provided with an additional climbing lane for part of the road.

After the Sozina Tunnel exit, there is a Frontal Toll Station already in operation.

Two bridges have been constructed at Ch.7+830 and Ch.8+100 of lengths 68m and 196m respectively.

Immediately after the bridge at Ch.8+100, the Ras Tunnel left branch of a length of 665m, has been constructed.

The existing 2-lane road ends at about Ch. -3+000 of Section II at the T junction with the road Podgorica-Petrovac.

For this Section I there is an existing Final Study for a 2x2 lane motorway.

As defined in the previous chapter, four alternatives are examined for this Project section. In particular:

- The first two alternatives, I-0 and I-1, maintain the existing 2-lane road. This has been constructed recently
- **Alternative I-2** involves the widening of the existing 2-lane road and addition of a second carriageway for about 9.23km to convert it to a 4-lane motorway, according to the existing Final Study.
- **Alternative I-3** is of a length of 9km, this includes a local variation of Alternative I-2, from Ch.6+079 until Ch.9+321 (separation of the new right carriageway of motorway), this has the following key features:
    - (a) The first section of the new right separated carriageway (serving traffic from Bar to Podgorica) runs downhill with a gradient of 6% compared to 4.70% of the alignment proposed in the existing Final Design. The gradient was increased to 6% in order to lower the carriageway redline across the flat terrain and to replace the two bridges proposed in the existing Final Design with high embankments.
    - (b) At about Ch.7+900 an underpass is proposed for the restoration of the existing local road.
    - (c) In comparison with the existing Final Design, the length of new right branch of Ras Tunnel is reduced by about 110m.
    - (d) This alternative alignment joins with the alignment of the existing Final Design at about Ch.9+125.

Alternative I-3 compared to **Alternative I-2** (existing Final Design):

(a) has smaller construction costs (cancellation of the 2 bridges of total length 370m and reduction of Ras Tunnel length by 110m),

(b) has better horizontal alignment (R=800m instead of R=475m and elimination of the S-curve of the Final Design),

(c) has smaller length by about 230m

(d) needs more expropriations of agricultural land,

(e) will be constructed without obstructing the traffic of the existing 2-lane road, and

(f) has a downhill gradient 6% for a length of about 1000m.

Moreover, **Alternative I-3** requires:

- Assessment of environmental and social impacts, especially for the section of the separated right carriageway of motorway.
- Assessment of constructability of the high embankments replacing the 2 bridges of Final Design as well as of the embankments across short thalwegs. On these locations the construction of reinforced embankments, if feasible, is preferred.
- Geotechnical evaluation for the new Ras Tunnel that is proposed in quite a distance from the existing tunnel.
- Investigation of the risks for the existing 2 lane road that would pose the construction of the new right carriageway in areas of proximity but different level. If such hazards are expected, then either the new carriageway will be relocated further away from the existing road or retaining structures will be constructed along the existing road.

Table 1-1 presents a qualitative comparison of route alternatives of Section I while **Table 1-2** includes their roadworks characteristics.

Alternative I-3 is selected as the preferred option for Section I, Djurmani – Virpazar.

Table 1-2

QUALITATIVE COMPARISON OF THE ALTERNATIVES

No	ISSUE/CHARACTERISTIC	Section I Djurmani-Virpazar	
		Alternatives	
		I-2	I-3
1	Length (m)	9230	9000
2	Horizontal curves number	8	8
3	Percentage of length with speed ≥100km/h	100,00%	80,58%
4	Percentage of length with speed = 80km/h		19,42%
6	Percentage of length with gradient i≤3%	68,86%	70,23%
6	Percentage of length with gradient 3%<i≤5%	31,14%	10,36%
7	Percentage of length with gradient 5%<i≤6%		19,41%
8	Percentage of length with open road	43,47%	47,73%
9	Percentage of length with tunnel	51,57%	51,67%
10	Percentage of length with bridges	4,96%	0,60%
11	Disturbances in urban areas	No	No
12	Occupations/Expropriation in expensive land	No	Few
13	Scale of surplus excavated materials	Small-medium	Small

Table 1-3

II. ROADWORKS CHARACTERISTICS		Unit	Section I Djurmani-Virpazar Alternatives	
			I -2	I -3
1.	**Total length**	m	9.230	9.000
2.	**Road Works open road**			
	a. new highway (4 lanes)	m	-	-
	b. Widening of existing road	m	4.012	4.296
	c. Length of reinforced & high embankments (both sides)	m	430	670
	d. Length of high cuts (both sides)	m		1.765
3.	**Major Bridges - Viaducts (per branch)**			
	number	pcs	-	-
	length	m	-	-
	width	m	-	-
	surface	m2	0	0
4.	**Bridges (per branch)**			
	number	pcs	6	3
	length	m	458	54
	width	m	13,85	13,85
	surface	m2	6.343	748
5.	**Overpasses**			
	number	pcs	1	1
	length	m	80	80
	width	m	10,00	10,00
	surface	m2	800	800
6.	**Underpasses**			
	number	pcs	2	3
	length	m	80	120
	width	m	10,00	10,00
	surface	m2	800	1.200
7.	**Tunnel (per bore)**			
	number	pcs	2	2
	length	m	4.760	4.650
8.	**Culverts**	pcs		
	number	pcs	9	10
	length	m	450	500
9.	**Hydraulic Arrangements**			
	stream regulation	m	0	0
	river revetment	m	0	0
10.	**Interchanges (major/connecting 2 motorways)**	pcs	0	0
11.	**Other Interchanges**	pcs	0	0
12.	**Tolls**	pcs	1	1
13.	**Length of roadworks for routine maintenance**	m	4.410	4.410

3.3. Section II: Virpazar - Farmaci

An existing design was available for this project section, it examined a route close to the existing Old National Road (O.N.R.), which passes through Lake Skadar as well as through swamp areas **(Alternative II-1).**

Another alternative alignment was examined: this follows a new north-west route. This **Alternative II-2** has the following characteristics:

- Bypasses the Skadar environmentally sensitive area in an optimal way,
- avoids the swamp area,
- does not affect the existing land uses and activities,
- has reliable construction costs,
- does not affect the traffic of the existing O.N.R.,
- utilises a 8.20km long section of the existing road Farmaci-Cetinje,
- reduces the route length and travel time to Cetinje

Alternative II-1 (east route) presented on drawings RDG SYS II 001 and 002, has the following key features:

- The alignment is 26.30km long and starts at Ch.10+100 of Alternative I-2 coinciding with Ch.9+870 of Alternative I-3 of Section I.
- An interchange is proposed at about Ch.-1+300 in order to connect the new motorway with the existing local road network.

  This interchange is located inside the swamp area and very close (about 250m) to the entry portal of the first tunnel.
- In the first section Ch. -3+541 - Ch.2+000 the motorway runs along the uphill western side of the existing O.N.R. and the Railway line. This section has 4 successive tunnels for the motorway passage through the foothills of the massif.
- After the exit of the fourth tunnel, an approximately 1300m long bridge is required where the motorway passes over the existing O.N.R. & railroad and then over Lake Skadar. The bridge is followed by an approximately 1460m long tunnel that runs through Mountain Vranjina. After the tunnel and up to Ch.7+000, the motorway lies on swampy terrain.
- Then the motorway crosses again the O.N.R. & railroad via a second bridge (160m long) at about Ch.9+000, and afterwards it passes over River Moraca via a 250m long bridge at about Ch.9+500.
- In section Ch.11+000 - Ch.20+000 the motorway passes through difficult mountainous terrain on the western side of River Moraca, resulting to many high cuts and embankments. Also, at about Ch.18+400 a very long and high bridge will have to be constructed. The horizontal alignment of the motorway consists of successive S-bends.
- At the end of this section, the motorway comprises an S-bend with radii R=450m and R=500m, and it meets Farmaci Interchange.

- Due to constructability reasons, the section from Ch.-3+541 until Ch.7+000 (bridge over the lake, tunnels before and after the bridge, swamp areas) will have to be constructed from the outset (first stage) as a full 2x2 lane motorway.

Alternative II-2 (north-west route), which is presented on the drawings RDG SYS II 003 and 004, has the following key features:

- It has the same starting point as Alternative II-1 and it is 28.30km long, i.e. 2km longer than Alternative II-1.
- An interchange is proposed at about Ch.1+100 in order to connect the new motorway with the existing local road network in the area of Virpazar.
- From Ch.2+000 to Ch.7+000 the motorway passes through the mountains via two tunnels of length about 2.25km and 1.14km.
- From Ch.7+000 to Ch.8+700 the motorway runs along the existing hill and on some locations there will be high cuts and embankments.
- In section Ch.8+700 - Ch.13+000 the motorway runs along hills and at about Ch.9+000 a 465m long tunnel is predicted for passing through the mountain there. In general, along the open sections of motorway there will be high cuts and embankments.
- In the next section Ch.13+000-Ch.15+000 the motorway crosses over the western edge of Lake Skadar via two bridges of big span and height.
- In section Ch.15+000-Ch.19+750 the motorway passes through a relatively gentle terrain and then joins the existing road Farmaci-Cetinje. This existing 2-lane road will be upgraded to become the new motorway. In particular:
  (a) The existing road will be widened and converted to a 2x2 lane motorway.
  (b) In section Ch.23+000-Ch.27+000, the horizontal alignment of the existing road will be improved if the topographical survey data reveal that such improvements and adjustments are necessary in order to tackle any geometric deviations from Standards and to adjust onto the land uses - activities along the new motorway.
  (c) At about Ch.19+320 an interchange will be constructed to connect the motorway with the existing road heading towards Cetinje and Budva.
  (d) New local roads will be constructed wherever required to restore the access to properties.
  (e) New overpasses/underpasses will be constructed wherever required to restore the link of the 2 areas either side of motorway.
- Farmaci Interchange is located at the end of section.

Table 2-1 presents the qualitative comparison of alternatives, and **Table 2-2** includes their roadworks characteristics.

Alternative II-2 is selected as the preferred option for Section II, Virpazor to Farmaci.

Table 2-1

QUALITATIVE COMPARISON OF THE ALTERNATIVES

No	ISSUE/CHARACTERISTIC	Section II Virpazar-Farmaci	
		Alternatives	
		II-1	II-2
1	Length (m)	26303	28295*
2	Horizontal curves number	24	34
3	Percentage of length with speed ≥100km/h	100%	81,37%
4	Percentage of length with speed = 80km/h	0%	18,63%
5	Percentage of length with gradient i≤3%	88,32%	57,80%
6	Percentage of length with gradient 3%<i≤5%	11,68%	23,84%
7	Percentage of length with gradient 5%<i≤6%	0%	18,37%
8	Percentage of length with elevation h<400m	100%	100%
9	Percentage of length with open road	77,34%	79,91%
10	Percentage of length with tunnel	12,58%	14,54%
11	Percentage of length with bridges	10,08%	5,55%
12	Disturbances in urban areas	Many	No
13	Occupations/Expropriation in expensive land	Many	No
14	Scale of surplus excavated materials	Medium-small	Medium
15	Scale of borrow materials	Medium	No
	* Alternative II-2 consists of about 20km new alignment and 8km widening/upgrade of existing 2-lane road into 4-lane motorway		

Table 2-2

II. ROADWORKS CHARACTERISTICS		Unit	Section II Virpazar-Farmaci	
			Alternatives	
			II -1	II -2
1.	**Total length**	m	26.303	28.295
2.	**Road Works open road**			
	a. new highway (4 lanes)	m	20.343	22.580
	b. Widening of existing road	m	-	-
	c. Length of reinforced & high emb/ents (both sides)	m	3.140	3.000
	d. Length of high cuts (both sides)	m	3.100	1.940
3.	**Major Bridges - Viaducts (per branch)**			
	number	pcs	2	2
	length	m	2.600	1.600
	width	m	13,85	13,85
	surface	m2	36.010	22.160
4.	**Bridges (per branch)**			
	number	pcs	28	10
	length	m	2.700	1.540
	width	m	13,85	13,85
	surface	m2	37.395	21.329
5.	**Overpasses**			
	number	pcs	1	3
	length	m	60	180
	width	m	10,00	10,00
	surface	m2	600	1.800
6.	**Underpasses**			
	number	pcs	7	9
	length	m	280	360
	width	m	10,00	10,00
	surface	m2	2.800	3.600
7.	**Tunnel (per bore)**			
	number	pcs	10	6
	length	m	6.620	8.290
8.	**Culverts**	pcs		
	number	pcs	47	43
	length	m	2.350	2.150
9.	**Hydraulic Arrangements**			
	stream regulation	m	0	0
	river revetment	m	0	0
10.	**Interchanges (major/connecting 2 motorways)**	pcs	0	0
11.	**Other Interchanges**	pcs	3	3
12.	**Tolls**	pcs	0	0
13.	**Length of roadworks for routine maintenance**	m	0	0

3.4. Section III: Farmaci - Smokovac

For this section (western bypass of Podgorica) existing design documentation is available, which has examined various alternative alignments.

In the study period the Consultant received plan drawings from the Study of Adriatic-Ionic Highway which concluded that the alignment proposed in this design is the preferred solution for this highway as it has taken into account the design constraints arising from the existing Urban Plan of the city of Podgorica, development plans and social impacts. This is **Alternative III-1**.

The Urban Plan of the City of Podgorica confirmed that:

- In the section from Farmaci until Zelenika Hill the alignment is compatible to the recently received drawing.
- After Ch.61+346 a variant of this alignment has been examined (**Alternative III-2**). This is described below.

In the area of Farmaci the alignment joins with Alternatives II-1 and II-2 of previous Section II.

Farmaci Interchange location depends on the alternative that will be selected for Section II.

Taking into account the requirements of TOR as well as the data we received for Adriatic - Ionic Highway, it is concluded that for the section from Farmaci (Ch.47+617) until Strganica (Ch.61+346) there can be only one feasible alignment.

For the next section after Ch.61+346, two alternatives were examined that would modify the alignment of the Existing Design. These alternatives:

- minimise the span of the bridge at about Ch.60+800
- cancel the 400m long bridge at about Ch.61+500
- minimise the spans and heights of the bridges of Strganica Interchange (connection of the 2 highways)
- minimise the impacts on the semi-urban area.

Alternative III-2 has the following key features:

- The interchange connecting Route 4 with Adriatic - Ionic Highway is predicted in Smokovac (instead of Strganica as in Alternative III-1).
- This interchange (in Smokovac) stretches inside an urban area and on difficult terrain, and therefore it will impose significant impacts.
- If **Alternative III-2** is selected, then it must be necessarily followed by Alternative IV-1 of the next Section IV.
- The new motorway results to demolition of the buildings at about Ch. 63+200, 63+600, 64+280, 64+440, 64+880, 65+100, 65+660.
- The new alignment damages the landscape of Licine hill, which is directly visible from the capital city of Podgorica.
- The new motorway has high embankments at its proximity with River Moraca (Ch.65+200-Ch.65+600).

- After the construction of Adriatic - Ionic Highway, the capital city of Podgorica and O.N.R. will have no direct connection with the Route 4.

Alternative III-1 has the following key features:

- The interchange connecting Route 4 with Adriatic - Ionic Highway is predicted in Strganica (instead of Smokovac of Alternative III-2).
- An interchange of simple layout and a new 2-lane road (of length about 2.50km) are predicted so that, until the completion of Adriatic-Ionic Highway, the ONR and Podgorica can connect directly with Route 4.
- **Alternative III-1** cancels the pre-mentioned disadvantages of Alternative III-2 in the section from Ch.63+200 (area of Strganica) until Ch.66+000 (Smokovac).
- **Alternative III-1** follows a northern route and is more favourable than Alternative III-2 in terms of

  (a) length (Alternative III-1 is 1.80km shorter),

  (b) construction costs,

  (c) cost of expropriations (Alternative III-1 passes through an area with less expensive land)

  (d) impacts on existing land uses

Alternatives III-1 and III-2 require the following:

- Assessment of environmental and social impacts
- Assessment of conditions for the foundation of embankments, especially in the area of Strganica
- Assessment of the geotechnical conditions in the areas of the 2 tunnels and bridges
- Further detailed design of alignments (mainly concerning the longitudinal profile) in the sections of Route 4 connecting with Adriatic - Ionic Highway where expensive major interchanges are proposed for future construction.
- Provision of reliable, as possible, technical data (horizontal alignment, longitudinal profile, locations and layouts of interchanges, etc).

Table 3-1 presents the qualitative comparison of alternatives, and **Table 3-2** includes their roadworks characteristics.

Alternative III-1 is selected as the preferred option for Section III, Farmaci to Strganica.

Table 3-1

QUALITATIVE COMPARISON OF THE ALTERNATIVES FROM FARMACI (CH 48+938) TO STRGANICA (CH 61+346)

NB : In this section, Alternatives III-1 & III-2 are identical (they are different after Strganica Interchange)

No	ISSUE/CHARACTERISTIC	Section III Farmaci-Strganica Alternatives III-1 & III-2
1	Length (m)	12409
2	Horizontal curves number	13
3	Percentage of length with speed ≥ 100km/h	100,00%
4	Percentage of length with gradient i≤3%	94,58%
5	Percentage of length with gradient 3%<i≤5%	5,42%
6	Percentage of length with elevation h<400m	100,00%
7	Percentage of length with open road	76,39%
8	Percentage of length with tunnel	17,33%
9	Percentage of length with bridges	6,29%
10	Disturbances in urban areas	Many
11	Occupations/Expropriation in expensive land	Many
12	Scale of surplus excavated materials	Small
13	Scale of borrow materials	Medium

Table 3-2

II. ROADWORKS CHARACTERISTICS		Unit	Section III Farmaci-Smokovac	
			Alternatives	
			III -1	III -2
1.	**Total length**	m	12.408	17.462
2.	**Road Works open road**			
	a. new highway (4 lanes)	m	9.478	14.482
	b. Widening of existing road	m	-	-
	c. Length of reinforced & high emb/nts (both	m	1.590	2.780
	d. Length of high cuts (both sides)	m	950	2.100
3.	**Major Bridges - Viaducts (per branch)**			
	number	pcs	2	2
	length	m	720	720
	width	m	13,85	13,85
	surface	m2	9.972	9.972
4.	**Bridges (per branch)**			
	number	pcs	4	5
	length	m	840	940
	width	m	13,85	13,85
	surface	m2	11.634	13.019
5.	**Overpasses**			
	number	pcs	1	2
	length	m	60	120
	width	m	10,00	10,00
	surface	m2	600	1.200
6.	**Underpasses**			
	number	pcs	3	5
	length	m	120	200
	width	m	10,00	10,00
	surface	m2	1.200	2.000
7.	**Tunnel (per bore)**			
	number	pcs	4	4
	length	m	4.300	4.300
8.	**Culverts**	pcs		
	number	pcs	25	38
	length	m	1.250	1.900
9.	**Hydraulic Arrangements**			
	stream regulation	m	0	0
	river revetment	m	0	0
10.	**Interchanges (major/connecting 2 motorways)**	pcs	0	0
11.	**Other Interchanges**	pcs	2	3
12.	**Tolls**	pcs	0	0
13.	**Length of roadworks for routine maintenance**	m	0	0

3.5. Section IV: Strganica (Smokovac) - Matesevo

For this Project section there is existing Design documentation available. These Design documents have examined many alternative alignments because of the difficult geomorphology difficulties of the section.

Alternatives of the existing Design documentation include the following key features:

- The redline of motorway starts at elevation 75m in the area of Smokovac, it reaches elevation 1160m at about Ch.30+000 and then the motorway runs downhill across the valley of Uvac with its redline elevation decreasing to about 1010m.
- The motorway passage through the valley of Moraca River is accomplished via bridges of large spans and heights (according to the existing Preliminary Design, in the area of Bioce the predicted bridge is 1000m long and 200m high).
- The harsh morphology and the requirement to comply with the maximum allowable gradients of the longitudinal profile resulted to many tunnels and bridges (there are some alternatives whose tunnels and bridges comprise to 59% of the total length).
- The harsh morphology makes the construction of interchanges almost impossible due to their cost.
- The starting point of alternatives is highly dependent on the alignment of Adriatic-Ionic Highway and on the location of its major interchange in the area of Strganica-Smokovac.

Taking into account the above issues, two alternatives have been selected for evaluation. **Alternative IV-1** has the major interchange (connecting Route 4 with Adriatic-Ionic Highway) in Smokovac and **Alternative IV-2** places this interchange in Strganica.

Alternative IV-1 (interchange in Smokovac) is presented in drawings RDG SYS IV 001 & 002 and has the following key features:

- Alignment starts from the area of Strganica, at Ch.61+346 of Alternative III-2. (so that alternative lengths are comparable). The route until Matesevo has total length of 45.93km (40.88km+5.05km of Alternative III-2-ii as shown on Figure 2).
- The first section Ch.61+346-Ch.66+400 of Alternative III-2 (about 5.05km long) has been already described in the previous paragraph.
- In the next section from Ch.0+000 (coincides with Ch.66+400 of Alternative III-2) until Ch.5+500, the motorway runs along the southern slopes of Vezesnik hill, following a route parallel to Moraca River, the railroad and the Old National Road (O.N.R.). This section includes 3 tunnels of large length and the major interchange that connects the two motorways is located in Smokovac. This interchange
    - will create significant impacts in the adjacent area,
    - does not provide direct connection of O.N.R. and capital city Podgorica with the new motorway of Route 4,
    - stretches in a harsh geomorphological area, together with the railroad, Moraca River and the existing development,
    - will consist of long and high bridges, thus deteriorating the landscape there,

- will create significant impacts imposed on traffic during construction,
- requires the construction from the outset - first stage - of a part of Adriatic-Ionic Highway to connect Podgorica and O.N.R. with the new motorway of Route 4. These highly expensive roadworks will further increase the costs of Stage A construction.

A temporary interchange must be constructed and operate until the full construction of Adriatic-Ionic Highway. This interchange, which is necessary for connecting Podgorica and O.N.R. with the new motorway of Route 4, will be expensive and it will create obstructions imposed on the existing land uses.

- Section Ch.5+500 - Ch.8+000 includes
  - a 370m long and 70m high bridge across the valley of Moraca River (compared to the 1000m long and 200m high bridge predicted by the Existing Preliminary Design), and
  - 2 other bridges that are about 400m and 350m long.
- In section Ch.8+000 - Ch.33+853:
  - The motorway passes through mountainous terrain that is particularly harsh on some locations (e.g. from Ch.12+000 until Ch.13+000).
  - For about 12km the longitudinal profile has a constant uphill gradient of 6%.
  - The motorway passes through terrains that have high altitudes (250m~1170m).
  - The alignment includes one very long tunnel (L≈4.20km) and 5 tunnels of much smaller length, as well as 5 bridges with relatively large spans.
- In the last section it is proposed to modify the alignment of the Existing Preliminary Design, from Ch.33+853 ≡ Ch.0+000 (Uvac) until Ch.6+908 (Matesevo).

  In comparison with Preliminary Design, the new alignment proposed in the current design:
  - reduces the total length of tunnels by about 7080m (2 tunnels of total length 970m compared with 14 tunnels of total length 8046m of Preliminary Design),
  - increases the total length of bridges by about 370m,
  - requires borrow materials for embankments and therefore it significantly reduces the deposits of excavated materials,
  - has lower maintenance and operational costs as a result of the reduction of tunnels length, and
  - Is friendlier to the road users as a result of the reduction of tunnels length.

Alternative IV-2 presented on drawing RDG SYS VI 003 (interchange in Strganica) starts from Ch.61+346 in Strganica area and at Ch.70+100 ≡ Ch.5+370 it connects with Alternative IV-1. After this connections point, the 2 alternatives are identical.

In comparison with **Alternative IV-1, Alternative IV-2** has the following key advantages:

- The motorway follows a route to the north of Strganica Interchange and it passes through an area that is not visible from Podgorica.
- The alignment is 1.80km shorter than Alternative IV-1.

- The alignment has only one tunnel of length 3.2km (compared with the 3 tunnels of Alternative IV-1, with same total length 3.2km).
- The alignment avoids the valley of Moraca, the O.N.R. and the railroad.
- Strganica Interchange (connecting Adriatic-Ionic Highway with Route 4) stretches in flat terrain and therefore it is less costly than the interchange of Alternative IV-1.

In the area of Bioce, both alternatives have the same bridge over Moraca valley.

Table 4-1 presents the qualitative comparison of alternatives and **Table 4-2** includes their roadwork characteristics.

Alternative IV-2 is selected as the preferred option for Section IV, Strganica – Matesevo.

Table 4-1

QUALITATIVE COMPARISON OF THE ALTERNATIVES

No	ISSUE/CHARACTERISTIC	Section IV Strganica (Smokovac) - Matesevo	
		Alternatives	
		III-2(ii) + IV-1	IV-2
1	Length (m)	45931	44145
2	Horizontal curves number	44	42
3	Percentage of length with speed ≥100km/h	65,42%	58,48%
4	Percentage of length with speed = 80km/h	34,58%	41,52%
5	Percentage of length with gradient i≤3%	59,04%	48,95%
6	Percentage of length with gradient 3%<i≤5%	6,39%	9,54%
7	Percentage of length with gradient 5%<i≤6%	34,58%	41,51%
8	Percentage of length with elevation h<400m	33,85%	31,17%
9	Percentage of length with elevation 400m<h<700m	10,89%	11,33%
10	Percentage of length with elevation 700m<h<1000m	11,56%	12,03%
11	Percentage of length with elevation h>1000m	43,70%	45,47%
12	Percentage of length with open road	68,95%	69,74%
13	Percentage of length with tunnel	21,12%	19,93%
14	Percentage of length with bridges	9,93%	10,33%
15	Disturbances in urban areas	Few	No
16	Occupations/Expropriation in expensive land	Yes	No
17	Scale of surplus excavated materials	Very large	Very large

Table 4-2

II. ROADWORKS CHARACTERISTICS		Unit	Section IV Smokovac-Matesevo	
			Alternatives	
			IV -1+III-2(ii)	IV -2
1.	**Total length**	m	45.931	44.145
2.	**Road Works open road**			
	a. new highway (4 lanes)	m	31.621	30.785
	b. Widening of existing road	m	-	-
	c. Length of reinforced & high emb/nts (both	m	3.880	4.710
	d. Length of high cuts (both sides)	m	6.020	6.040
3.	**Major Bridges - Viaducts (per branch)**			
	number	pcs	2	2
	length	m	740	740
	width	m	13,85	13,85
	surface	m2	10.249	10.249
4.	**Bridges (per branch)**			
	number	pcs	37	36
	length	m	8.480	8.380
	width	m	13,85	13,85
	surface	m2	117.448	116.063
5.	**Overpasses**			
	number	pcs	4	4
	length	m	240	240
	width	m	10,00	10,00
	surface	m2	2.400	2.400
6.	**Underpasses**			
	number	pcs	9	9
	length	m	360	360
	width	m	10,00	10,00
	surface	m2	3.600	3.600
7.	**Tunnel (per bore)**			
	number	pcs	22	24
	length	m	19.400	17.600
8.	**Culverts**	pcs		
	number	pcs	82	85
	length	m	4.100	4.250
9.	**Hydraulic Arrangements**			
	stream regulation	m	0	0
	river revetment	m	0	0
10.	**Interchanges (major/connecting 2 motorways)**	pcs	0	0
11.	**Other Interchanges**	pcs	2	2
12.	**Tolls**	pcs	0	0
13.	**Length of roadworks for routine maintenance**	m	0	0

3.6. Section V: Matesevo - Andrijevica

For this Project section there is Existing Design documentation available. This documentation examined alternative alignments. The major feature is that the motorway passage is across the mountain (with elevation of 1200m) located between Matesevo (elevation of 1010m) and Andrijevica (elevation of 730m).

The two alternatives presented in the drawings include the following key features:

- Start from Ch.6+908 of previous Section IV and are about 24km long.
- An approximately 3600m long tunnel is predicted for the motorway passage through the mountain located at about Ch.13+000.
- The alignments pass through harsh geomorphological areas with relatively high elevations.
- Bridges and high embankments are predicted across the valleys
- High cuts and tunnels are predicted along the existing hillsides.
- Two interchanges are predicted for Matesevo and Andrijevica.

Alternative V-1 (presented on the drawings RDG SYS V 001 and 002)

- It starts from Matesevo Interchange and it is 24.05km long.
- It passes through the first hillside (at about Ch.1+300) via a tunnel of length of about 690m.
- Then and up to the highest terrain point, 4 tunnels of small length and 6 bridges are proposed.
- Then a very long tunnel (L=3.6km) is predicted at the highest terrain point (altitude of 1200m).
- After this tunnel, the motorway runs downhill towards Andrijevica and it includes
    - 2 tunnels of small length
    - 4 bridges relatively low
    - 6 bridges relatively high

Alternative V-2 (presented on the drawings RDG SYS V 003 and 004)

- It starts from Matesevo Interchange and it is 24km long.
- It passes through the first hillside via a 530m long tunnel.
- In the next section and until the highest terrain point, it includes
    - 2 tunnels of small length
    - 4 segments with high cuts (tunnels may be required if the geotechnical conditions are adverse)
    - one bridge only
    - high embankments across 5 five thalwegs
- Then a very long tunnel (L=3.5km) is predicted at the highest terrain point (altitude 1200m).
- After this tunnel, the motorway runs downhill towards Andrijevica and it includes

- 3 segments with high cuts
- a low bridge
- 5 relatively high bridges
- a 1.2km long segment (at about Ch.22+500) with gradient 5.70% (this specific gradient is applied in order to reduce the height of embankments and to avoid a long bridge).

Section V has harsh geomorphology and rather high terrain elevation and therefore the two alternatives examined are essentially equivalent. The two alignments will be finalised in the next design stage, based on reliable topographical and geotechnical data.

Table 5-1 presents the qualitative comparison of alternatives, and **Table 5-2** includes their roadworks characteristics.

Alternative V-1 is selected as the preferred option for Section V, Matesevo to Andrijevica

Table 5-1

QUALITATIVE COMPARISON OF THE ALTERNATIVES

No	ISSUE/CHARACTERISTIC	Section V Matesevo-Andrijevica	
		Alternatives	
		V-1	V-2
1	Length (m)	24050	24000
2	Horizontal curves number	21	19
3	Percentage of length with speed ≥100km/h	100%	96%
4	Percentage of length with speed = 80km/h	0%	4%
5	Percentage of length with gradient i≤3%	53%	53%
6	Percentage of length with gradient 3%<i≤5%	47%	43%
7	Percentage of length with gradient 5%<i≤6%	0%	4%
8	Percentage of length with elevation 700m<h<1000m	26,5%	27,0%
9	Percentage of length with elevation h>1000m	73,5%	73%
10	Percentage of length with open road	71,1%	73,5%
11	Percentage of length with tunnel	20,7%	19,0%
12	Percentage of length with bridges	8,2%	7,5%
13	Disturbances in urban areas	No	No
14	Occupations/Expropriation in expensive land	No	No
15	Scale of surplus excavated materials	Large	Large
16	Scale of borrow materials	Medium	Medium

Table 5-2

II. ROADWORKS CHARACTERISTICS		Unit	Section V Matesevo-Andrijevica	
			Alternatives	
			V -1	V -2
1.	**Total length**	m	24.048	24.000
2.	**Road Works open road**			
	a. new highway (4 lanes)	m	17.091	17.633
	b. Widening of existing road	m	-	-
	c. Length of reinforced & high emb/nts (both	m	4.900	4.880
	d. Length of high cuts (both sides)	m	3.900	3.890
3.	**Major Bridges - Viaducts (per branch)**			
	number	pcs	2	2
	length	m	1.520	1.380
	width	m	13,85	13,85
	surface	m2	21.052	19.113
4.	**Bridges (per branch)**			
	number	pcs	15	15
	length	m	2.455	2.255
	width	m	13,85	13,85
	surface	m2	34.002	31.232
5.	**Overpasses**			
	number	pcs	-	-
	length	m	-	-
	width	m	-	-
	surface	m2	0	0
6.	**Underpasses**			
	number	pcs	5	5
	length	m	200	200
	width	m	10,00	10,00
	surface	m2	2.000	2.000
7.	**Tunnel (per bore)**			
	number	pcs	10	8
	length	m	9.940	9.100
8.	**Culverts**	pcs		
	number	pcs	67	67
	length	m	3.350	3.350
9.	**Hydraulic Arrangements**			
	stream regulation	m	0	0
	river revetment	m	0	0
10.	**Interchanges (major/connecting 2 motorways)**	pcs	0	0
11.	**Other Interchanges**	pcs	2	2
12.	**Tolls**	pcs	0	0
13.	**Length of roadworks for routine maintenance**	m	0	0

3.7. Section VI: Andrijevica - Poda

For this Project section existing design documentation is available. The key features include:

(a) urban constraints for 6km along the area of Berane (Ch.8+000~Ch.14+000)

(b) harsh geomorphology of the 2 segments before and after Berane, of a total length of 20km.

The alternatives presented on the drawings have the following key features:

- The alignments begin at the northern area of Andrijevica and are about 26km long.
- In the first section Ch.0+000-Ch.8+000 the alignments are set out considering the following constraints:
  - River Lim
  - existing road Andrijevica - Berane
  - scattered urban development
  - harsh geomorphology on the western side of existing road
- In the next section Ch.8+000-Ch.14+000, the alignments are defined mainly by the existing urban area, the fixed location of Berane Interchange and the existing airport.
- In the last section, from Ch.14+000 until Poda, the alignments are defined mainly by the relatively harsh morphology.

Alternative VI-1 is the same as the existing Design.

Alternative VI-2 (presented on drawings RDG SYS VI 001~002) generally follows the same route as Alternative VI-1 but it has the following variations:

- According to the Existing Design, in section Ch.0+000-Ch.8+000 the motorway crosses River Lim at 4 locations, it moves very close to the river and elsewhere it is placed onto the existing road. This alignment results to 4 bridges over the river, protection works for the motorway, revetment of the river and very long restorations of the existing road. On the contrary, Alternative VI-2 cancels the above roadworks because the motorway is now situated between the river and the existing road.
- In the section Ch.4+200-Ch.5+500 Alternative VI-2 follows a route to the west of existing road and it passes across the mountain via a 750m long tunnel. This modification of alignment cancels the demolition of buildings.
- In section Ch.13+750-Ch.17+000 Alternative VI-2 moves further to the east of Alternative VI-1 by applying a curve of radius R=500m and then a straight until the exit portal of tunnel. This modification is proposed for better adjustment of the motorway onto the existing terrain.

Alternative VI-3 (drawing RDG SYS VI 003) is the variation of Alternative VI-2 from Ch.3+800 until Ch.6+713. This variation improves the motorway geometry and it minimises the interferences with the existing road and the river.

Alternative VI-4 (drawing RDG SYS VI 004) is the variation of Alternative VI-2 from Ch.13+200 until Ch.17+500. This variation

- cancels high bridges
- minimises the deterioration of landscape

- improves the motorway geometry
- avoids high cuts and high embankments

Table 6-1 presents the qualitative comparison of alternatives, and **Table 6-2** includes their roadworks characteristics.

Alternative VI-4 is selected as the preferred option for Section VI, Andrijevica to Poda

Table 6-1

QUALITATIVE COMPARISON OF THE ALTERNATIVES

No	ISSUE/CHARACTERISTIC	Section VI Andrijevica-Berane-Poda		
		Alternatives		
		VI-2	VI-3	VI-4
1	Length (m)	26183	26070	25680
2	Horizontal curves number	21	20	20
3	Percentage of length with speed ≥100km/h	100%	100%	100%
4	Percentage of length with gradient i≤3%	83%	83%	84%
5	Percentage of length with gradient 3%<i≤5%	17%	17%	16%
6	Percentage of length with elevation 400m<h<700m	40%	40%	41%
7	Percentage of length with elevation 700m<h<1000m	60%	60%	59%
8	Percentage of length with open road	86%	86%	83%
9	Percentage of length with tunnel	12%	12%	16%
10	Percentage of length with bridges	2%	2%	1%
11	Disturbances in urban areas	Yes	Yes	Yes
12	Occupations/Expropriation in expensive land	Yes	Yes	Yes
13	Scale of surplus excavated materials	Medium	Medium	Medium

Table 6-2

II. ROADWORKS CHARACTERISTICS		Unit	Section VI Andrijevica - Poda			
			Alternatives			
			VI -1	VI -2	VI -3	VI -4
1.	**Total length**	m	26.220	26.183	26.069	25.680
2.	**Road Works open road**					
	a. new highway (4 lanes)	m	22.970	22.553	22.389	21.260
	b. Widening of existing road	m	-	-	-	-
	c. Length of reinforced & high emb/nts (both	m		2.680	2.680	1.860
	d. Length of high cuts (both sides)	m		2.320	2.500	1.570
3.	**Major Bridges - Viaducts (per branch)**					
	number	pcs	-	-	-	-
	length	m				
	width	m	-	-	-	-
	surface	m2	0	0	0	0
4.	**Bridges (per branch)**					
	number	pcs	28	4	4	2
	length	m	1.760	860	860	440
	width	m	13,85	13,85	13,85	13,85
	surface	m2	24.376	11.911	11.911	6.094
5.	**Overpasses**					
	number	pcs	-	2	2	2
	length	m	-	120	120	120
	width	m	-	10,00	10,00	10,00
	surface	m2	0	1.200	1.200	1.200
6.	**Underpasses**					
	number	pcs	-	13	13	13
	length	m	-	520	520	520
	width	m	-	10,00	10,00	10,00
	surface	m2	0	5.200	5.200	5.200
7.	**Tunnel (per bore)**					
	number	pcs	8	8	8	8
	length	m	4.740	6.400	6.500	8.400
8.	**Culverts**	pcs				
	number	pcs	29	30	30	27
	length	m	1.450	1.500	1.500	1.350
9.	**Hydraulic Arrangements**					
	stream regulation	m	0	0	0	0
	river revetment	m	0	0	0	0
10.	**Interchanges (major/connecting 2 motorways)**	pcs	0	0	0	0
11.	**Other Interchanges**	pcs	1	2	2	2
12.	**Tolls**	pcs	0	0	0	0
13.	**Length of roadworks for routine maintenance**	m	27.400	27.400	27.400	27.400

3.8. Section VII: Poda - Boljare and Poda - Bijelo Polje - Existing Serbian Border checkpoint

3.8.1. Poda - Boljare

For this Project section, review and optimisation of the existing designs generated the following Alternatives. These alternative alignments were set out taking account of the following design parameters:

(a) End of the motorway in the area of Boljare (new Serbian Border checkpoint) where the Serbian part of the motorway is expected to reach.

(b) Harsh geomorphology

(c) Elevation difference between the start (~ +620m) and end (~ +1270m).

Alternative VII-1 (presented on drawings RDG SYS VII 001 and 002):

- is 25.30km long
- in the first section from Ch.27+500 until Ch.42+328 (High Point):
  - the redline of motorway starts at 625m and ends at 1224m
  - the longitudinal profile of motorway runs uphill along the whole section
  - on 2 segments (of length 9.14km and 2.07km) the longitudinal gradient is 5%
  - a 700m long tunnel is predicted along a segment with gradient 5%
  - four bridges are predicted
  - there are many segments with relatively high cuts and embankments
- in the last section from the High Point (Ch.42+328) until Boljare:
  - the motorway has good horizontal alignment (minimum radius R=800m)
  - on 3 segments of length 2.07km, 2.36km and 1.00km, the gradient is greater than 5%.
  - a 450m long tunnel and a 100m long bridge are predicted
  - there are many segments with high cuts and embankments

Alternative VII-2 (presented on drawings RDG SYS VII 003 and 004):

- is the variation of Alternative VII-1 from Ch.34+000 until Ch.47+000.
- is 30.62km long, i.e. it is 5.33km shorter than Alternative VII-1.
- has better longitudinal profile than Alternative VII-1 (gradient 5% on one segment of length 4.21km and on 2 segments of length 1km and 0.8km the gradient is greater than 5%).
- is not essentially different from Alternative VII-1, as far as tunnels and bridges are concerned.

Alternative VII-3 (presented on drawings RDG SYS VII 005 and 006):

- is the variation of Alternative VII-1 from Ch.27+500 until Ch.47+000.
- has almost the same length as Alternative VII-1.
- Its gradients are worse than those of Alternative VII-1.
- has bigger length of tunnels.

Section VII-1 is selected as the preferred option for Section VII, Poda to Boljare.

3.8.2. Poda - Bijelo Polje - Existing Serbian Border checkpoint

Alternatives VII-4 are selected and examined herein for the case that the construction of new section Poda-Boljare will be delayed. With these alternatives and via the existing road, the new motorway will end at the existing Serbian Border checkpoint, to the north of Bijelo Polje.

The alternatives examined herein are:

- **VII-4-0**: It follows the route of the existing road
- **VII-4-1**: It follows the route of the existing road and it also includes a new alignment, which is about 6.10km long from Ch.6+419 (Zaton area) until Ch.12+516 where it adjusts onto an existing urban road.
- **VII-4-2**: It follows the route of existing road and it also includes a new alignment, which is about 5.64km long from Ch.7+102 until Ch.21+000 of the existing road.

These Alternatives are presented on drawing RDG SYS VII 007.

Alternative VII-4-0

- This follows the route of the existing road that is 32.65km long.
- The existing road has 2 traffic lanes and no emergency lanes.
- It passes through the difficult segment along the canyon of River Lim (length of 3.95km) and then it runs through the broad urban - commercial corridor of Bijelo Polje (length of 11.25km).
- It follows the recently constructed Bypass of Bijelo Polje, which is 4.80km long (Ch.16+650-Ch.21+450).

Below follows the detailed description of the key features of the existing route and the feasibility - constructability of upgrading / widening the existing road.

The road has one traffic lane per direction, it does not have emergency lanes and in general its longitudinal profile has gentle gradients. According to the morphology and the nature of activities developed along the route, the existing road can be divided into the following 3 sections:

<u>Section 1: Ch.0+000-Ch.9+500 (L=9.50km)</u>

This is an existing road that has good geometry and passes through settlements and agricultural areas on hilly-flat terrain. The road runs through Slatina, Brestovik, Pasika Polje & Zaton and it has several at-grade junctions with local & agricultural roads.

The horizontal alignment of existing road consists of 28 curves; 7 curves have radii R=150m~200m and 21 curves have radii R≥250m.

Concerning longitudinal profile, the road has gentle gradients and generally it runs on embankments. On some locations of the right side, there are cuts of relatively medium height.

In the 3 areas Ch.3+500-Ch.4+100, Ch.5+300-Ch.5+900 and Ch.8+700-Ch.9+000, the road runs through settlements where houses and other buildings lie close to both edgelines of the road, thus not allowing the widening of road. The other segments of road do not impose any significant limitations for widening.

Section 2: Ch.9+500-Ch.13+450, Ribarevine (L=3.95km)

This is an existing road that runs through the canyon of River Lim. At the end (area of Ribarevine) the road crosses over the river (via a bridge) and it connects (via an at-grade roundabout) with the existing road Kolasin-Mojkovac-Bijelo Polje.

In this section the road has the following problems of operation and traffic safety:

i. Along the left edgeline of road, which mainly lies on high embankments, the existing safety guardrails are old and in some areas they are damaged and not replaced. Also there are several areas without guardrails which are necessary.

ii. Along the right edgeline of road, which has cuts, the side formations are not adequate and in general the road imposes hazards on traffic. In particular:

   - The cuts slopes are unstable & close to the road platform and in many areas there is no space available between the road edgeline and the toe of cuts for accommodating the rockfalls. Moreover, some areas have supporting walls but these are old, need to be repaired and in general they fail withholding the rockfalls.

     Note also that the start and end of these walls are not protected with safety guardrails and therefore the walls impose significant risks for the passive safety of motorists.

   - Concentrated rainwater stands still on some parts of the lateral drainage gutter, and also there are some areas with no gutters at all. In general, the existing infrastructure does not guarantee effective collection and removal of the rainwater coming from road platform and external basins.

iii. There are no lay-bys on the right side of road (i.e. for the traffic stream heading to Bijelo Polje).

iv. The bridge over River Lim has only pedestrian fences and it does not have safety guardrails for vehicles.

For this 4km long section of existing road, any upgrade roadworks (e.g. provision of Emergency Lanes, new structures for withholding (intercepting the rockfalls, new longitudinal drainage system, etc) require widening of the existing road but this is particularly difficult due to the following reasons:

i. Existing traffic cannot be served during the construction of new roadworks. Any temporary interruption of traffic is not feasible because it will cut off the link of the settlements with Bijelo Polje and the link of the south-west area of Kosovo with Serbia.

ii. The geomorphology of this particular road section is rather difficult. On the right side there are high cuts (being unstable on some locations) accompanied with some supporting walls, and the left side includes River Lim with intense vegetation and retaining walls.

In addition to the problems identified above, the high construction costs for widening the current road must also be evaluated. If the existing road is widened towards the side of river, significant roadworks and structures will arise such as cantilever semi-bridges, walls with piles, reinforced embankments, etc). Yet again if the road is widened towards its right upgrade side, then the resulting roadworks will still be significant and costly (cuts of big height and volume, significant stabilization works for the cuts slopes, risks of landslides, etc).

Section 3: Ch.13+450-Ch.32+650 (L=19.20km)

1. In the first segment Ch.13+450 - Ch.16+650 (length 3.20km) the road has urban character since it enters the city of Bijelo Polje. Houses and commercial buildings lie along both edgelines of road, thus not allowing widening of the road. Sidewalks and electric lighting poles lie along almost the whole right edgeline of road.

2. At about Ch.16+650 there is an at-grade T-type intersection that connects the road with the beginning of the recently constructed Bypass of the city centre. The Bypass is about 4.80km long, it consists of one traffic lane per direction & sidewalks along both edgelines and it does not have Emergency Lanes.

   The Bypass (along which supplementary roadworks are still being carried out as it was revealed on our recent site visit there) ends at about Ch.21+450 where there is an at-grade T-type intersection with the road Bijelo Polje - Existing Serbian Border.

   The major constructed roadworks/structures of the Bypass are:

   i. Eight (8) at-grade intersections (5 T-junctions and 3 crossroads, i.e. 4-leg junctions).
   ii. High retaining and supporting walls.
   iii. Two bridges over River Lim and 3 bridges over draining lines.
   iv. One overpass of transverse local road.
   v. Speed limit signs of 50km/h and signs indicating the pedestrian crossings on the road platform (level crossings).
   vi. Lateral drain inlets (gulleys), which however extend further inside the road platform and therefore they impose hazards for the traffic.

   Along both edgelines of Bypass there are houses having direct access to the road via special configurations of the lateral sidewalks (i.e. in front of the houses, the typical height of curbs is lowered down to the level of platform).

   The horizontal alignment of Bypass has successive S-curves and the worst segment is Ch.19+000 until Ch.21+450 where small radii had been applied (R=150m, 200m and 250m). Similarly, the longitudinal profile has successive sag/crest curves (about 2 curves every kilometre). Many vertical crest curves, in conjunction with the horizontal curves, limit the sight distance posing risks to the motorists.

   Moreover, in the areas of cuts and supporting walls there is evident lack of longitudinal drainage works (such as external continuity ditches) that however are required in order to intercept the rainwater of external basins and to protect the road platform against it.

   Taking account of

   - the level pedestrian crossings,
   - the small width of road,
   - the poor geometry of road,
   - the existence of many junctions, and
   - the existence of many entries-exits of the roadside houses

it is concluded that in the near future the Bypass will not be able to satisfactorily serve the through-traffic North-South with a acceptable Level of Service and with the appropriate level of safety.

3. In its last segment (of length 11.20km) the existing road starts from the end of Bypass, it passes through settlements and ends at the first frontier checkpoint at about Ch.32+645. The existing railroad runs parallel to the road, on the upgrade area, and at about Ch.29+670 the railroad passes over the road via an Overbridge.

   In the segment Ch.21+450 - Ch.24+700 (L≈3.25km) the road passes through an urban area. Houses and other buildings lie very close to both edgelines of road thus not allowing widening the road.

   In the next segment Ch.24+700 - Ch.27+400 (L≈2.70km) the road passes through Sutivan. Along the right edgeline of road there are buildings and electric lighting poles. On the left side, there is free space available between the road edgeline and the railroad, and this space can be utilised in order to provide an additional lane.

   In segment Ch.27+400 - Ch.29+670 (L≈2.27km), where the road passes through a small settlement, it is feasible to widen the road across both its edgelines in order to provide additional lanes.

   In the last segment Ch.29+670 - Ch.32+645 (L≈2.97km) along its left side the road has cuts & some local supporting walls, on its right edgeline there are high embankments and on some location retaining walls. Along the right edgeline of road there are several areas with no safety guardrails that however are needed. Also the beginning and end of the left supporting walls are not protected with guardrails and therefore these walls impose hazards for the passive safety of motorists. In this segment it is rather difficult to widen the existing road due to difficulties of traffic maintenance during construction, adverse geomorphology and existing walls.

Alternative VII-4-2

- This is 24.40km long and it consists of

  (a) 2 sections of existing road of total length 18.80km, and

  (b) a new alignment of length 5.60km between the 2 existing road sections

- It is 8.26km shorter than Alternative VII-4-0.
- The new alignment starts at Ch.7+102 of existing road (Alternative VII-4-0), it follows a new northwest route passing through the mountain via an approximately 2000m long tunnel and it ends at Ch.21+000 of existing road (end of Bijelo Polje Bypass).
- This new alignment will have motorway-like characteristics in terms of geometry and cross-section and also cancels the existing route through Lim canyon and Bijelo Polje. Therefore this new road will offer better Level of Service and safety conditions to the through North - South traffic.
- The construction of the new road will affect local agricultural traffic only, in comparison with the upgrade roadworks on the existing road (Alternative VII-4-0) that will create serious impacts on urban & through traffic as well as on the commercial activities aside the existing road.
- The new road can be converted into full 4-lane motorway if required in the future (e.g. in case the completion of new Frontier checkpoint in Boljare is delayed too long, or if the traffic demand dictates it).

Alternative VII-4-1

It was decided to examine this alternative in order to minimise the length of the new tunnel of Alternative VII-4-2.

The new road starts at Ch.6+419 of existing road and ends at Ch.12+516 where it connects with an existing urban road. Then this urban road connects with Bijelo Polje Bypass at about Ch.21+000.

The resulting new tunnel is about 1200m long, i.e. 800m shorter than the tunnel of Alternative VII-4-2.

The further investigation of Alternative VII-4-1 requires the Montenegro State to provide the Consultant with the Design of "Stage B" of Bijelo Polje Bypass. If Stage B predicts that the Bypass will extend further to the north (by 1650m at least), then Alternative VII-4-1 would be the preferred alignment because it has shorter tunnel (1.20km vs 2.00km of Alt VII-4-2), shorter route and less impacts on the inhabited environment than Alternative VII-4-2)

Table 7-1 presents the qualitative comparison of alternatives, and Table **7-2** includes their roadworks characteristics.

Alterntive VII-4-1 is selected as the preferred option for Section VII, Poda to Bijelo Polje to the existing Serbia Border Checkpoint.

Table 7-1

QUALITATIVE COMPARISON OF THE ALTERNATIVES

No	ISSUE/CHARACTERISTIC	Section VII Poda - Boljare and Poda - Bijelo Polje - Serbian Borders		
		Alternatives		
		VII-1	VII-2	VII-3
1	Length (m)	25285	30625	25234
2	Horizontal curves number	17	20	13
3	Percentage of length with speed ≥100km/h	83,52%	94,09%	67,18%
4	Percentage of length with speed = 80km/h	16,48%	5,91%	14,15%
5	Percentage of length with speed <80km/h	0%	0%	18,67%
6	Percentage of length with gradient i≤3%	26,56%	45,52%	42,10%
7	Percentage of length with gradient 3%<i≤5%	56,96%	48,57%	25,09%
8	Percentage of length with gradient 5%<i≤6%	16,48%	5,91%	14,14%
9	Percentage of length with gradient i>6%	0%	0%	18,67%
10	Percentage of length with elevation 400m<h<700m	11,13%	9,19%	9,93%
11	Percentage of length with elevation 700m<h<1000	23,73%	27,18%	21,81%
12	Percentage of length with elevation h>1000m	65,14%	63,63%	68,26%
13	Percentage of length with open road	92,21%	95,63%	86,53%
14	Percentage of length with tunnel	4,55%	1,89%	10,03%
15	Percentage of length with bridges	3,24%	2,48%	3,44%
16	Disturbances in urban areas	No	No	No
17	Occupations/Expropriation in expensive land	No	No	No
18	Scale of surplus excavated materials	Small	Small	Large
19	Scale of borrow materials	Medium	Medium	No

Table 7-2

II. ROADWORKS CHARACTERISTICS		Unit	Section VII Poda - Serbian Borders		
			Alternatives		
			VII -1	VII -2	VII -3
1.	**Total length**	m	25.286	30.626	25.319
2.	**Road Works open road**				
	a. new highway (4 lanes)	m	23.316	29.286	21.919
	b. Widening of existing road	m	-	-	-
	c. Length of reinforced & high embank/nts (both	m	3.340	4.310	1.890
	d. Length of high cuts (both sides)	m	1.660	1.900	3.290
3.	**Major Bridges - Viaducts (per branch)**				
	number	pcs	-	-	-
	length	m			
	width	m	-	-	-
	surface	m2	0	0	0
4.	**Bridges (per branch)**				
	number	pcs	10	14	8
	length	m	1.640	1.520	1.740
	width	m	13,85	13,85	13,85
	surface	m2	22.714	21.052	24.099
5.	**Overpasses**				
	number	pcs	4	6	3
	length	m	240	360	180
	width	m	10,00	10,00	10,00
	surface	m2	2.400	3.600	1.800
6.	**Underpasses**				
	number	pcs	8	10	7
	length	m	320	400	280
	width	m	10,00	10,00	10,00
	surface	m2	3.200	4.000	2.800
7.	**Tunnel (per bore)**				
	number	pcs	4	4	10
	length	m	2.300	1.160	5.060
8.	**Culverts**	pcs			
	number	pcs	74	88	64
	length	m	3.700	4.400	3.200
9.	**Hydraulic Arrangements**				
	stream regulation	m	0	0	0
	river revetment	m	0	0	0
10.	**Interchanges (major/connecting 2 motorways)**	pcs	0	0	0
11.	**Other Interchanges**	pcs	1	1	1
12.	**Tolls**	pcs	0	0	0
13.	**Length of roadworks for routine maintenance**	m	0	0	0

4. GEOLOGICAL/GEOTECHNICAL CONSIDERATIONS

All available data referenced in the Terms of Reference has been reviewed. In addition we have considered information available in the geological mapping and undertaken several site inspections, walk-over surveys and geological reconnaissance at the study areas. Consequently, the main geological features along the various alternative alignments were identified.

Furthermore, any specific geological features that could pose risks to the project or increase its cost e.g. landslides, instabilities, phreatic water table, soil formations susceptible to liquefaction, formations with poor geotechnical properties were identified. The experience gained over the last years by the design of various projects in the broader area and specifically in Montenegro was also taken into account.

This section of the Technical Options report focuses to the earthworks and the tunnels of the various alternative alignments along all sections sections of the Motorway.

4.1. General Geology – Geomorphology of Montenegro

The geological structure of the wider territory of Montenegro is a result of the influence of several factors like the sedimentation and geodynamics within this part of Mediterranean geosyncline, the underthrusting of African tectonic plate under the Eurasian one, the intensive neotectonic movements and the forming of expressed exogenous relief. That is why the project area is characterized not only by different lithostratigraphic content and complex tectonic structure, but also by unique geomorphologic, engineering geological, hydrogeological and seismotectonic conditions.

Dinarides

Montenegro belongs to the Dinarides mountain chain where Paleozoic crystalline schist and Middle and Upper Triassic limestone are distinguished. The main part of Montenegro consists of limestone formations, covered by diabase-chert formations. The Dinarides formation is characterized by greater or smaller over-troughs of magmatic rocks and ultramaphites. Referring to its structure, the following two areas are distinguished: area of the Earth's crust compression (wide coastal belt in Montenegro, with numerous napes) and the area of the Earth's crust opening (the rest part, with numerous horsts and trenches, as well as confining neo-tectonic faults). In the Dinarides the predominant topographic type in terrains of carbonate rocks is karst. Karst forms in exposed limestones are particularly well developed in Montenegro. Prokletije, Durmitor and other high mountains have preserved relics of a glacial topography; cirques, troughs, moraines, formed during the Pleistocene. The Dinarides consist predominantly of crushed and karstified Mesozoic limestones. This world famous karst region greatly differs in hydrogeology and geomorphology from the neighbouring regions. Groundwater flows through extended systems of karst channels and fractures.

Karst of Montenegro

Over two-thirds of the territory of Montenegro belongs to the karst of south-eastern Dinarides. The karst in Montenegro differs along the territory, by its distribution, position, its occurrences (various forms and dimensions) and processes. This comes as a consequence of diverse sedimentation conditions, as well as different geologic evolution of individual parts of the Dinaric geosyncline (both in space and time). A segment of the Dinaric geosyncline which forms the terrain of Montenegro is predominantly (on two thirds of the territory) built up of limestone and dolomite sediments (from

Devonian to the nowadays). Since the end of Devonian period (ending phase of Caledonian orogeny) it has been uplifted and lowered by numerous phases of Hercynian and Alpine orogeny. Due to epeirogenic and orogenic movements in different geological times, since the end of the Devonian period to the final uplifting of Dinaric geosyncline, when the present territory of Montenegro (end of Middle Miocene) has been formed, some parts of the geosyncline bottom have been uplifted and lowered. This caused favourable conditions for sedimentation of different products, among which were dominant those who have formed limestones and dolomites of great thickness and distribution. It is easily noticeable that the epeirogenic and orogenic movements have been advancing from north-east to south-west. The climate was also variable, but mostly favourable for the development of karstification. Simultaneously with these movements, particularly during the Laramidian orogeny (Upper Cretaceous - Lower Paleogene), the folding, faulting, over-thrusting and even movements which caused creating of napes occurred. As a result, the rock porosity increased, favouring the karstification process and forming today's karst - a geological product of very complex occurrences and processes.

With the aim to present the most important properties of the Montenegrin karst, its complexity as well as the characteristic differences of individual parts of the territory, karst zoning was carried out. The most logical way to do this was to identify the karstic properties of the individual geotectonic units of Dinarides, which built up the territory of Montenegro. Therefore, the properties of the Durmitor Overthrust, the High-Karst Zone, the Pindus-Cukali Zone (in the territory of Montenegro Budva-Bar Zone) and the Adriatic-Ionian fold System (in the territory of Montenegro Adriatic fold System) are presented.

The most common and the most often cited names for geotectonic units of Dinarides have been deliberately kept. Parts of the Dinaric geosyncline, which formed rocks in general and by this the karst in the territory of Montenegro, had different and specific geologic evolutions. Subsequently, on the terrains of cited geotectonic units, specific karsts with present properties and appearance developed. With development of the karstification processes the karst differences of the geotectonic units became smaller. This characteristic is notable in the karst of Montenegro.

Karst of the Durmitor nape, although spacious (over 5.000 km^2) and several kilometres thick, with large aquifers, is divided into several regions among which are significant karst of northern and north-western Montenegro, karst of Bjelasica and karst of north-eastern Montenegro. Due to the presence of Late Palaeozoic and Lower Triassic clayey-marly-sandy beds, Middle Triassic eruptive rocks and Middle and Upper Jurassic diabase-chert formation rocks, karst in these regions does not represent a unique entity. Karst of these regions has the characteristic of holokarst. The limestones and dolomites of these regions are the oldest ones and they have been exposed to karstification for the longest period. The karstified limestones and dolomites of this geotectonic unit, although mutually separated, build up the largest and the highest mountain massifs in Montenegro.

Although there are canyons deeper than 1000 m, the karstification of limestone and dolomites of this geotectonic unit proceeds and descends deeper than fluvial erosion. Karst of this geotectonic unit is characterized by fluvial erosion (deep canyons), glacier erosion and lacustrine erosion. As a result, karst of this geotectonic unit, apart from characteristics common to holokarst, has properties of high-mountain, fluvial, glacial and contact karst.

In the territory of Montenegro, the High-Karst Zone has the greatest extent. The terrain of this geotectonic unit is mainly built up of Mesozoic (Triassic, Jurassic and Cretaceous) limestones and dolomites of several kilometres of thickness. This thickness is even larger, due to the reverse faulting and overthrusting and thus repeating of carbonate series. The karst of this region is characterised by all surface occurrences and all processes characteristic for holokarst. Within the karst of this geotectonic unit exist syncline regions build up of impermeable flysch beds.

The layers of Durmitor flysch of the uppermost north-eastern parts of this geotectonic unit have various hydrogeological features and functions. In the terrains built up of clayey-marly-sandy beds and at lower elevations, such as the valley of Vrbnica and Gornja Moraca, the layers of Durmitor flysch are impermeable and represent a boundary. In the terrains built up of varied limestones, comprising narrow zone and located at the height of over 1.000 m, as in the case of south-western slopes of the Durmitor massif, they represent a water permeable medium. It is interesting to mention that the deepest cave (897 m) in the territory of Montenegro explored by speleologists is located in these rocks. The middle belt of High-Karst Zone in the territory of Montenegro is built up of Upper Cretaceous-Paleogene flysch beds. The distribution, position and impermeable conditions cause this flysch to have a function of elevated and lateral boundary. The karstification of limestones and dolomites in this area is below the base level of erosion, below the sea level and is deeper than 1.000 m. The High-Karst Zone has all the prominent characteristics of: fluvial erosion (deep canyons of Komarnica and Moraca rivers with their tributaries), glacial erosion (on the high mountains), lacustrine, sea and combined erosion. The spacious Zeta depression with the largest lake on the Balkan Peninsula - Skadar Lake, is situated in the High-Karst Zone. Parts of the bottom of this lake represent a crypto-depression. Sublacustrine springs (vruljas) exist in the Lake, with bottoms at depth of over 80 m below water level which is about 6,5 m above sea level. In the Zeta Plain loess deposits are found.

Along the internal belt of Bokokotorska Bay, from Morinj, across Risan, Perast and Orahovac to Kotor, the High-Karst Zone is in direct contact with the sea. In these terrains the largest vrulja on the Adriatic coast are located, called Sopot. The vast differences in water-yielding capacity of the constant and periodic karst springs indicate strong karstification of High-Karst Zone limestones and dolomites. The difference between minimum and maximum water yielding capacity is over 350 m^3.

Karst of the Pindus-Cukali zone, in the territory of Montenegro Budva-Bar Zone, is characterised by contact and contact-fluvial relatively low karst. Notable within this zone is frequent alteration of karstified limestones and dolomites with terrains built up of sedimentary and volcanic rocks. The seepage aquifers and the seepage karst aquifers in the karstic terrains of this zone, outside of the sea influence, are few and of small depth. Their dynamic reserves are small, providing hardly 5 l/s during the drought periods. The seepage karst aquifers of this geotectonic unit are, in several places, in immediate contact with the sea. These are low and shallow aquifers with brackish water. In this karstic area, water-rich aquifers with dynamic reserves do not exist.

The reason for this is a small distribution of cavernous limestones. In this region there are cavernous limestones with static reserve which give by pumping, during the drought period of the year, over 50 l/s of water (Opacica).

Karst of the Adriatic-Ionian fold System (in the territory of Montenegro-Adriatic fold System) is represented by karst with anticline structures and separated by synclinal structures built up of flysch deposits. These folds, which strike from Albania and across the hinterland of Ulcinj towards north-west, sink under the sea at the north-western margin of the Bar plain. Only one of them, the anticline structure of Grbalj and Lustica, appears again in south-eastern marginal part of Mrcevo plain trending to Dubrovnik. Karst of the Adriatic anticline structures in the hinterland of Ulcinj and external folds of the Bokokotorska Bay are characterized by the occurrences of exposed, coastal karst. This karst is low but with deep slope below the sea level.

4.2. Hydrological Conditions

Regarding the hydrological conditions of the area of Motorway, there is a vast network of rivers that drains the area of the project, with the main water courses being Moraca, Lim and Tara Rivers.

In its upper and middle part of the flow, Moraca River is a highly mountain river. Its length is 113,4 km and the area of the river basin, according to the Hydrological Station (H.S.) of Podgorica, is 2628 km^2. The most important tributary of the Moraca River is Zeta. Its length is 85 km, and river basin area according to the H.S. Danilovgrad, is 1216 km^2.

Skadar Lake covers less than 400 km^2 with minimum water level and up to 525 km2 with maximum water level registered. The Lake is primarily filled by Moraca River, including Crnojevica River and Orahovstica Rivers as well as Kiri River in Albania. The Lake is drained by the Bojana River.

Lim River is the most important Montenegrin River from the hydrographical point of view. It flows out of the Lake Plav, although Vruja and Grncar rivers make a part of its source, which by confluence make Ljuca River that flows into the Lake Plav. Before the town of Andrijevica, Lim River receives Murino River and Zlorecica as its left tributaries, and Djuricka River, Rzenicka, Velicka and Komaraca as its right tributaries. From the town of Andrijevica to the town of Berane, Lim River receives Krastica, Trebicka, Sevarinska Rivers from the left and Bistrica River from the right. From the town of Berane to the town of Bijelo Polje, Lim River receives Brzava and Ljubovica Rivers as its left tributaries, Dapsicka and Ljesnica Rivers at its right tributaries. From Bijelo Polje to Dobrakovo, it receives Bjelopoljska and Ljesnica Rivers from the left and Bjelopoljska and Bistrica Rivers from the right. The area of the Lim River basin to Dobrakovo is 2880km2 and its length is 234,2km.

Tara River emerges from the Maglic Kariman peaks. From the source to the Drcka river mouth, the right basin of the Tara River is more developed than the left one. Major tributaries are Opasanica and Drcka, Pcinja, Plasnica, Stitarica, Ravnjak and Ljutica springs. From the right side, the River Tara receives Skrbusa, Svinjaca, Jezerstica, Rudnjaca, Bjelojevicka and Selacka rivers. The area of the Tara River basin according to the Hydrological Station Scepan Polje, is 2040 km2, while its length is 148,4km.

The Piva River has created a basin at the high massif of Montenegrin Mountains. This river bears several names along its flow. Its source, part underneath the South-Western slopes of the Durmitor Mountain up to the town of Savnik, is called Bukovica. It joins Bijela in Savnik and continues further under the name Pridvorica until it reaches the confluence of Gornja Komarnica into the Pridvorica. The river continues further downwards under the name Komarnica all the way to relocated Monastery of Piva, where it receives the tributary Sinjaci and is named Piva. The river flows to the Scepan Polje, where it meets Tara River and creates Drina River. The area of the Piva River basin is estimated to be about 1784 km^2 up to Scepan Polje. Upper Komarnica springs from Durmitor and flows through a 600m deep and about 40 km long canyon. Along the Komarnica flow, karst phenomena are being created.

The Ibar River originates from the north-eastern slopes of the Hajla Mountain. Main tributaries are Zupanica, Limnicka, Ibarac, Grahovska, Bukovacka, Balticka and Backa Rivers.

The Cehotina River originates from the Stozer Mountain. It is the second largest tributary of Drina after the Lim River. It is composed of Koraci and Brezovski streams. Tributaries of the Cehotina River are

Koricka, Maocnica, Vezisnica and Voloder Rivers. The area of the Cehotina River basin according to the H.S. of Gradac is 809,8 km^2 and its length is 128,5 km.

In general no systematic groundwater table is anticipated to be encountered. Only scattered, isolated and perched water tables of a generally restricted extent, usually distinguished by a moderate hydraulic potential are envisaged. By taking into account the aforementioned hydrogeological conditions, underground water inflows or seepages are not expected to generate or develop any critical problems or triggering conditions regarding the stability of the Earthworks of the project.

4.3. Geotechnical Conditions of the Broader Area of Interest

According to the distribution of the geotechnical formations along various alternatives of the route, to the results and the findings of the desk studies and of the site visits performed the following main geotechnical features along each section of the route are mentioned.

Section I: Djurmani – Virpazar

Regarding the Djurmani – Virpazar section mainly conglomerates, peridotite and limestone formations up to approximately the first few hundred meters of the Sozina Tunnel are expected. The main part of the Sozina Tunnel is believed to be in limestone and calcareous dolomite formations. After the exit of Sozina Tunnel mainly limestone and dolomite formations, weathered and relatively of medium mechanical characteristics as well as surface diluvium and alluvium deposits of 5m ~ 10m thickness are expected. For the first three to four kilometres after the exit of Sozina Tunnel the presence of soil like formations is more intense compared to the last kilometres of the Djurmani - Virpazar section.

Section II: Virpazar – Farmaci

Concerning the Virpazar – Farmaci section, for the first five kilometres of the specific section massive dolomite formations are expected. The aforementioned formations, as well as limestone formations are also anticipated north of the Skadar Lake in the area where alternative alignment II-2 stretches.

In the area where alternative alignment II-1 stretches, east of Skadar lake and for a length of two to three kilometres, the Motorway passes through a marsh, swamp area with a substratum of poor geotechnical properties. Afterwards and for approximately four to five kilometres the route passes through a plain area containing mainly soil like deposits including alluvial, diluvia and terrace deposits. Then and up to Farmaci, calcareous sediments, limestone and dolomite formations with thin bedding and karsts with local appearance of surface diluvium, alluvium and cohesive deposits of 5m ~ 10m thickness are anticipated to be met.

Section III: Farmaci - Smokovac (including Podgorica by-pass)

In the specific section mainly calcareous sediments, limestone and dolomite formations with thin bedding and karsts with local appearance of surface diluvium, alluvium and cohesive deposits of 5m ~ 10m thickness are anticipated to be met.

Section IV: Smokovac – Mateshevo

In the first part of the Smokovac – Mateshevo section, mainly calcareous sediments, limestone and dolomite formations with thin bedding and karsts with local appearance of surface diluvium, alluvium and cohesive deposits of 5m ~ 10m thickness are anticipated.

Approximately 10km to 12km before Uvac, the geology changes and flysch, very fine sand, clayey marls and sandstone formations are expected. This flysch, known as Durmitor flysch in geological literature is mainly represented by arenaceous-marly facies, and partly by limestone facies. The basis of this series of sediments includes calcareous breccia and conglomerate, followed by arenaceous micrite while arenaceous marl occurs as a permanent member of flysch series of sediments. Arenaceous marl occurs in form of layers 10-20cm thick, with different colours, from grey-green to dark red. In addition to arenaceous marl, quartzose sandstone, argillaceous shale, argilloschist, with some cherts, quartzite and phyllite also occur. Locally appearance of surface diluvium and alluvium deposits of 5m ~ 10m thickness are also expected.

Section V: Mateshevo – Andrijevica

Flysch, marl, malry limestone, sandstone, shale, claystone as well as conglomerate formations with local appearance of surface diluvium and alluvium deposits of 5m ~ 10m thickness are expected in the Mateshevo – Andrijevica section. Marly limestone, limestone, dolomitic limestone and dolomite formations are expected to be found locally.

Section VI: Andrijevica – Berane – Poda

For the specific section, the geological formations anticipated are similar to the Mateshevo – Andrijevica section; flysch, marl, malry limestone, sandstone, shale, claystone, as well as, conglomerate formations. Especially after Andrijevica and up to Poda, that the route runs closely to River Lim, alluvial formations and locally and for a limited extent some conglomerate, shale and limestone formations are anticipated.

Section VII: Poda – Boljare/Serbian border

For the specific section, for the first fifteen kilometres mainly terrace and alluvial deposits are normally expected with the local appearance of some marly sandstone, marly limestone, shale and limestone formations. Then, for the next approximately ten kilometres marly sandstone and shale formations are expected with the local appearance of limestone and especially at the beginning of the section alluvial should be anticipated. For the last approximately fifteen kilometres of the section, limestone and dolomite are in general the predominant geological formations while locally and for a limited extent marly limestone and shale may also be found.

In the following figures the geological maps in the area of interest are presented.

Figure 2: Geological Map of Montenegro – Section I.

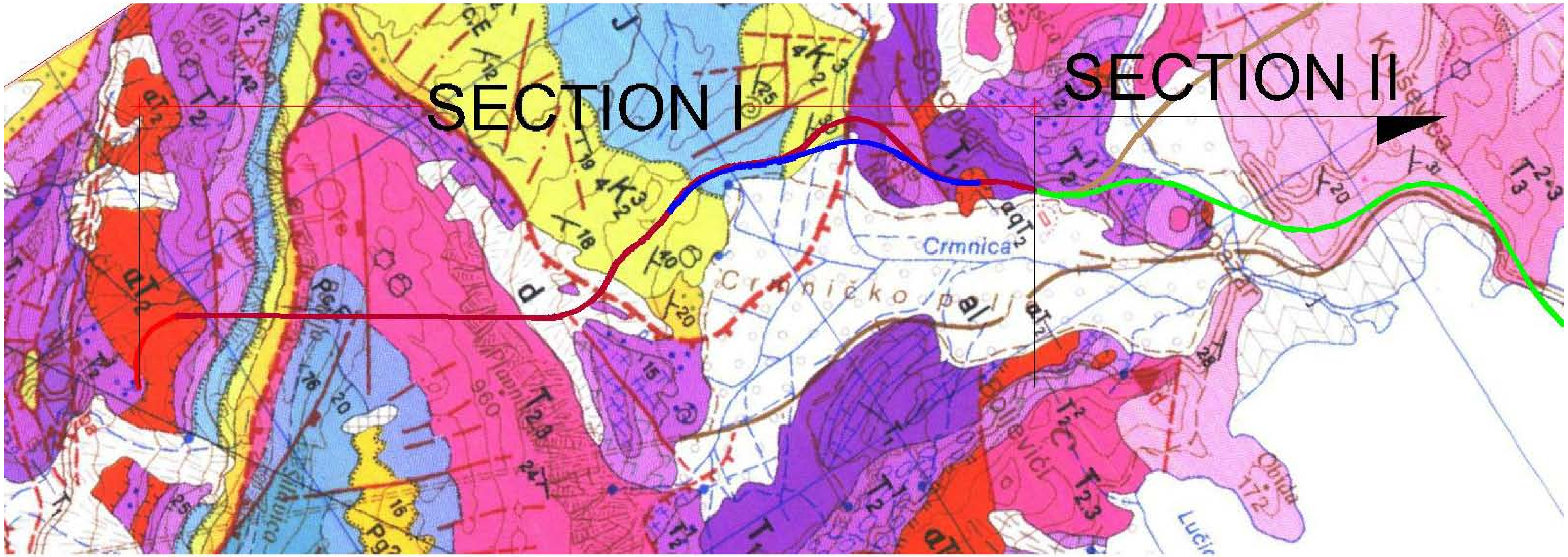


Figure 3: Geological Map of Montenegro – Section II.

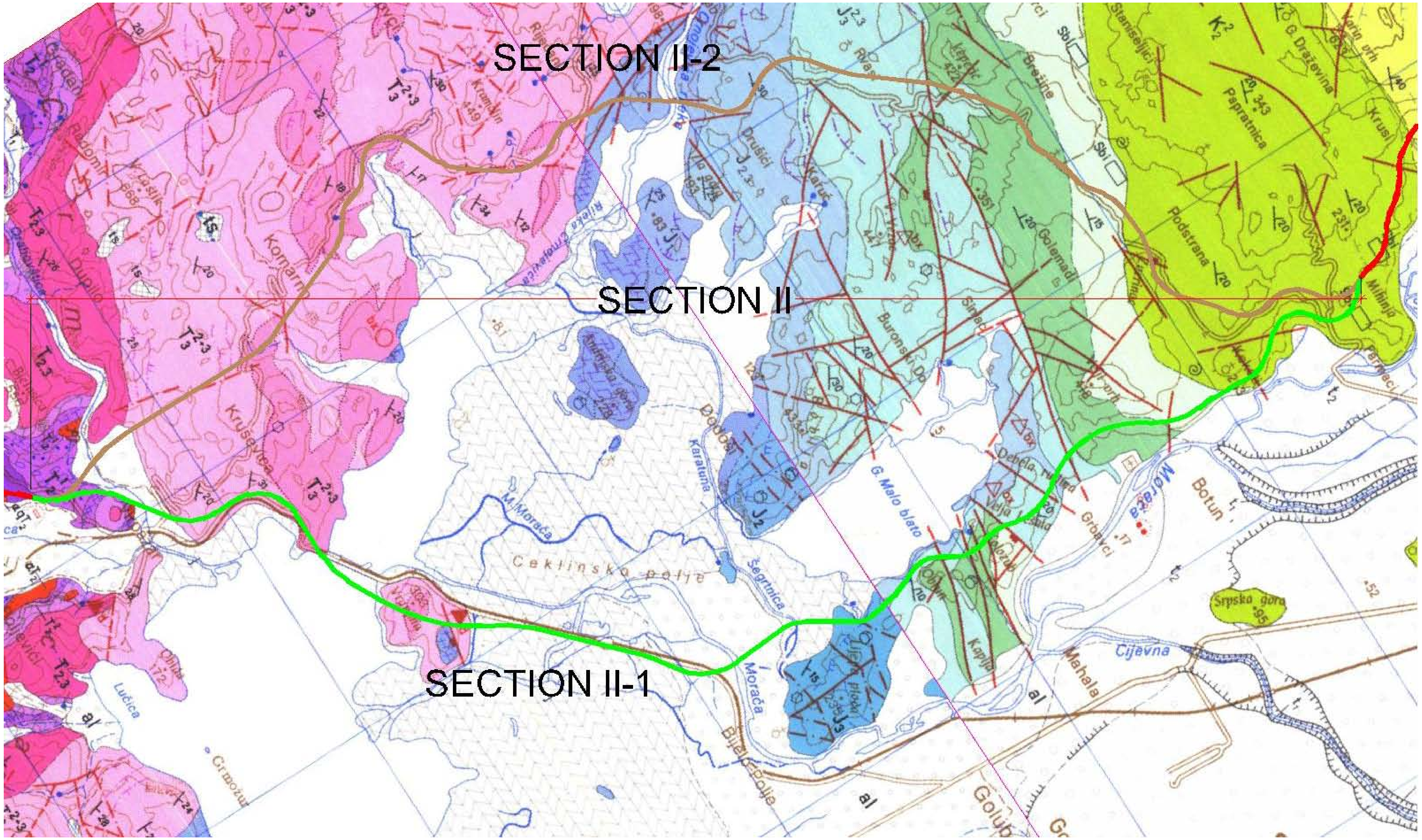


Figure 4: Geological Map of Montenegro – Section III.

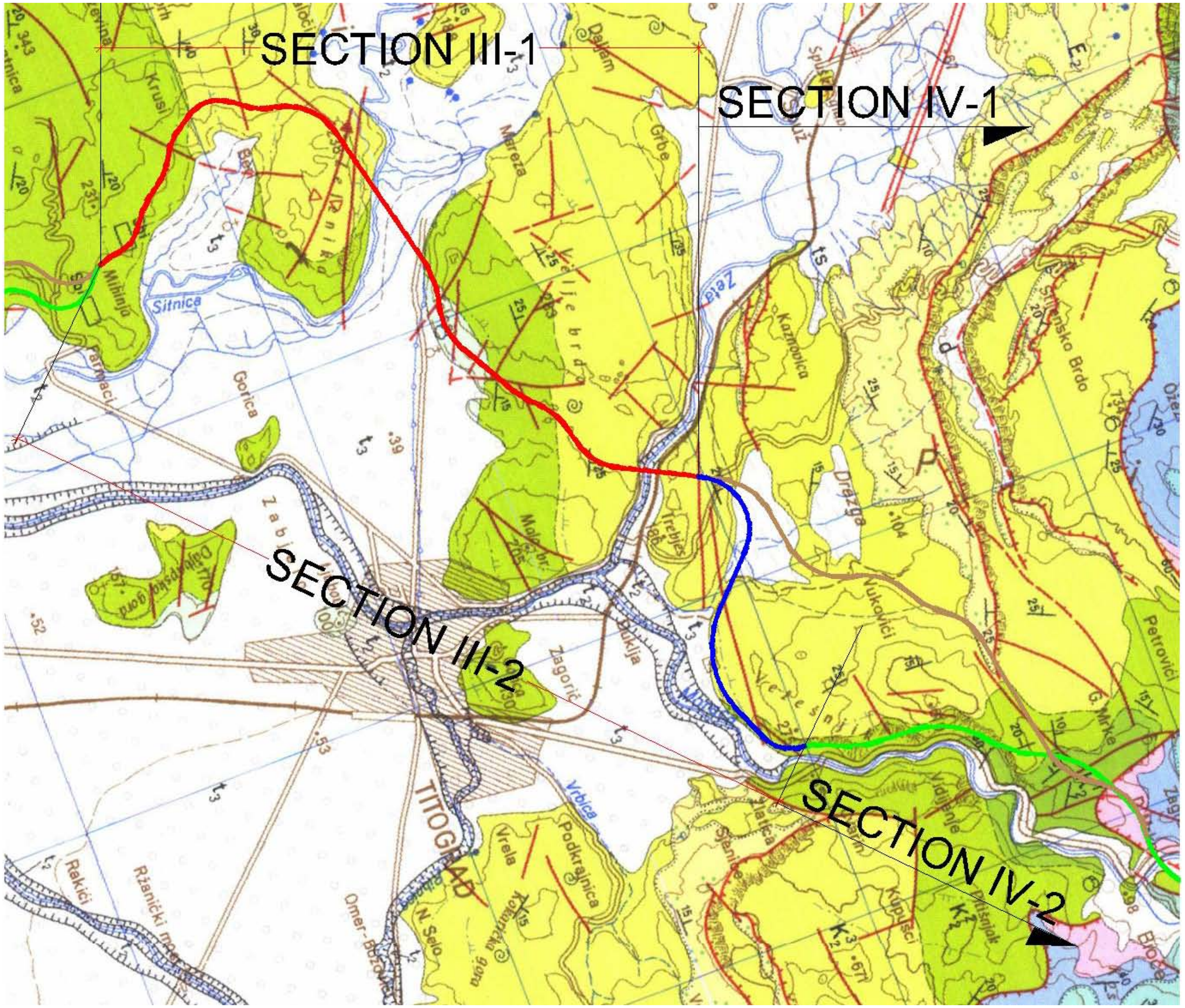


Figure5: Geological Map of Montenegro – Section IV.

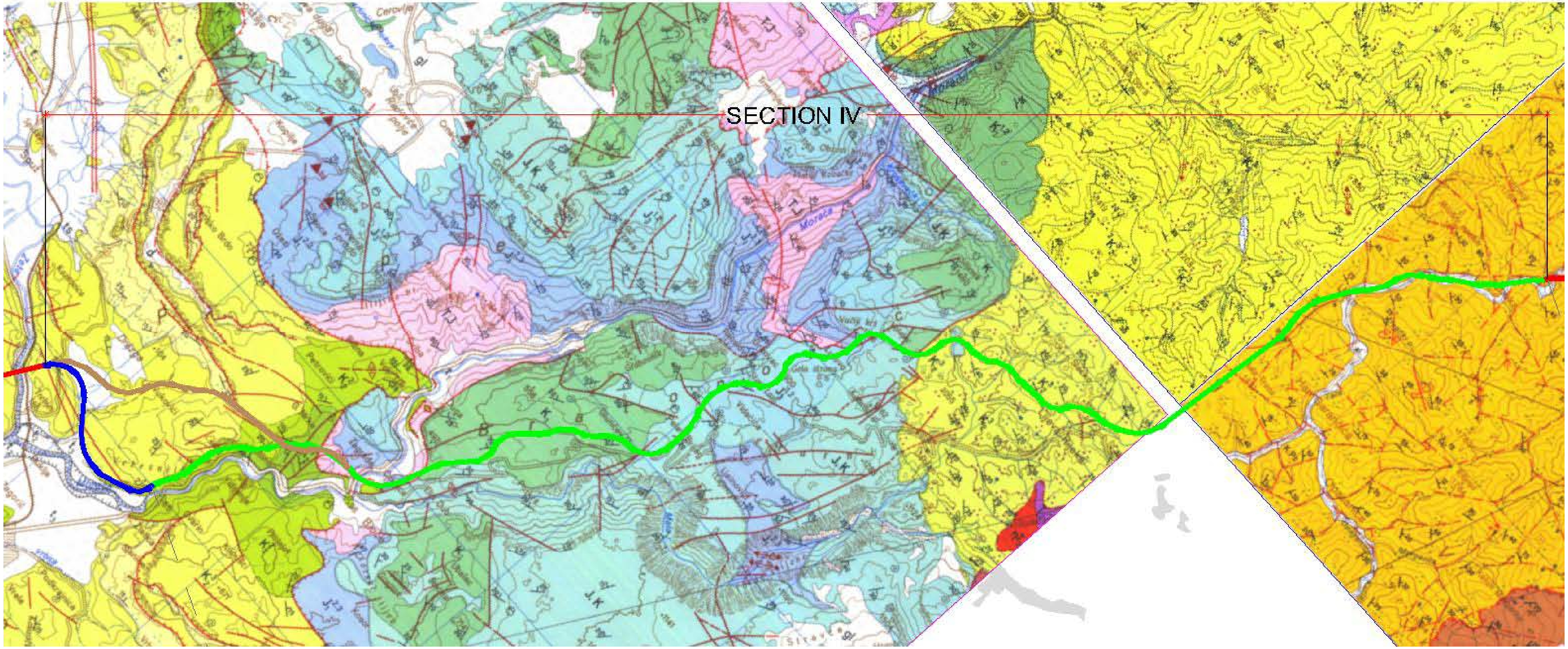


Figure6: Geological Map of Montenegro – Section V.

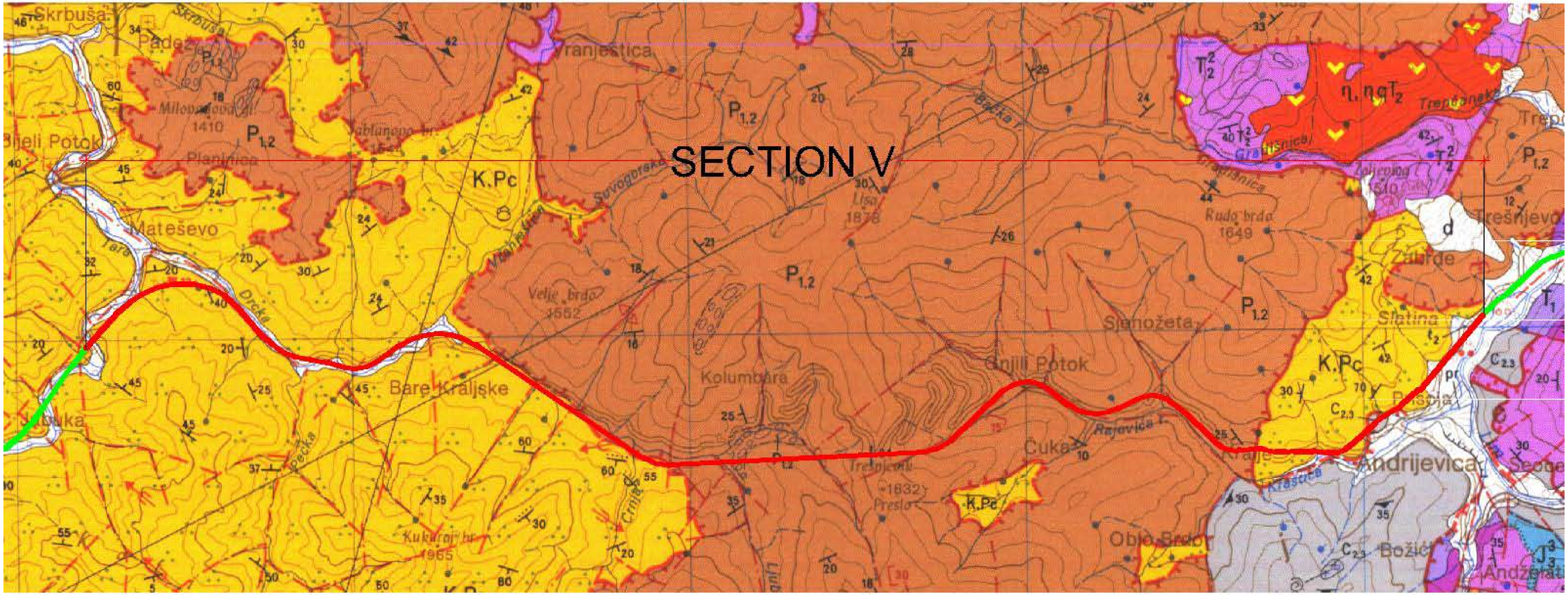


Figure 7: Geological Map of Montenegro – Section VI.

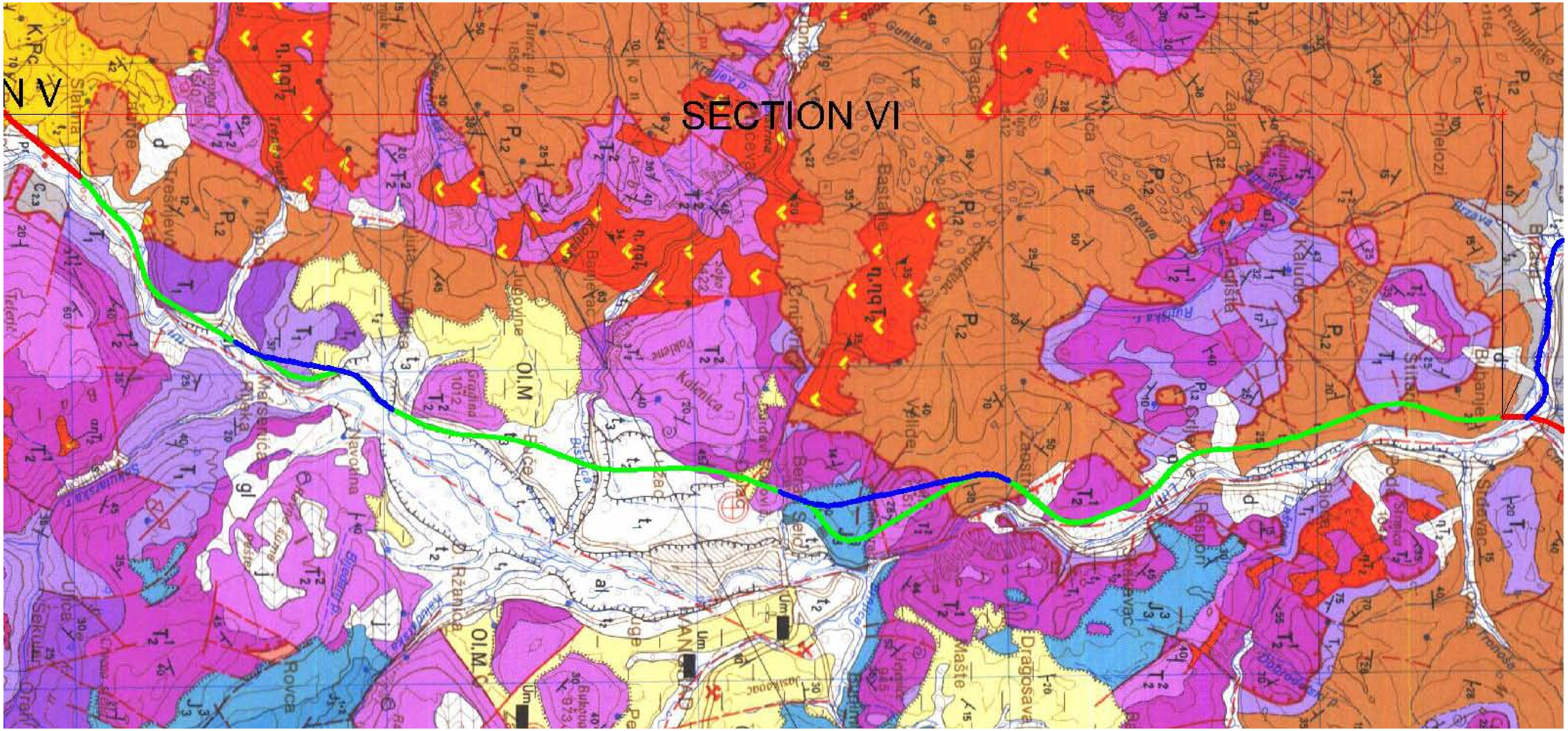


Figure 8: Geological Map of Montenegro – Section VII.

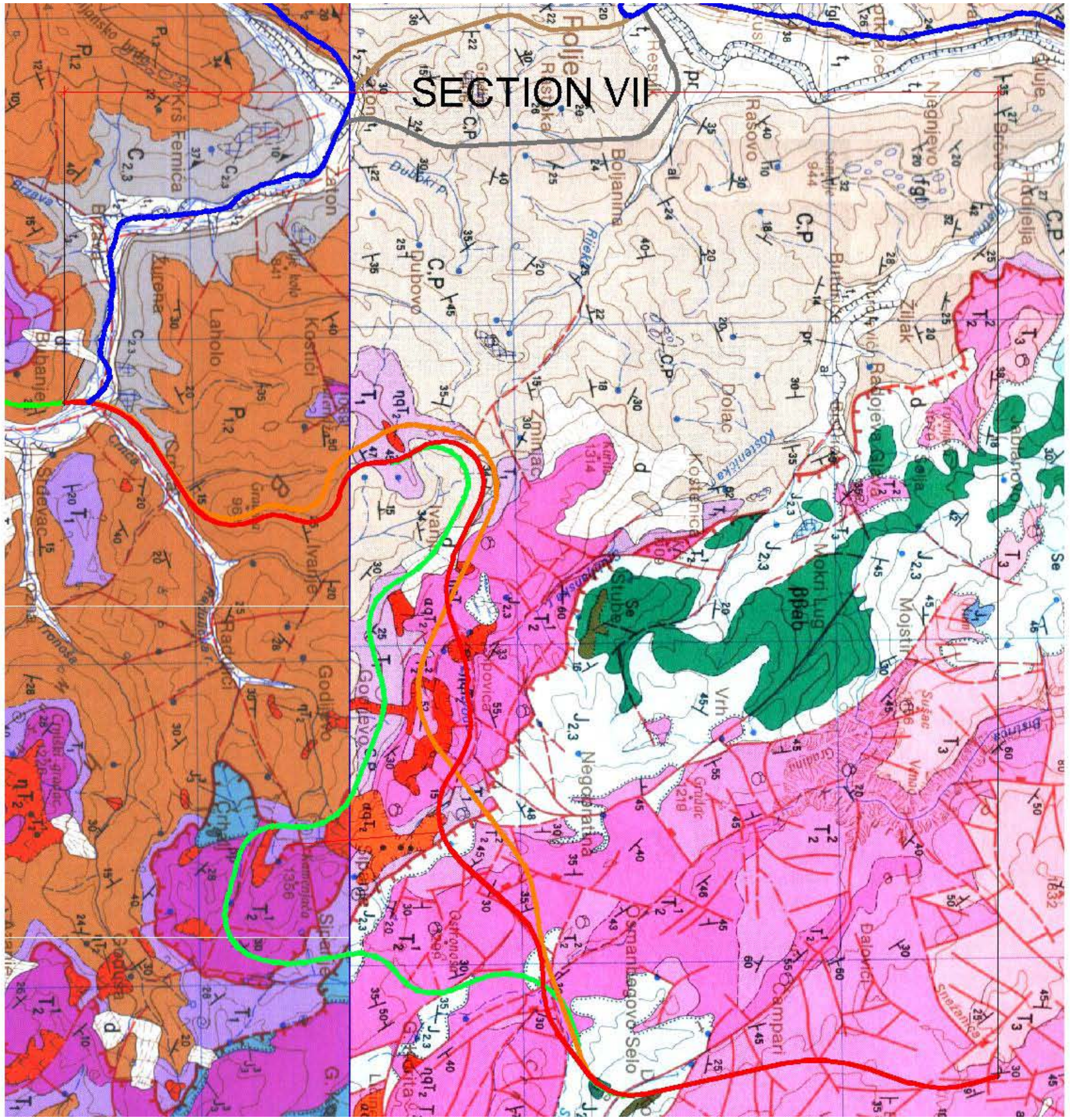
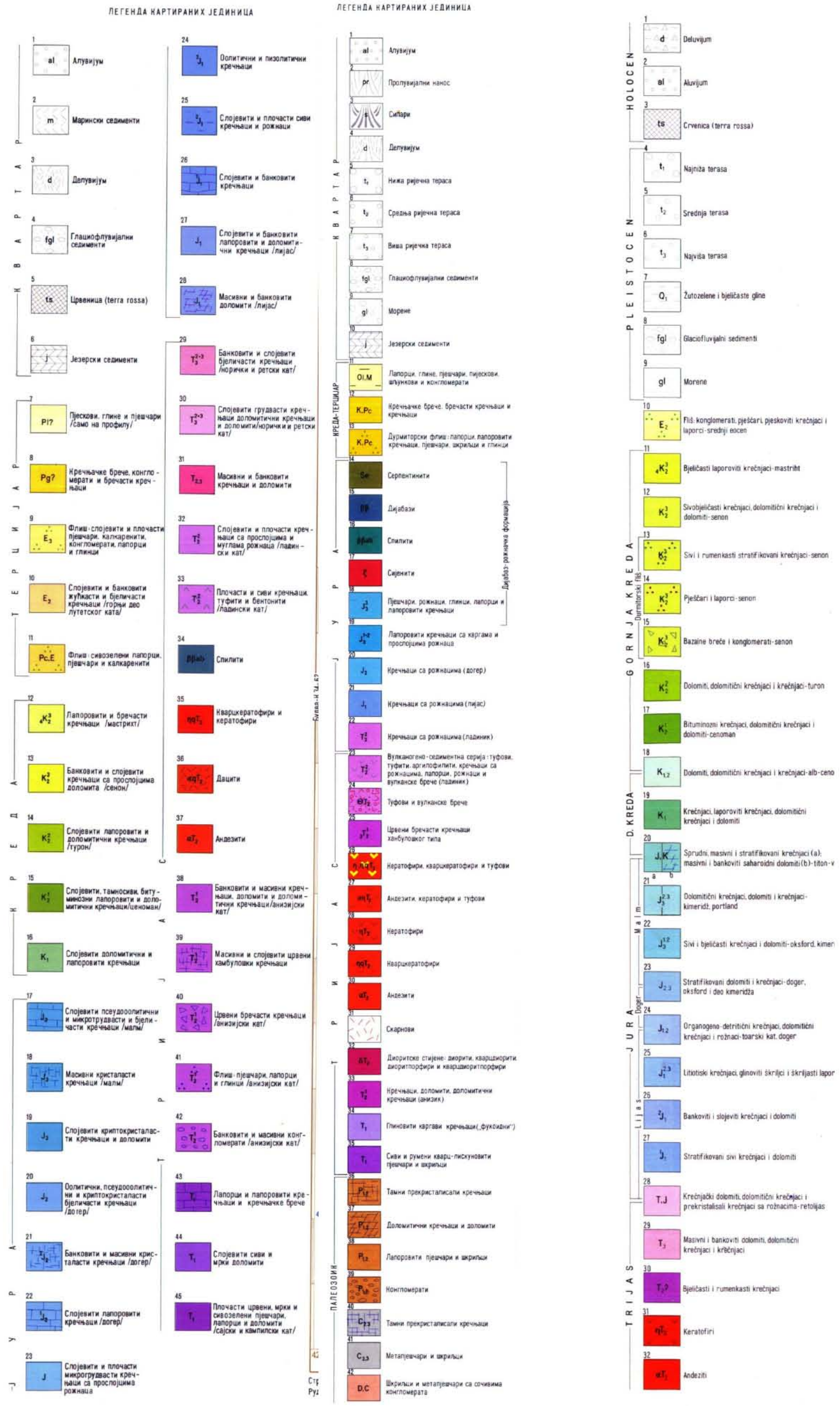
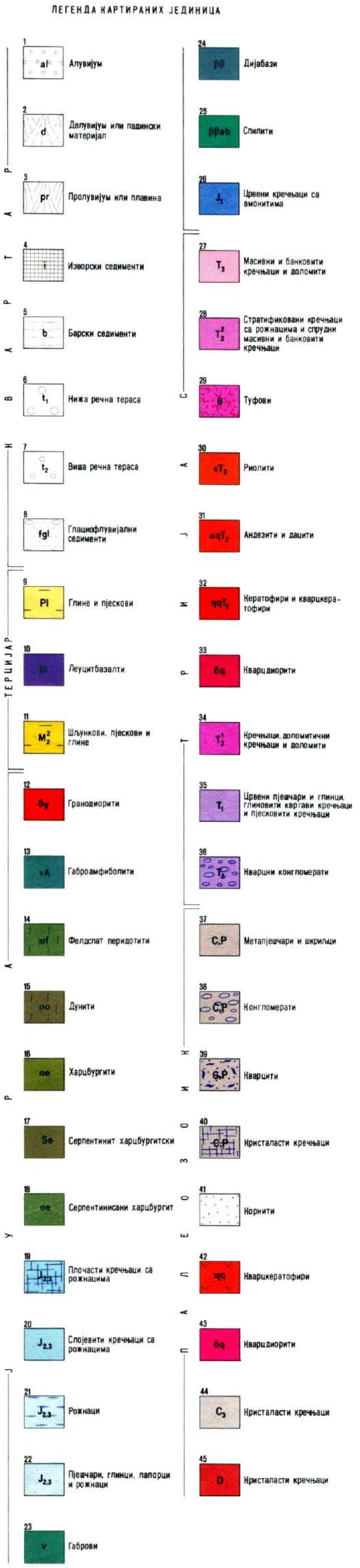
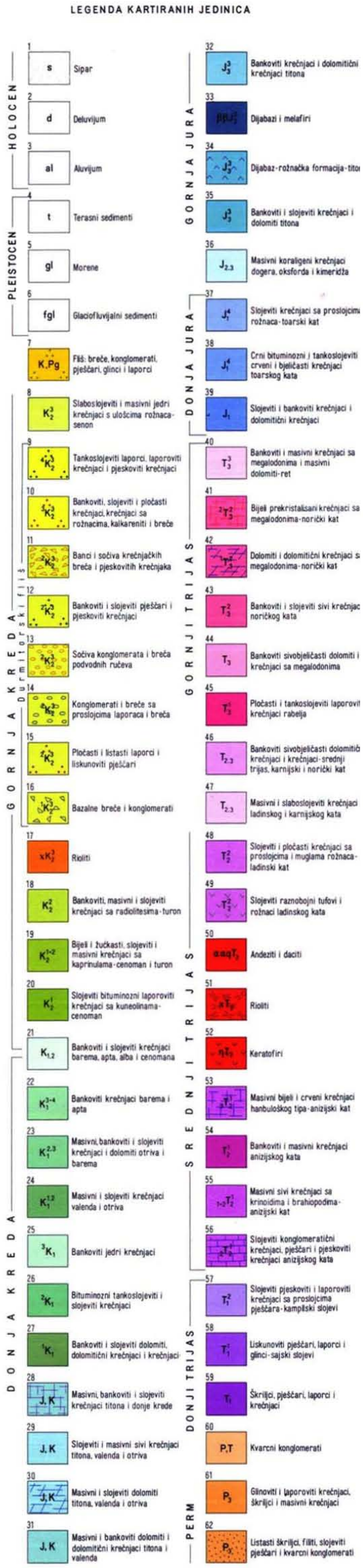


Figure 9: Legends of Geological Maps.




ЛЕГЕНДА КАРТИРАНИХ ЈЕДИНИЦА
КВАРТАР
ТЕРЦИЈАР
ЈУРА
ТРИЈАС
ПАЛЕОЗОИК
1 al Алувијум
2 d Делувијум или падински материјал
3 pr Пролувијум или плавина
4 i Изворски седименти
5 b Барски седименти
6 t1 Нижа речна тераса
7 t2 Виша речна тераса
8 fgl Глациофлувијални седименти
9 Pl Глине и пјескови
10 Леуцитбазалти
11 M22 Шљункови, пјескови и глине
12 Гранодиорити
13 vA Габроамфиболити
14 Фелдспат перидотити
15 Дунити
16 Харцбургити
17 Se Серпентинит харцбургитски
18 Серпентинисани харцбургит
19 J2,3 Плочасти кречњаци са рожнацима
20 J2,3 Слојевити кречњаци са рожнацима
21 J2,3 Рожнаци
22 J2,3 Пјешчари, глинци, лапорци и рожнаци
23 v Габрови
24 ββ Дијабази
25 Спилити
26 J1 Црвени кречњаци са амонитима
27 T3 Масивни и банковити кречњаци и доломити
28 T22 Стратификовани кречњаци са рожнацима и спрудни масивни и банковити кречњаци
29 Туфови
30 T2 Риолити
31 T2 Андезити и дацити
32 T2 Кератофири и кварцкератофири
33 Кварцдиорити
34 T21 Кречњаци, доломитични кречњаци и доломити
35 T1 Црвени пјешчари и глинци, глиновити квргави кречњаци и пјесковити кречњаци
36 Кварцни конгломерати
37 C,P Метапјешчари и шкриљци
38 C,P Конгломерати
39 C,P Кварцити
40 C,P Кристаласти кречњаци
41 Корнити
42 Кварцкератофири
43 Кварцдиорити
44 C3 Кристаласти кречњаци
45 D Кристаласти кречњаци

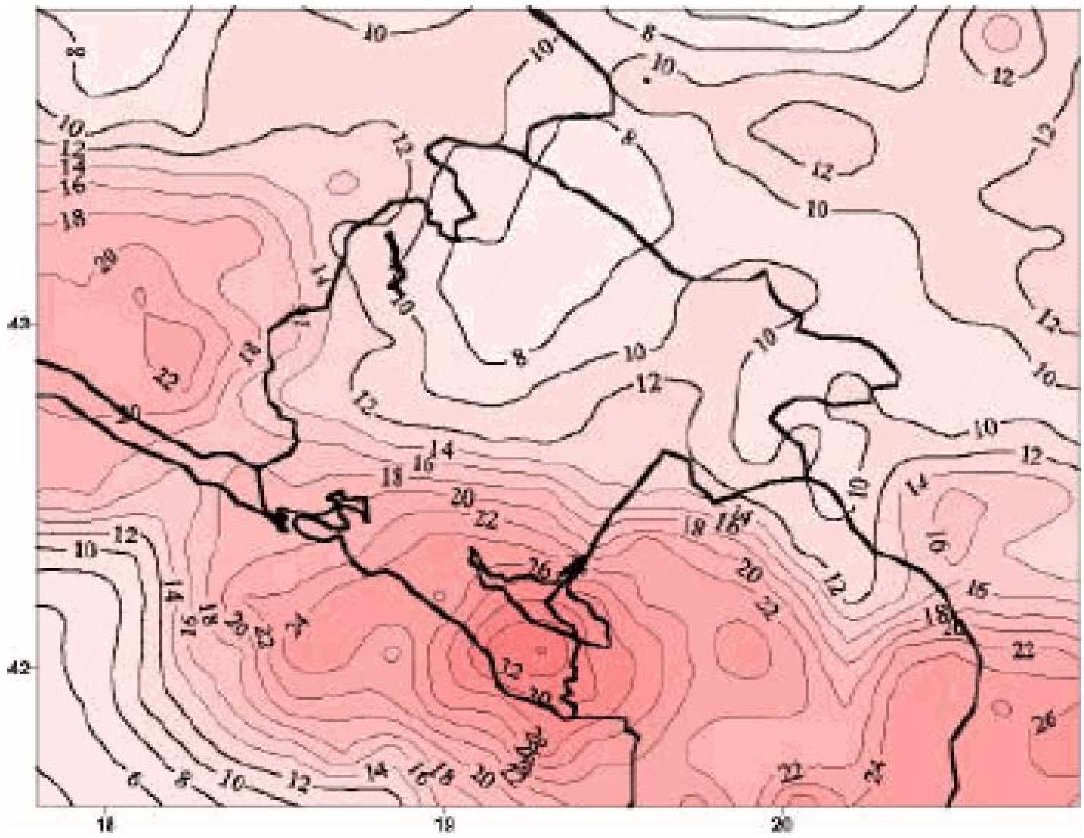

LEGENDA KARTIRANIH JEDINICA
HOLOCEN
PLEISTOCEN
GORNJA KREDA
Durmitorski fliš
DONJA KREDA
GORNJA JURA
DONJA JURA
GORNJI TRIJAS
SREDNJI TRIJAS
DONJI TRIJAS
PERM
1 s Sipar
2 d Deluvijum
3 al Aluvijum
4 t Terasni sedimenti
5 gl Morene
6 fgl Glaciofluvijalni sedimenti
7 K,Pg Fliš: breče, konglomerati, pješčari, glinci i laporci
8 K23 Slaboslojeviti i masivni jedri krečnjaci s uloščima rožnaca-senon
9 Tankoslojeviti laporci, laporoviti krečnjaci i pjeskoviti krečnjaci
10 Bankoviti, slojeviti i pločasti krečnjaci, krečnjaci sa rožnacima, kalkareniti i breče
11 Banci i sočiva krečnjačkih breča i pjeskovitih krečnjaka
12 Bankoviti i slojeviti pješčari i pjeskoviti krečnjaci
13 Sočiva konglomerata i breča podvodnih ručeva
14 Konglomerati i breče sa proslojcima laporaca i breča
15 Pločasti i listasti laporci i liskunoviti pješčari
16 Bazalne breče i konglomerati
17 Rioliti
18 K22 Bankoviti, masivni i slojeviti krečnjaci sa radiolitesima-turon
19 K21-2 Bijeli i žućkasti, slojeviti i masivni krečnjaci sa kaprinulama-cenoman i turon
20 K21 Slojeviti bituminozni laporoviti krečnjaci sa kuneolinama-cenoman
21 K1,2 Bankoviti i slojeviti krečnjaci barema, apta, alba i cenomana
22 K13-4 Bankoviti krečnjaci barema i apta
23 K12,3 Masivni, bankoviti i slojeviti krečnjaci i dolomiti otriva i barema
24 K11,2 Masivni i slojeviti krečnjaci valenda i otriva
25 3K1 Bankoviti jedri krečnjaci
26 2K1 Bituminozni tankoslojeviti i slojeviti krečnjaci
27 1K1 Bankoviti i slojeviti dolomiti, dolomitični krečnjaci i krečnjaci
28 J,K Masivni, bankoviti i slojeviti krečnjaci titona i donje krede
29 J,K Slojeviti i masivni sivi krečnjaci titona, valenda i otriva
30 J,K Masivni i slojeviti dolomiti titona, valenda i otriva
31 J,K Masivni i bankoviti dolomiti i dolomitični krečnjaci titona i valenda
32 J33 Bankoviti krečnjaci i dolomitični krečnjaci titona
33 Dijabazi i melafiri
34 J33 Dijabaz-rožnačka formacija-tito
35 J33 Bankoviti i slojeviti krečnjaci i dolomiti titona
36 J2,3 Masivni koraligeni krečnjaci dogera, oksforda i kimeridža
37 J14 Slojeviti krečnjaci sa proslojcima rožnaca-toarski kat
38 J14 Crni bituminozni i tankoslojeviti crveni i bjeličasti krečnjaci toarskog kata
39 J1 Slojeviti i bankoviti krečnjaci i dolomitični krečnjaci
40 T33 Bankoviti i masivni krečnjaci sa megalodonima i masivni dolomiti-ret
41 Bijeli prekristalisani krečnjaci sa megalodonima-norički kat
42 Dolomiti i dolomitični krečnjaci s megalodonima-norički kat
43 T32 Bankoviti i slojeviti sivi krečnjac noričkog kata
44 T3 Bankoviti sivobjeličasti dolomiti i krečnjaci sa megalodonima
45 T31 Pločasti i tankoslojeviti laporovi krečnjaci rabelja
46 T2,3 Bankoviti sivobjeličasti dolomitič krečnjaci i krečnjaci-srednji trijas, karnijski i norički kat
47 T2,3 Masivni i slaboslojeviti krečnjaci ladinskog i karnijskog kata
48 T22 Slojeviti i pločasti krečnjaci sa proslojcima i muglama rožnaca-ladinski kat
49 T22 Slojeviti raznobojni tufovi i rožnaci ladinskog kata
50 Andeziti i daciti
51 Rioliti
52 Keratofiri
53 Masivni bijeli i crveni krečnjaci hanbuloškog tipa-anizijski kat
54 T21 Bankoviti i masivni krečnjaci anizijskog kata
55 Masivni sivi krečnjaci sa krinoidima i brahiopodima-anizijski kat
56 Slojeviti konglomeratični krečnjaci, pješčari i pjeskoviti krečnjaci anizijskog kata
57 T12 Slojeviti pjeskoviti i laporoviti krečnjaci sa proslojcima pješčara-kampilski slojevi
58 T11 Liskunoviti pješčari, laporci i glinci-sajski slojevi
59 T1 Škriljci, pješčari, laporci i krečnjaci
60 P,T Kvarcni konglomerati
61 P3 Glinoviti i laporoviti krečnjaci, škriljci i masivni krečnjaci
62 P3 Listasti škriljci, filiti, slojeviti pješčari i kvarcni konglomerati

4.4. Seismicity

During the period 1983-1986, seismic regionalization, as well as detailed microzonation of all urban environments of the territory of Montenegro was carried out. The following figure illustrates the seismic hazards of Montenegro in terms of maximum horizontal acceleration for a return period of 200 years and for a probability of occurrence 70% (Source: Seismological Observatory of Montenegro).

For the entire Motorway the horizontal design seismic acceleration decreases along the route from Djurmani to Boljare / Serbian Border from a value in the range of 0.30g to a lower value in the range of 0.10g.

Figure 10: Seismic Hazard Map of Montenegro.



4.5. Geotechnical engineering for earthworks

4.5.1. Road Cuts

General

For the purposes of comparing the various alternative alignments a certain design philosophy of the cut slopes was developed that took into consideration the need of minimizing the environmental impact, the excavation volumes and the cost of the project, always inside the boundaries of the short and long term safe performance of the cuts and in conjunction with the international best practice.

Geometry and Support Measures of Cuts

For the purposes of elaborating comparing the various alternative alignments, seven typical Cuts' Sections are defined. These sections are indicative and they are used in order to outline the general concept of the Cuts' Design (see relevant drawings). During the Design stage of the project and as the results of the geotechnical campaign will be available; a more detailed evaluation will need to be performed by considering the specific geometrical and geological characteristics of each cut. Consequently and by taking into account the available techniques and the best international practice, the support measures and the detail of the Cuts' typical sections will be modified accordingly.

By taking into account the different geotechnical/geological formations various slope inclinations are proposed. Indicatively, for limestone and dolomite the slope inclination is 3:1 (v:h), for flysch formations the slope inclination varies from 1:1 (v:h) to 3:2 (v:h) and for soil like formations the slope inclination is 1:1 (v:h). For safety reasons and the need for future maintenance by local treatment to any section, benches of 3m width and of an inward bench gradient of 6%, will be located every 6m~8m of slope height for slopes steeper than 1:1 (v:h) and every 4m ~ 6m for slope inclinations of 1:1 (v:h) or flatter. In order for the presence of loose soil material or highly weathered rock to be taken into account, the last 2m of the cuts near the surface, will have a slope inclination of 1:1.

The support measure patterns consist of the following:

I. In competent ground conditions, no systematic support measures are usually required apart from non systematic (spot) drainage holes according to the local hydrogeological conditions and the selected removal of small pieces of unstable rock.

II. In competent massive rockmass (i.e. Limestone, Dolomite) but with a high potential of rock falls due to detached rock-boulders or due to the presence of steep natural terrain without vegetation, a rockfall barrier system with energy absorption capacity of 1000kJ ~ 2000kJ and of height 3m ~ 4m may be installed. No systematic support measures are usually required apart from drainage holes according to the local hydrogeological conditions and the selected removal of small pieces of unstable rock.

III. Slope protection with steel wire mesh (Tecco type of GEOBRUGG or similar) with steel rockbolts fully grouted of various length and diameter, installed in a staggered grid depending on the conditions.

Wherever a high potential of rock falls is identified then the installation of rockfall protection barriers and fences has been explored. The functioning principle is identical for all rockfall protection systems. The task is to absorb the impact energy by means of elastic ring nets which are fastened to ropes braced between steel posts. Some of the braced ropes feature devices to transform the energy. This transformation serves to absorb the energy which cannot be taken up by the net alone any more.

In order to retain the rockfall events and prevent rocks and debris from falling on the roadway, in cases where the catchment area is too small and the installation of other protection systems, such as barriers and fences, is not possible, then a steel wire mesh net used as a drapery system can be applied.

The application of the support measured patterns will be based on the cuts' geometry and on a method like the Geological Strength Index (GSI) of the rockmass. The GSI is a system of rock-mass characterization that has been developed in engineering rock mechanics to meet the need for reliable input data, particularly those related to rock-mass properties required as inputs into numerical analysis or closed form solutions for designing tunnels, slopes or foundations in rocks. The geological character of rock material, together with the visual assessment of the mass it forms, is used as a direct input to the selection of parameters relevant for the prediction of rock-mass strength and deformability. This approach enables a rock mass to be considered as a mechanical continuum without losing the influence geology has on its mechanical properties. It also provides a field method for characterizing difficult-to-describe rock masses.

The areas of application for the Cuts' typical sections will be defined during the detailed design of the project when sufficient geological – geotechnical information will be available. The Cut's typical sections may also be modified during the Design Stage. The detailed dimensioning of the retaining measures will be carried out during the Design Stage of the Project.

4.5.2. Road Embankments

General

Taking into consideration the need of short and long term safe performance of the highway embankments, the concept is based on using up the most appropriate slope angles and geometries, minimizing the fill volumes and the cost of the project. In order for the arising environmental impact to be diminished, appropriate retaining and consolidation measures are adopted, according to the international best engineering practise, considering the assumptions made in this report regarding the geotechnical characteristics.

Geometry and Support Measures of Embankments

For the purposes of elaborating the current Technical Options, four typical Embankments' are initially defined. These sections are indicative and they are used in order to outline the general concept of the Embankments' Design (see relevant drawings). During the Design stage of the project and as the results of the geotechnical campaign will be available; a more detailed evaluation will be performed by considering the specific geometrical and geological characteristics of each embankment. Consequently and by taking into account the available techniques and the best international practise, the retaining and consolidation measures and the detail of the Embankments' typical sections may be modified. Currently, the areas of application of the Embankments' typical sections are determined on "one-by-one case" of the alignment's sections.

Regarding the general geometry and the main characteristics of the typical cross-sections of the embankments, the slope inclination is 2:3 (v:h). In case that local conditions require steeper slopes, then slope inclinations of 1:1 (v:h) and of 2:1 (v:h) with 3m wide benches located every 10m height from the crest of the embankment and in conjunction with gabion boxes may be suitable.

The necessary stability measures of the cross-sections, described in the following paragraphs, constitute indicative solutions for specific geometrical configuration of the embankments sections:

I. In sections with embankments of height less than 12.0m, with a slope inclination 2:3(v:h), geogrid reinforcement requirements are usually not expected. However, appropriate measures for surface slope protection such as implementation of either 3D geosynthetic grid or vegetation layer and hydroseeding are considered, in most cases.

II. In sections with embankments of height greater than 12.0m, with a slope inclination 2:3 (v:h), geogrid reinforcement requirements are usually expected. Detailed dimensioning (ultimate design tensile strength, length, locations of implementation) will be executed in the design stage of the under study project.

III. In sections of embankments with a slope inclination 1:1 (v:h), geogrid reinforcement requirements are normally expected and gabions (2.0 x 1.5 x 1.0m, length x width x height) will be foreseen at the slope's face. Detailed dimensioning (ultimate design tensile strength, length, locations of implementation) will be executed in the design stage of the under study project.

IV. In sections of embankments with a slope inclination 2:1 (v:h), geogrid reinforcement requirements are normally expected and gabions (2.0 x 1.0 x 1.0m, length x width x height) will be foreseen at the slope's face. Detailed dimensioning (ultimate design tensile strength, length, locations of implementation) will be executed in the design stage of the under study project.

In order to deal with any potential instability problems connected with the existing ground, improvement/drainage spurs or discontinuous layer may be provided. Provision for improvement/drainage spurs or discontinuous layer at the base of the embankment is made, in order for drainage of the interface between the slope and the embankment to be accomplished.

Aiming to protect fines from being washed into the voids of an adjacent coarser material, filter layers are usually considered in the interface of the embankments body and the improvement/drainage layer, as well as in the interface of the improvement/drainage layer and the substratum.

V. In cases where reinforced earth walls are applied, a solution of high strength precast concrete modular facing units (precast concrete or key block panels), connected to the backfilling soil by the use of either steel tendons or by geogrid reinforcement. Detailed dimensioning of the reinforced earth walls will be executed in the design stage of the project. Reinforced earth walls have not been considered for overall height greater than 30m.

VI. In cases where reinforced concrete retaining walls are applied, the concrete will be of quality C20/25 and the quality of the steel reinforcement will be B500c (tensile strength 500N/mm2). The retaining wall will be situated above a lean concrete layer of quality C12/15, 10cm thick. Also, on surfaces of the retaining walls, which are going to be in touch with the ground, a waterproofing isolation with double layer of asphaltic daub in suitable positions as well as a drainage pipe surrounded by granular filling material will be applied.

Especially for embankments constructed near the river-bed, like those at the end of Section IV near Tara River and in the vicinity of Andrijevica near Lim River, special hydraulic protection should be foreseen. For those embankments foreseen in the broader river bed, the layer of the improvement and drainage material would have an increased thickness according to the Hydraulic Study. Moreover, mattresses could be so that the maximum flood level is covered.

The detailed dimensioning of the retaining measures will be carried out during the Design Stage of the Project.

4.5.3. Ground Improvement

Reasonable provisions have been made for possible ground improvement under the body of certain embankment stretches for a part of the corresponding zones. Generally, the first layer of topsoil would be removed. Then an improvement/drainage layer, as defined above, under the base of the embankments would be constructed. A further examination of the various sections in relation to the height of the embankment and to the substratum conditions will need to be carried out in detail, during the design stage of the project. The drainage/improvement layer, of approximately 0.5m ~ 1.0m thickness according to the local conditions, is foreseen to extent approximately 1.0m from the toe of the embankment. The material of the improvement layer will usually be granular and will not contain any organic soils.

If the improvement/drainage system is not sufficient for the satisfaction of the required Factor of Safety, then the option of implementing geotextiles or geogrids inside is investigated.

Especially for sections of high embankments, double-sided or especially one-sided (abrupt slopes of existing ground), on formations of poor geotechnical conditions, the possibility of increasing the stability by the construction of bored piles made of reinforced concrete, may be thoroughly investigated. The piles are estimated to have a diameter in the order of 1.0m, but their detailed design will be carried out in the design stage of the under study project, if it is required in accordance to the prevailing geotechnical conditions.

It is noted, that the improvement/drainage layer, as long as it has a coefficient of permeability higher than 10^{-3}m/sec, it would also act as a drainage layer. With the probable implementation of a drainage layer the equivalent permeability of the substratum is increased and most importantly the drainage length is reduced and consequently the required time for the consolidation to be completed is also reduced. The time for consolidation depends upon the square of the distance the water must travel to exit the soil.

In cases where the drainage layer is not sufficient for the consolidation to be completed in the desired time and the foundation soil is relatively soft (indicatively low SPT values), then vertical band drains may be installed in square or triangular patterns that would normally shorten the drainage path within the cohesive soil layer. Indicatively, vertical drains might be installed in the substratum of embankments with a high water table, where the substratum would have a coefficient of vertical consolidation smaller than 3×10^{-6}m/sec and drainage length greater than 10.0m.

By the installation of vertical drains, consolidation is then mainly due to horizontal radial drainage, resulting in the faster dissipation of excess pore water pressure. Vertical drains installed in the upper soil layer would enable the embankment to be brought into service much sooner, most settlement can occur during construction, thus keeping post-construction settlement to a minimum. In case the requirements for the stability of the embankment are not fulfilled, then the vertical drains can be used in conjunction with geotextiles or pile rows. The equivalent diameter of the vertical drains would be in the order of 10cm. The detailed dimensioning of the vertical drains will be executed in the design stage of the under study project.

Especially for the alternative alignment II-1 of the Virpazar – Farmaci section, passing through the marsh, swamp area after Skadar Lake, the demands of ground improvement such as improvement layer, geotextiles, reinforced concrete bored piles, and vertical band drains of the substratum for the foundation of any embankment stretches are believed to be increased.

For that specific section and if there are considerable problems like long required time for the consolidation of the substratum to be fulfilled, high risk of liquefaction or a high percentage of organic soils, then the option of constructing stone columns may not be eliminated.

It is anticipated that very limited part of the understudy area would show soil conditions that would justify the use of stone columns. It is anticipated that the stone columns would be of 0.8m ~ 1.2m diameter, their length would be around 15.0m and they would be placed in a rectangular pattern at an axial distance of 2.0D ~ 3.0D, where D is their diameter. The detailed dimensioning and the areas of application of the stone-columns will be carried out in the design stage.

By the application of the above mentioned ground improvement measures and by the gradual scaling of their application, during the detailed design, an efficient design of the embankments is accomplished. The demands of ground improvement material and the stone quarried are expected to be very limited and consequently the environmental impact and the disturbance caused, will be limited. Moreover the combination of the aforementioned technical solutions, that comprise the cutting edge of the embankment construction technology, would be according to the modern international practise.

4.5.4. Rock Fall & Avalanches

The main geological features that could pose risks to the proposed project or increase the cost include landslides, instabilities, soil formations susceptible to liquefaction, rock-falls, and avalanches. .

The assessment of the required support measures to mitigate the hazards posed by rock-falls or avalanches constitutes a quite specialized and demanding engineering field. The main mitigation measures against rock-falls are:

- Scaling of loose rock segments.
- Open pit rock-fall barriers
- Anchoring meshes of Tecco or similar type in conjunction with rock anchors.
- Rock-fall drapes.
- Special rock-fall protection barriers.

The main mitigation measures against avalanches these are:

- Snow fences, barriers and bridges.
- Avalanches and snow high energy absorption nets.
- Shed.
- Braking mounds.
- Deflecting dams.
- Catching Dams.

Most of the aforementioned avalanche mitigation measures are usually of significant cost and they are generally used only where there is a threat to inhabited areas. It is also quite usual to install of monitoring systems that can detect mass movements and activate an automatic alarm signal when a certain threshold value is exceeded. If it is also required the avalanches can be artificially released by the use of remote trigger systems.

A separate detailed design would need to be performed against the specific identified hazards for specific areas, where specific problems have been recorded in the past due to rock-falls or avalanches. The specific areas would need to be visited and specific data would need to be collected including:

- Topographical data and slopes of terrain.
- Identification of major joint and discontinuity sets.
- Estimation of size of loose rock segments.
- Vegetation cover of the slopes.
- Data collection of recorded avalanches and rock-falls.
- Meteorological data.
- Possible avalanches paths.
- Mapping of existing protection measures.

- Identification of areas that could suffer significant potential damages due to an avalanche or a rock-fall event, like houses, villages, factories etc.

Once the above data are collected then a specific risk – hazard assessment shall be performed, specific measures and actions shall be proposed for each high hazard area and the required works and quantities shall be estimated.

It noted that although specific measures have been taken into account as part of the present study, for mitigating the hazard of rockfalls and avalanches like anchoring meshes, special rock-fall protection barriers, Cut & Cover structures, in certain areas where high or steep cuts are foreseen from the present study, special structures (Cut & Cover or Lane Covers) may need to be considered during the Design stage.

4.6. Concept Design of Tunnels

4.6.1. Basic Data

Based on the layout and the longitudinal profile drawings elaborated as part of the Technical Options Report, for the various alternative alignment of the seven sections, the following twin-bore underground tunnels and the respective cut and cover structures of their portals, are foreseen along the alignment. The main data of tunnels of each alternative alignment of each section are presented in the table below.

Table 8: Main Tunnel Data.

Section	Alternative	Tunnel	Chainage		1st Bore (length)	2nd Bore (length)	Overburden
			Start	End			
SECTION I: DJURMANI - VIRPAZAR	I-2	1	0+902	5+052	constructed	4150	>250
		2	8+355	8+965	constructed	610	110
	SUM				**-**	**4760**	
	I-3	1	0+875	5+025	constructed	4150	>250
		2	8+215	8+715	constructed	500	110
	SUM				**-**	**4650**	
SECTION II: VIRPAZAR - FARMACI	II-1	1	-0+941	-0+341	600	600	120
		2	0+039	0+279	240	240	50
		3	0+539	1+199	660	660	100
		4	1+489	1+839	350	350	80
		5	3+289	4+749	1460	1460	220
	SUM				**3310**	**3310**	
	II-2	1	2+270	4+520	2250	2250	370
		2	5+390	6+790	1400	1400	235
		3	8+710	9+175	465	465	50
	SUM				**4115**	**4115**	
SECTION III: FARMACI - SMOKOVAC	III-1	1	53+200	54+600	1400	1400	140
		2	56+250	57+000	750	750	70
	SUM				**2150**	**2150**	
	III-2	1	53+200	54+600	1400	1400	140
		2	56+250	57+000	750	750	70
	SUM				**2150**	**2150**	

SECTION IV: SMOKOVAC - MATESHEVO	IV-1	1	0+650	1+350	700	700	180
		2	1+435	2+735	1300	1300	250
		3	2+790	3+990	1200	1200	180
		4	12+680	13+030	350	350	40
		5	21+580	21+780	200	200	50
		6	24+020	24+520	500	500	60
		7	24+995	25+295	300	300	40
		8	26+340	26+790	450	450	70
		9	29+450	33+650	4200	4200	220
		10	36+798	36+948	150	150	30
		11	39+070	39+420	350	350	120
	SUM				**9700**	**9700**	
	IV-2	1	65+590	67+890	2300	2300	130
		2	12+680	13+030	350	350	40
		3	21+580	21+780	200	200	50
		4	24+020	24+520	500	500	60
		5	24+995	25+295	300	300	40
		6	26+340	26+790	450	450	70
		7	29+450	33+650	4200	4200	220
		8	36+798	36+948	150	150	30
		9	39+070	39+420	350	350	120
	SUM				**8800**	**8800**	

SECTION V: MATESHEVO-ANDRIJEVICA	V-1	1	1+080	1+610	530	530	100
		2	3+900	4+120	220	220	40
		3	5+250	5+550	300	300	30
		4	10+890	14+460	3570	3570	200
		5	22+080	22+430	350	350	40
	SUM				**4970**	**4970**	
SECTION V: MATESHEVO - ANDRIJEVICA	V-2	1	1+070	1+600	530	530	40
		2	3+900	4+120	220	220	30
		3	5+260	5+560	300	300	200
		4	10+930	14+430	3500	3500	90
	SUM				**4550**	**4550**	
SECTION VI: ANDRIJEVICA - PODA	VI-2	1	4+190	4+940	750	750	80
		2	12+640	13+040	400	400	100
		3	15+150	16+550	1400	1400	170
		4	17+580	18+230	650	650	80
	SUM				**3200**	**3200**	
	VI-3	1	4+200	5+000	800	800	130
		2	12+640	13+040	400	400	100
		3	15+150	16+550	1400	1400	170
		4	17+580	18+230	650	650	80
	SUM				**3250**	**3250**	
	VI-4	1	4+190	4+940	750	750	80
		2	12+640	13+040	400	400	100
		3	13+830	16+230	2400	2400	330
		4	17+580	18+230	650	650	80
	SUM				**4200**	**4200**	
O LJ A R E	VII-1	1	37+340	38+040	700	700	60

		2	45+930	46+380	450	450	70
	SUM				**1150**	**1150**	
	VII-2	1	34+100	34+220	120	120	30
		2	51+260	51+720	460	460	60
SECTION VII: PODA - BOLJARE & PODA - BIJELO POLJE	**SUM**				**580**	**580**	
	VII-3	1	33+860	33+980	120	120	40
		2	36+790	37+390	600	600	100
		3	39+450	40+400	950	950	100
SECTION VII: PODA - BOLJARE & PODA - BIJELO POLJE	VII-3	4	41+400	41+800	400	400	60
		5	45+970	46+430	460	460	80
	SUM				**2530**	**2530**	
	VII-4-1	1	8+960	10+140	1180	1180	130
	SUM				**1180**	**1180**	
	VII-4-1	1	8+470	10+470	2000	2000	250
	SUM				**2000**	**2000**	

It is noted that the left bores of the Sozina Tunnel and of the Ras Tunnel have already been constructed.

The typical cross section foreseen for the tunnels by taking into account the TEM standards (third edition, February 2002) has the following characteristics:

Typical lane widths for tunnel sections (2 lanes):

- 3.75m (left lane) + 3.75m (right lane) + 2×0.50, with 5.0m free height.

The pavement is determined 1.00m wide with free height of 2.50m.

4.6.2. Tunnel Layout

The proposed layout for each tunnel with the arrangements of the pedestrian and vehicular cross passages, as well as the positions of the lay-bys, should fulfill as a minimum the requirements according to the European Union Directive 2005/54/EC. Consequently, an emergency exit is required every 500m, cross connections for emergency services are required every 1500m and lay-bys every 1000m.

The free span of the inner lining of the pedestrian cross-passages is approximately 2.40m; their free height is approximately 2.75m. The crown curvature of their inner lining is determined by an arch radius of 1.20m.

As it regards the dimensions of the inner lining of the vehicular cross-passages, these are approximately 5.20m and 3.80m for the maximum width and the free height respectively. The crown curvature of their inner lining is determined by an arch radius of 2.60m.

The maximum width of the inner lining of the emergency lay-by cross-section is determined to be 2.50m greater in comparison to the relative width of the typical main tunnel section.

A certain number of emergency niches with appropriate geometry thus making possible the installation of required safety and emergency devices (phone and foam - liquid distinguisher,) have been located along both bores of the tunnels of the project. These niches are always placed in the right sidewall of each tunnel bore according to the direction of traffic and are distributed in distances (according to the EU Directive), which do not exceed 150m.

For ensuring the complete control and the maintenance requirements of the tunnel drainage systems, drainage niches are also foreseen along the left sidewall of each bore of the tunnel according to the direction of traffic.

For the following tunnels with length greater than 3km one smoke extraction adit for each twin bore tunnel is assumed to may be needed due to their lengths:

- Section I — Alternatives I-2 & I-3 – Tunnel 1 (Sozina), length 4150m.
- Section IV — Alternative IV-1 – Tunnel 9, length 4200m.
  Alternative IV-2 – Tunnel 7, length 4200m.
- Section V — Alternative V-1 – Tunnel 4, length 3570m.
  Alternative V-2 – Tunnel 4, length 3500m.

In order to develop a more economical and cost effective solution, the implementation of single bore bidirectional tunnels has been considered, leading to a significant reduction in the tunnels' length.

All tunnel layouts shall satisfy the operational requirements of bidirectional traffic. In order to establish the aforementioned design concept, the following issues will need to be considered.

- According to international recommendations, which are based on common design practice in various countries, as well as, on the opinions of the experts on the PIARC WG4 committee, the total minimum width of the paved area (between the walkway's curb stone) in bidirectional tunnels should be 8.50m.
- Since there will be the option of constructing the second tunnel bore at a later stage, where possible the shortest bore shall be constructed first.
- Where only one bore of each tunnel is proposed to serve as a single bidirectional tunnel, the emergency niches should be constructed in both tunnel's sidewalls (one for each traffic lane direction), by keeping distances of 150m, according to the EU Directive 2005/54/EC. The drainage niches, shall be foreseen in both tunnel's sidewalls.
- According to the EU Directive, the lay-bys in each tunnel longer than 1500m should be placed every 1000m along the sidewall of each traffic direction lane. Thus, in case of the proposed bi-directional tunnels, additional lay-bys should also be foreseen in the left sidewall of each tunnel.
- Pedestrian emergency exits (evacuation adits) should be foreseen in tunnels every 500m, for traffic loads greater than 2000 vehicles per lane, according to the EU Directive.

- Vehicular emergency exits should be foreseen every 1500m in tunnels longer than 1500m, for traffic loads greater than 2000 vehicles per lane, according to the EU Directive.
- Certain calculations and E/M ventilation analyses should prove the eventual need for fire smoke extraction point, by means of either ventilation adits or shafts.

The holistic approach for the final determination of the main characteristics and civil work layouts of the single tube bidirectional tunnels should be performed during the Design Stage, by considering the combined operation of the interactive role of both the emergency exits and the smoke extraction points (if any), in order to provide the best balanced arrangement of the tunnel complex.

Following the aforementioned, in case that a single bore is to be constructed in order to serve bidirectional traffic, then a cost surcharge of 30% for tunnels longer than 500m is considered.

4.6.3. Design Concept of Main Tunnels

Considering the geological conditions which are expected based on the limited geological / geotechnical available data, the preliminary design of the typical cross sections of excavations and outer lining of the main tunnels, the lay bys, the pedestrian and vehicular cross passages and the niches, was executed.

The excavation and outer lining categories are determined according to the available geological data and having as a basic criterion the GSI index.

Up to eight (8) excavation and outer lining categories are initially determined for the main tunnels. However, considering the geotechnical investigation program and the «Geological - geotechnical final evaluation», the overburden thickness and the potential special engineering geology conditions for the project's Final design, the criteria for determining the excavation and outer lining categories will be re-examined. According to the above-mentioned statement, it is clear that the proposed excavation and outer lining sections are indicative and not restrictive since they will be modified and finalized at the «Project's final design».

In the following table the typical details of the main rockmass support class are presented.

Table 9: Typical Details of Main Rockmass Support Classes.

	TYPICAL DETAILS OF MAIN ROCKMASS SUPPORT CLASSES FOR TUNNELS							
	A	*B*	*C*	*D*	*E*	*EF*	*F1*	*F2*
EXCAVATION METHOD	DRILL + BLAST	DRILL + BLAST	DRILL + BLAST / HEAVY HAMMER	HEAVY HAMMER / MECHANICAL EXCAVATION	MECHANICAL EXCAVATION	MECHANICAL EXCAVATION	MECHANICAL EXCAVATION	MECHANICAL EXCAVATION
CONVERGENCE CONSTR.TOLERANCES	2cm	2cm	3cm	5cm	5cm	5cm	8cm	8cm
CONSTR. STAGES	FULL FACE	FULL FACE OR TH + BENCH	TH + BENCH	TH + BENCH	TH + BENCH	TH + BENCH + INVERT	TH + BENCH + INVERT	TH + BENCH + INVERT
ROUND LENGTH (m)	2.5 - 3.5	2.5-3.5 (TH) 5.0-7.0 (B) OR 2-3m FULL FACE	2.0-3.0 (TH) 4.0-6.0 (B)	1.5-2.5 (TH) 3.0-5.0 (B)	1.0-2.0 (TH) 2.0-4.0 (B)	1.0-2.0 (TH) 2.0-4.0 (B)	0.9-1.2 (TH) 1.8-2.4 (B)	0.9-1.2 (TH) 1.8-2.4 (B)
F.R. SHOTCRETE (cm)	3 - 5	5 (TH OR FULL FACE)	10 (TH)	10 (TH), 5(B)	15 (TH, B)	15 (TH, B)	20 (TH, B)	20 (TH, B)
SHOTCRETE (cm)	3	3 (TH, B OR FULL FACE)	3 (TH), 7 (B)	5 (TH, B)	5 (TH, B)	5 (TH, B)	5 (TH, B)	5 (TH, B)
STEEL MESH	-	IR 1T188, 100° TH	IR 1T188, 140° TH	-	-	-	-	-
LG / STEEL SETS	-	-	IR LG 70/18/25 TH @ RL	LG 70/18/25 TH @ RL	LG 90/20/26 (TH + B) @ RL	HEB 120 (TH + B) @ RL	HEB 120 (TH + B) @ RL	HEB 120 (TH + B) @ RL
ROCKBOLTS	SPOT, 5-8 PCS, SWELLEX, 3m,100kN, TH	6 PCS /3m/TH +2 PCS/3m/B, SWELLEX, 100kN @ RL	(4+2) PCS/(4.5m+3m)/TH + 2 PCS/3m/B, 25mm, B500c @ RL	(6+4) PCS/(4.5m+3m)/TH + 2 PCS/3m/B, 25mm, B500c @ RL	10 PCS/5m/TH + 4 PCS/4m/B, 25mm, B500c @ RL	10 PCS/5m/TH + 4 PCS/4m/B, 25mm, B500c @ RL	12 PCS/6m/TH + 4 PCS/6m/B, SD 30/11 300kN @ RL	12 PCS/6m/TH + 6 PCS/6m/B, SD 30/11 300kN @ RL
SPILES	-	-	-	IR 20-30PCS/4-6m/100o TH/ 32mm B500c/ @ 2m	IR 20-30PCS/4-6m/100o TH/32mm B500c/ @ 1.5m	IR 20-30PCS/4-6m/100o TH/32mm B500c/ @ 1.5m	IR 20-30PCS/6m/100o TH/ 32mm B500c/ @ 3.0m	-
FOREPOLES	-	-	-	-	-	-	-	ST37, Φ114.3mm/100.1mm /12m @ 9m/ 114° @ 0.3m
FACE SHOTCRETE (cm)	-	IR 3 (TH)	IR 3 (TH)	3 (TH)	5 (TH)	5 (TH)	5 (TH)	5 (TH)
FACE BOLTS	-	-	SPOT 3-5 PCS / 8m, 200kN @ 5m (TH)	5-8 PCS / 8m, 200kN @ 4m (TH)	12 PCS / 12m, 200kN @ 8m (TH)	18-20 PCS / 12m, 200kN @ 8m (TH)	18-20 PCS / 12m, 200kN @ 8m (TH)	18 – 20 PCS / 12m, 200kN @ 6-8m (TH)
TEMP. INVERT	-	-	-	-	IR, 20cm, 1T188	20cm, 1T188	20cm, 1T188	20cm, 1T188
FINAL INVERT	-	-	-	-	-	20cm, 1T188	20cm, 1T188	20cm, 1T188
ELEPH. FOOT	-	-	-	IF REQUIRED (TH)	IF REQUIRED (TH)	TH, ENLARGEMENT 0.5m	TH, ENLARGEMENT 0.5m	TH, ENLARGEMENT 0.5m-1.3m
INNER LINING (cm)	30	30	30	35	35	40 / 50 invert	40 / 50 invert	40 / 50 invert
TUNNEL SECTION	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSED	CLOSED	CLOSED
SECONDARY MEASURES (IR)	Rockbolts	Rockbolts	Rockbolts, shotcrete	Rockbolts, LG (B)	Rockbolts, spiles, steel mesh	Rockbolts, spiles, steel mesh	Rockbolts, spiles, steel mesh	Rockbolts, grouting, forepoles, steel mesh
GSI / TUNNELING CONDITIONS	>60	50-60	40-50	30-40	25-35	15-25 Minor fault and shear zones	<20 Minor fault and shear zones	<20 Soil-like materials, fault zones, portals, shear zones
EXPECTED AVERAGE OVERBREAK (cm)	15	10	10	10	5	5	5	5

4.6.4. Tunnel Construction Issues

Formation of tunnel portals

Cut & Cover structures will be constructed in the areas of the tunnel portals. These structures will be inside the excavated cuts of the highway in the areas of the portals.

The cut and cover structure is predicted to be constructed according to the relative specifications. Concrete's quality will be B35 (C30/37) and B500c quality steel will be used for the reinforcement. For the inner surface formation, the same steelwork with the one used in the main tunnels will be employed. The concreting of the cut and cover will be executed from the down to the top in zones, in the following sequence, bottom - sidewall – crown.

Inner lining structure of the tunnels

The geometry of inner lining cross section of the main tunnel is open horseshoe for competent rock/semi-rock categories and closed horseshoe for fractured semi-rock/earth categories. The inner surface of the lay bys is of open horseshoe geometry. The geometry of pedestrian and vehicular cross passages inner lining is vaulted. The inner lining dimension for each case is analytically presented at the relevant drawings.

The cast in place concrete's quality along the tunnels of the project will be B35 (C30/37), and the steel reinforcement will be steel of B500c quality.

Geotechnical Measurement Program during Construction.

It is necessary that during construction, appropriate geotechnical measurements and observations are executed aiming to the evaluation of the effectiveness of the applied excavation procedure and the applied immediate support measures as well as the comparison to the predictions of the design, so that appropriate modifications, are applied to the works, due to the in situ conditions, if required.

Measurements and tests will be appropriately adjusted to the in situ conditions, executed in such a density and frequency so that a better image is formed, for the encountered and formed conditions after the excavation.

Beyond all those mentioned above, there is a provision for a systematic geotechnical engineering mapping of the tunnel face for the existing geological – geotechnical conditions confirmation and a suitable adjustment of the support measures, where is required.

5. MAJOR BRIDGES AND VIADUCTS

5.1. Design Standards

Bridges shall be designed in full compliance with Eurocodes (EN with a design life of at least 100 years. The following main Eurocodes will be used:

EN 1990: Basis of Structural Design

EN 1991: Actions on Structures

EN 1992: Design of Concrete Structures

EN 1993: Design of Steel Structures

EN 1994: Design of Composite Concrete and Steel Structures

EN 1997: Geotechnical Design

EN 1998: Design of Structures for Earthquake Resistance

EN 1337: Structural Bearings

EN 206-1: Concrete: specification, conformance, production and conformity

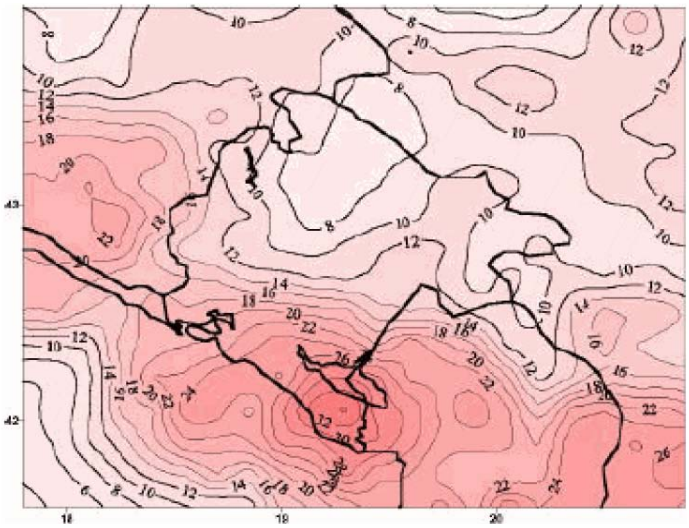
EN10080: Steel for the reinforcement of concrete

EN10138: Prestressing steels

Regarding the seismic design of bridges, the following figure illustrates the seismic hazard of Montenegro in terms of maximum horizontal acceleration for a return period of 200 years and for a probability of occurrence 70% (Source: Seismological Observatory of Montenegro).

From the following figure it is concluded that the horizontal design seismic acceleration varies along the route from a value in the range of 0.30g to a lower value in the range of 0.10g. The above as well as the corner periods will be defined in detail during the Detailed Design stage.

Figure 11 horizontal design seismic analysis



5.2. Concept Design

5.2.1. General

All bridges shall be provided with:

- Approach slabs.
- Vehicular containment systems complying with national standards or, where no national standard exists, recognised European standards. Safety barriers shall extend over the approach zones and have similar stiffness to and be fixed rigidly to adjoining bridge deck parapets.
- Pedestrian parapets not less than 1.0 metres in height, where required.
- Effective bridge deck waterproofing systems allied with positive bridge deck drainage.
- Bridge bearings and expansion joint systems that maximize durability and minimize maintenance liability.
- Sulphate resisting cement where aggressive ground or ground water conditions are encountered.
- Corrosion protection for all concrete and steel components exposed to saline water spray from the road surface.
- Suitable fixing points for light columns, where appropriate.
- 4 x 100 mm service ducts in both outer edges of motorway bridges and 2 x 100 mm service ducts in both outer edges of other road bridges. Service ducts shall be laid to a continuous fall so as to be self draining.

5.2.2. Bridge Categories

In the current study the route is divided in seven sections. A number of alternative road alignments have been elaborated for each section. The major bridges/viaducts included in the each section and alternative of the route are tabulated in Table 12

In addition, the number of overpasses and underpasses for every section are shown in Table 11:

Table 10: Overpasses and Underpasses per section

Sections				
1	Djurmani - Virpazar	*Alternative I-2*	*Alternative I-3*	
		1 Overpass 1 Underpass	1 Overpass 2 Underpasses	
2	Virpazar – Farmaci	*Alternative II-1*	*Alternative II-2*	
		1 Overpass 7 Underpasses	3 Overpasses 9 Underpasses	
3	Farmaci – Smokovac	*Alternative III-1*	*Alternative III-2*	
		1 Overpass 3 Underpasses	2 Overpasses 5 Underpasses	
4	Smokovac – Matesevo	*Alternative IV-1*	*Alternative IV-2*	
		3 Overpasses 7 Underpasses	4 Overpasses 9 Underpasses	
5	Matesevo - Adrijevica	*Alternative V-1*	*Alternative V-2*	
		5 Underpasses	5 Underpasses	
6	Adrijevica – Poda	*Alternative VI-2*	*Alternative VI-3*	*Alternative VI-4*
		2 Overpasses 13 Underpasses	4 Underpasses	4 Underpasses
7	Poda – Serbain Borders	*Alternative VII-1*	*Alternative VII-2*	*Alternative VII-3*
		4 Overpasses 8 Underpasses	6 Overpasses 10 Ups	3 Overpasses 7 UPs

The main geometric characteristics (length, width, maximum pier height, etc) and the proposed construction method for each of the major bridges/viaducts are depicted in the relevant tables of the Appendix.

The major bridges/viaducts can be divided in 3 main categories, with respect to the deck construction method that is proposed to be adopted:

- The first category concerns bridges with a deck consisting of a series of **simply supported precast prestressed concrete I-beams**, precast reinforced concrete slabs supported on the edge of the adjacent beams top flanges and in-situ reinforced concrete deck slab and cross beams at the ends of each span, over the supports. Each precast beam is supported on the piers or abutments through one laminated elastomeric bearing anchored to both elements. This series of bearings offer a considerable seismic isolation of the deck. Continuity slabs, locally separated from the precast beams, are provided in the intermediate supports.

  For usual cases of motorway bridges (no climbing lane), the total deck width for each branch is 13.85m and 5 precast beams are used.

  For interchanges bridges, the deck width may vary from smaller to larger than the typical values.

  External horizontal action (wind, brake-load and seismic actions) are transferred to the supporting elements through the bearings. The shear flexibility of the bearings allows limitations to an acceptable level of the horizontal reactions due to imposed deck deformations (concrete shrinkage and creep and temperature variation).

  For all the bridges of the above type, shallow foundation is proposed, with pad footings.

  This category contains most of the project's bridges, as shown at the relevant table.

- The second category regards bridges to be constructed by **balanced cantilever** method. The deck section is a single box girder and is fixed to the piers.

  The piers section is hybrid, utilizing double blades at the top 20m and a box section at the rest of the pier height.

  The piers are going to be constructed using a climbing formwork.

  Regarding the support system of the deck, the deck is fixed to all piers as already mentioned.

- The third category regards bridges the deck of which will be **cast in-situ** using conventional scaffolding. This category consists of typical reinforced concrete underpasses, overpasses and single branch motorway bridges at the interchanges. The overpasses deck section will be prestressed concrete voided slab, while the motorway bridges deck section will be prestressed concrete box girder.

  The piers section will be a solid wall, with appropriate pier head on the top in order for the deck to lay on it. Since in some cases the pier height is up to 20m, the above piers will be constructed with climbing formwork, while the short piers with conventional scaffolding supported on the ground.

  The deck will be supported on the piers through anchored laminated elastomeric bearings, which offer a considerable seismic isolation of the deck.

  For all the bridges of the above type, shallow foundation is proposed, with pad footings.

5.2.3. Proposed arrangement for Bridge Inspection and Maintenance

Envisaged inspections include mainly inspection of bearings, dampers, roadway joints, and drainage system and road equipment located on the bridge.

Routine maintenance is envisaged for drainage outlets, roadway joints and road equipment. This can be done from the top of the deck with a minimum intervention in traffic.

Heavy maintenance (replacement) is envisaged for bearings and joints. Measures for bearings replacement shall be included in the detailed design, such as provision of replaceable parts of bearings, positions of jacks for synchronized lifting of supports, design of relevant bridge elements (mainly support cross-beams) to carry the jacking actions without affecting traffic. Replacement of roadway joints shall require short-term reduction of the number of the usable traffic lanes and shall be carried out at off-peak hours and on a period of the year with low traffic volumes.

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION I : DJURMANI - VIRPAZAR (ALTERNATIVE_I-2)	1	Motorway R.B.	6+510	BR	34,00	13,85	470,90	6,00	Precast prestressed beam	
	2	Motorway R.B.	7+845	BR	132,00	13,85	1828,20	3,00	Precast prestressed beam	
		Motorway L.B.		BR	68,00	13,85	941,80	3,00		HAS ALREADY BEEN CONSTRUCTED
	3	Motorway R.B.	8+125	BR	238,00	13,85	3296,30	22,00	Precast prestressed beam	
		Motorway L.B.		BR	196,00	13,85	2714,60	22,00		HAS ALREADY BEEN CONSTRUCTED
	4	Motorway R.B.	9+430	BR	10,00	13,85	138,50	11,00	Casted in-situ using conventional scaffolding	
		Motorway L.B.		BR	10,00	13,85	138,50	11,00		HAS ALREADY BEEN CONSTRUCTED
	5	Motorway R.B.	9+585	BR	10,00	13,85	138,50	8,00	Casted in-situ using conventional scaffolding	
		Motorway L.B.		BR	10,00	13,85	138,50	8,00		HAS ALREADY BEEN CONSTRUCTED
	6	Motorway R.B.	10+025	BR	34,00	13,85	470,90	9,00	Precast prestressed beam	
		Motorway L.B.		BR	34,00	13,85	470,90	9,00		HAS ALREADY BEEN CONSTRUCTED

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION II : VIRPAZAR - FARMACI (ALTERNATIVE_II-1)	1	Motorway R.B.	2+569	BR	1300,00	13,85	18005,00	17,00	Precast prestressed beam	TANKI
		Motorway L.B.		BR	1300,00	13,85	18005,00	17,00		
	2	Motorway R.B.	4+889	BR	40,00	13,85	554,00	11,00	Precast prestressed beam	
		Motorway L.B.		BR	40,00	13,85	554,00	11,00		
	3	Motorway R.B.	6+543	BR	100,00	13,85	1385,00	9,00	Precast prestressed beam	
		Motorway L.B.		BR	100,00	13,85	1385,00	9,00		
	4	Motorway R.B.	6+908	BR	50,00	13,85	692,50	9,00	Precast prestressed beam	
		Motorway L.B.		BR	50,00	13,85	692,50	9,00		
	5	Motorway R.B.	7+450	BR	50,00	13,85	692,50	10,00	Precast prestressed beam	
		Motorway L.B.		BR	50,00	13,85	692,50	10,00		
	6	Motorway R.B.	8+458	BR	90,00	13,85	1246,50	11,00	Precast prestressed beam	
		Motorway L.B.		BR	90,00	13,85	1246,50	11,00		
	7	Motorway R.B.	8+988	BR	160,00	13,85	2216,00	12,00	Precast prestressed beam	
		Motorway L.B.		BR	160,00	13,85	2216,00	12,00		
	8	Motorway R.B.	9+439	BR	250,00	13,85	3462,50	11,00	Precast prestressed beam	
		Motorway L.B.		BR	250,00	13,85	3462,50	11,00		

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION II : VIRPAZAR - FARMACI (ALTERNATIVE_II-1)	9	Motorway R.B.	10+058	BR	20,00	13,85	277,00	8,00	Casted in-situ using conventional scaffolding	
		Motorway L.B.		BR	20,00	13,85	277,00	8,00		
	10	Motorway R.B.	10+269	BR	100,00	13,85	1385,00	5,00	Precast prestressed beam	
		Motorway L.B.		BR	100,00	13,85	1385,00	5,00		
	11	Motorway R.B.	10+830	BR	20,00	13,85	277,00	5,00	Casted in-situ using conventional scaffolding	
		Motorway L.B.		BR	20,00	13,85	277,00	5,00		
	12	Motorway R.B.	12+678	BR	20,00	13,85	277,00	8,00	Casted in-situ using conventional scaffolding	
		Motorway L.B.		BR	20,00	13,85	277,00	8,00		
	13	Motorway R.B.	13+158	BR	90,00	13,85	1246,50	17,00	Precast prestressed beam	
		Motorway L.B.		BR	90,00	13,85	1246,50	17,00		
	14	Motorway R.B.	18+348	BR	260,00	13,85	3601,00	32,00	Balanced cantilever	
		Motorway L.B.		BR	260,00	13,85	3601,00	32,00		
	15	Motorway R.B.	19+328	BR	100,00	13,85	1385,00	21,00	Precast prestressed beam	
		Motorway L.B.		BR	100,00	13,85	1385,00	21,00		

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION III : FARMACI - SMOKOVAC (ALTERNATIVE_III-1)	1	Motorway R.B.	54+888	BR	300,00	13,85	4155,00	12,00	Precast prestressed beam	
		Motorway L.B.		BR	300,00	13,85	4155,00	12,00		
	2	Motorway R.B.	60+086	BR	120,00	13,85	1662,00	8,00	Precast prestressed beam	
		Motorway L.B.		BR	120,00	13,85	1662,00	8,00		
	3	Motorway R.B.	60+807	BR	360,00	13,85	4986,00	87,00	Balanced cantilever	
		Motorway L.B.		BR	360,00	13,85	4986,00	87,00		

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION IV : SMOKOVAC - MATESEVO (ALTERNATIVE_IV-1)	1	Motorway R.B.	5+669	BR	370,00	13,85	5124,50	38,00	Balanced cantilever	
		Motorway L.B.		BR	370,00	13,85	5124,50	38,00		
	2	Motorway R.B.	6+431	BR	400,00	13,85	5540,00	27,00	Precast prestressed beam	
		Motorway L.B.		BR	400,00	13,85	5540,00	27,00		
	3	Motorway R.B.	7+330	BR	350,00	13,85	4847,50	17,00	Precast prestressed beam	
		Motorway L.B.		BR	350,00	13,85	4847,50	17,00		
	4	Motorway R.B.	15+583	BR	350,00	13,85	4847,50	20,00	Precast prestressed beam	
		Motorway L.B.		BR	350,00	13,85	4847,50	20,00		
	5	Motorway R.B.	19+028	BR	170,00	13,85	2354,50	8,00	Precast prestressed beam	
		Motorway L.B.		BR	170,00	13,85	2354,50	8,00		
	6	Motorway R.B.	20+480	BR	150,00	13,85	2077,50	5,00	Precast prestressed beam	
		Motorway L.B.		BR	150,00	13,85	2077,50	5,00		
	7	Motorway R.B.	23+638	BR	400,00	13,85	5540,00	14,00	Precast prestressed beam	
		Motorway L.B.		BR	400,00	13,85	5540,00	14,00		
	8	Motorway R.B.	24+770	BR	350,00	13,85	4847,50	38,00	Balanced cantilever	
		Motorway L.B.		BR	350,00	13,85	4847,50	38,00		
	9	Motorway R.B.	27+023	BR	400,00	13,85	5540,00	25,00	Precast prestressed beam	
		Motorway L.B.		BR	400,00	13,85	5540,00	25,00		

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION IV : SMOKOVAC - MATESEVO (ALTERNATIVE_IV-1)	10	Motorway R.B.	27+692	BR	150,00	13,85	2077,50	12,00	Precast prestressed beam	
		Motorway L.B.		BR	150,00	13,85	2077,50	12,00		
	11	Motorway R.B.	34+814	BR	240,00	13,85	3324,00	10,00	Precast prestressed beam	
		Motorway L.B.		BR	240,00	13,85	3324,00	10,00		
	12	Motorway R.B.	35+335	BR	200,00	13,85	2770,00	7,00	Precast prestressed beam	
		Motorway L.B.		BR	200,00	13,85	2770,00	7,00		
	13	Motorway R.B.	36+422	BR	80,00	13,85	1108,00	7,00	Precast prestressed beam	
		Motorway L.B.		BR	80,00	13,85	1108,00	7,00		
	14	Motorway R.B.	37+174	BR	280,00	13,85	3878,00	6,00	Precast prestressed beam	
		Motorway L.B.		BR	280,00	13,85	3878,00	6,00		
	15	Motorway R.B.	37+757	BR	140,00	13,85	1939,00	4,00	Precast prestressed beam	
		Motorway L.B.		BR	140,00	13,85	1939,00	4,00		
	16	Motorway R.B.	38+100	BR	170,00	13,85	2354,50	6,00	Precast prestressed beam	
		Motorway L.B.		BR	170,00	13,85	2354,50	6,00		
	17	Motorway R.B.	38+600	BR	100,00	13,85	1385,00	5,00	Precast prestressed beam	
		Motorway L.B.		BR	100,00	13,85	1385,00	5,00		
	18	Motorway R.B.	39+537	BR	120,00	13,85	1662,00	5,00	Precast prestressed beam	
		Motorway L.B.		BR	120,00	13,85	1662,00	5,00		
	19	Motorway R.B.	40+004	BR	140,00	13,85	1939,00	5,00	Precast prestressed beam	
		Motorway L.B.		BR	140,00	13,85	1939,00	5,00		

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION V : MATESEVO - ANDRIJEVICA (ALTERNATIVE_V-1)	1	Road		BR	35,00				Casted in-situ using conventional scaffolding	
	2	Motorway R.B.	0+860	BR	220,00	13,85	3047,00	6,00	Precast prestressed beam	
		Motorway L.B.		BR	220,00	13,85	3047,00	6,00		
	3	Motorway R.B.	2+087	BR	160,00	13,85	2216,00	11,00	Precast prestressed beam	
		Motorway L.B.		BR	160,00	13,85	2216,00	11,00		
	4	Motorway R.B.	14+974	BR	80,00	13,85	1108,00	10,00	Precast prestressed beam	
		Motorway L.B.		BR	80,00	13,85	1108,00	10,00		
	5	Motorway R.B.	15+584	BR	360,00	13,85	4986,00	41,00	Balanced cantilever	
		Motorway L.B.		BR	360,00	13,85	4986,00	41,00		
	6	Motorway R.B.	16+086	BR	250,00	13,85	3462,50	21,00	Precast prestressed beam	
		Motorway L.B.		BR	250,00	13,85	3462,50	21,00		
	7	Motorway R.B.	18+027	BR	400,00	13,85	5540,00	37,00	Balanced cantilever	
		Motorway L.B.		BR	400,00	13,85	5540,00	37,00		
	8	Motorway R.B.	20+610	BR	160,00	13,85	2216,00	18,00	Precast prestressed beam	
		Motorway L.B.		BR	160,00	13,85	2216,00	18,00		
	9	Motorway R.B.	21+390	BR	340,00	13,85	4709,00	22,00	Precast prestressed beam	
		Motorway L.B.		BR	340,00	13,85	4709,00	22,00		

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION VI : ANDRIJEVICA - PODA (ALTERNATIVE_VI-2)	1	Motorway R.B.	14+821	BR	210,00	13,85	2908,50	32,00	Balanced cantilever	
		Motorway L.B.		BR	210,00	13,85	2908,50	32,00		
	2	Motorway R.B.	20+036	BR	220,00	13,85	3047,00	6,00	Precast prestressed beam	
		Motorway L.B.		BR	220,00	13,85	3047,00	6,00		

Section	Bridge No	Road	Chainage (Km)	Type (UP,OP,BR)	Length (m)	Width (m)	Area (m2)	Max Height (m)	Construction Method	Remarks
SECTION VII PODA - SERBIAN BORDERS (ALTERNATIVE_VII-1)	1	Motorway R.B.	29+680	BR	20,00	13,85	277,00	10,00	Casted in-situ using conventional scaffolding	
		Motorway L.B.		BR	20,00	13,85	277,00	10,00		
	2	Motorway R.B.	34+430	BR	300,00	13,85	4155,00	24,00	Precast prestressed beam	
		Motorway L.B.		BR	300,00	13,85	4155,00	24,00		
	3	Motorway R.B.	37+090	BR	300,00	13,85	4155,00	22,00	Precast prestressed beam	
		Motorway L.B.		BR	300,00	13,85	4155,00	22,00		
	4	Motorway R.B.	41+190	BR	100,00	13,85	1385,00	10,00	Precast prestressed beam	
		Motorway L.B.		BR	100,00	13,85	1385,00	10,00		
	5	Motorway R.B.	44+530	BR	100,00	13,85	1385,00	11,00	Precast prestressed beam	
		Motorway L.B.		BR	100,00	13,85	1385,00	11,00		

Table 11: Bridge Categories

6. PHASING OF CONSTRUCTION

The hilly or mountainous terrain in most sections of the route dictates that the percentage of tunnels and bridges/viaducts is significant. It varies in the hilly areas from about 17% in section III (Farmaci – Strganica or Smokovac) to more than 50% in section I (Djurmani-Virpazar). In the mountainous areas of section IV (Strganica or Smokovac to Matesevo) and section V (Matesevo to Andrijevica) it is 30.2% and 26.7% respectively.

As a result there is a need for high investment costs early in the project. European safety standards place strict controls on the design of tunnels and bridges for a given level of service and safety even when traffic levels are quite low.

Therefore the possibility of phased construction of carriageways, tunnel bores and or second branches of bridges has been fully evaluated. The possibilities examined included:

- a single two-lane carriageway with climbing/overtaking lanes where necessary and depending also on the percentage of heavy trucks (as per the most conservative German standards, i.e. 2+1 lanes in part of the route but with reduced safety considerations)
- a 2 plus 1 lanes scheme with a safety barrier in the median area which offers increased road safety
- rehabilitation of parts of the existing national road network particularly at the north of the route (where low traffic volumes are expected)which will pay emphasis to significant improvements to the safety standards

It should be noted that irrespective of the sub-phasing to be used for the first two of the above alternatives, the width of the corridor was studied even from this early stage as a dual carriageway motorway corridor. This will enable future construction of the second carriageway at a later stage.

It is also recognized that the cost of a single two-lane carriageway is more than half the cost of a dual motorway. Likewise the ultimate cost of a phased dual motorway will be higher than building a dual motorway at the outset. The economic and financial analyses will determine the optimum timing of the phasing.

Having all the above in mind the following adoption per section and alternative of single two-lane carriageway and dual two-lane carriageway is proposed. It takes into consideration:

- the difficulties in certain areas, due to the demanding terrain, in executing the second branch of a bridge or a tunnel
- the fact that gradient more than 4% is observed in certain sub-sections of the route resulting to the need from early on of a climbing/overtaking lane

For example, it can be observed that section III (Farmaci to Smokovac) should always be considered as a dual two-lane carriageway, section V (Matesevo-Andrijevica) the adoption of single two-lane carriageway is applicable to 70% of the section while in section VII (Poda to Serbian Border the rehabilitation/improvement of the existing road to higher safety levels is short term and medium term a plausible scenario.

In general, If the identified zones of single two-lane carriageway are also zones of low traffic volumes than the likelihood of adopting a phased construction increase significantly since the full dual two-lane carriageway in this particular section may not be required in the short term or medium term.

Some notes on the applicability of short /medium term of single bi-directional tunnels and single branch bridges follow:

Use of single bore bi-directional tunnels

Single bore bi-directional tunnels will also be considered. This can lead to reduction in overall tunnel length. All tunnel layouts will have to satisfy the operational requirements of bi-directional traffic. In order to establish this design concept, the following issues will need to be considered.

- According to international recommendations, which are based on common design practice in various countries, and on the opinions of the experts on the PIARC WG4 committee, the total minimum width of the paved area (between the walkway's curb stone) in bidirectional tunnels should be 8.50m.
- Since there will be the option of constructing the second tunnel bore at a later stage, where possible the shortest bore shall be constructed first.
- Where only one bore of each tunnel is proposed to serve as a single bidirectional tunnel, the emergency niches should be constructed in both tunnel's sidewalls (one for each traffic lane direction), by keeping distances of 150m, according to the EU Directive 2005/54/EC. The drainage niches, shall be foreseen in both tunnel's sidewalls.
- According to the EU Directive, the lay-bys in each tunnel longer than 1500m should be placed every 1000m along the sidewall of each traffic direction lane. Thus, in case of the proposed bi-directional tunnels, additional lay-bys should also be foreseen in the left sidewall of each tunnel.
- Pedestrian emergency exits (evacuation adits) should be foreseen in tunnels every 500m, for traffic loads greater than 2000 vehicles per lane, according to the EU Directive.
- Vehicular emergency exits should be foreseen every 1500m in tunnels longer than 1500m, for traffic loads greater than 2000 vehicles per lane, according to the EU Directive.
- Certain calculations and E/M ventilation analyses should prove the eventual need for fire smoke extraction point, by means of either ventilation adits or shafts.

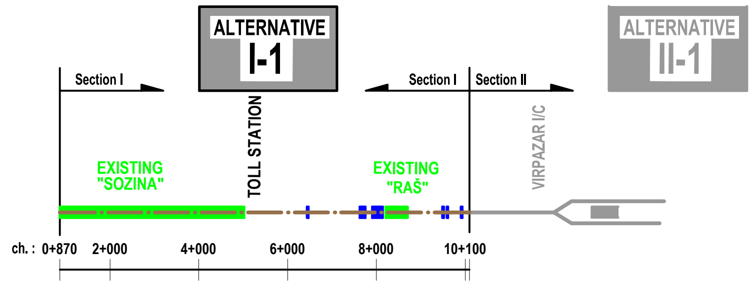
The holistic approach for the final determination of the main characteristics and civil work layouts of the single tube bi-directional tunnels shall be performed by considering the combined operation of the interactive role of both the emergency exits and the smoke extraction points (if any), in order to provide the best balanced arrangement of the tunnel complex.

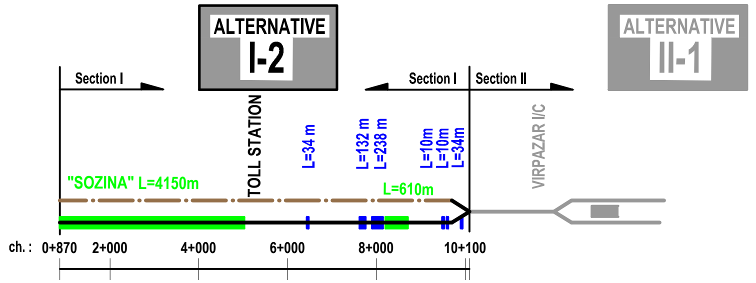
Single branch bridges

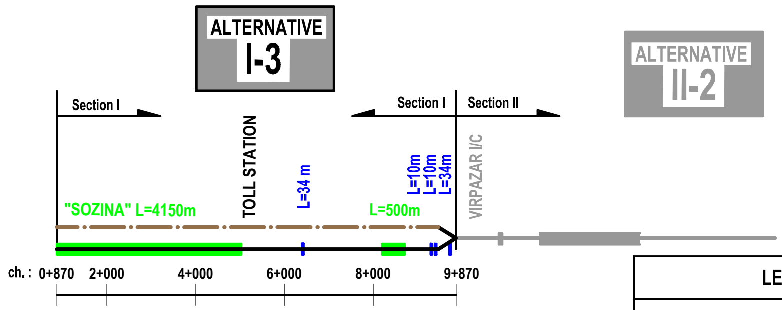
In case only one branch of the bridge is to be constructed in the initial phase of the project (with the second branch following, depending on the traffic volumes) the foundations of the piers and abutments of both branches shall be constructed during the construction of the first branch. The same applies for any other item which facilitates the construction of the second branch. For instance, the construction of part of the piers and/or the abutments of the second branch shall be executed during the initial phase of the project.

All the above rely significantly on the traffic flow figures with time that will be observed along the route as they will be predicted in the final report and certainly they will be considered in the evaluation of the technical options with respect to initial capital expenditure considerations.

SECTION - I







NOTES

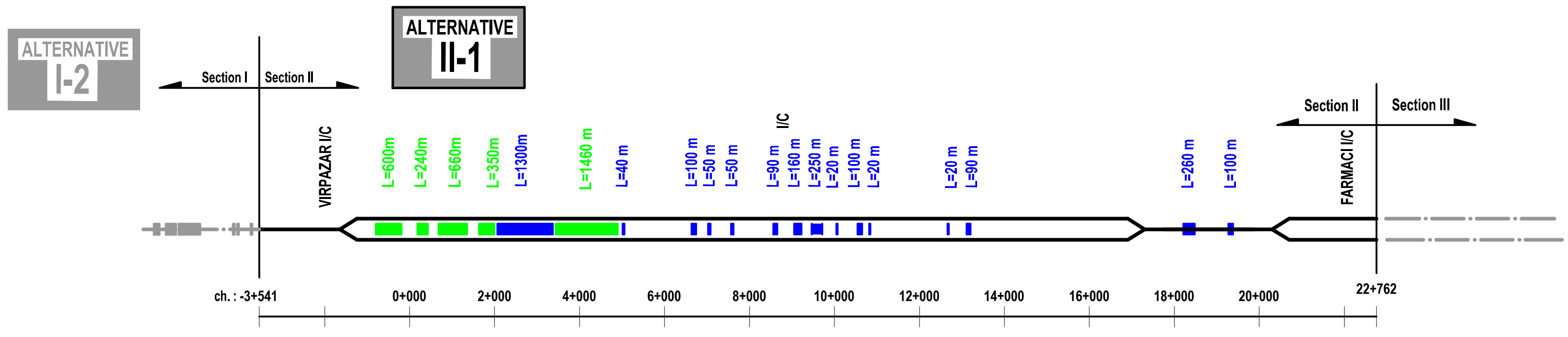
1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

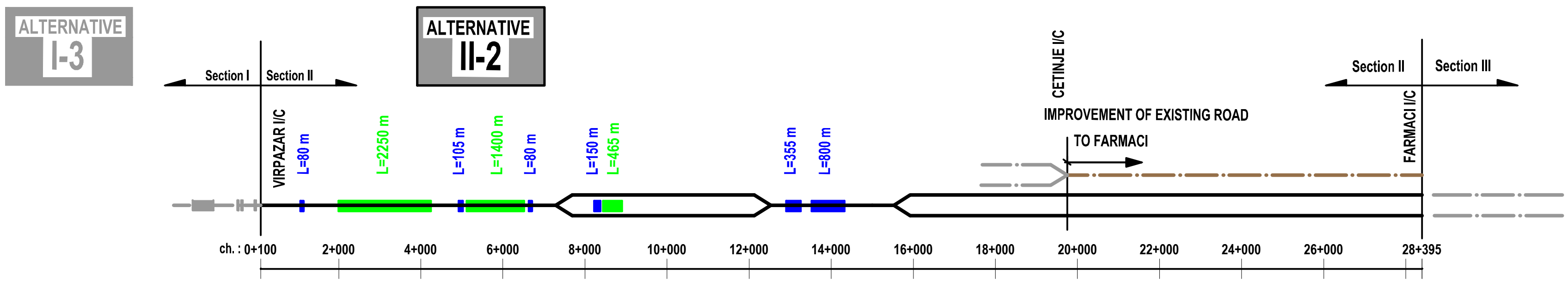
	Alt. I - 1	Alt. I - 2	Alt. I - 3
"Single two-lane" (m) / (%)	9.230 / (100%)	0 / (00.0%)	0 / (00.0%)
" Dual two-lane" (m)	0	9.230	9.000
Total Length (m)	9.230	9.230	9.000

LEGEND

IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - II





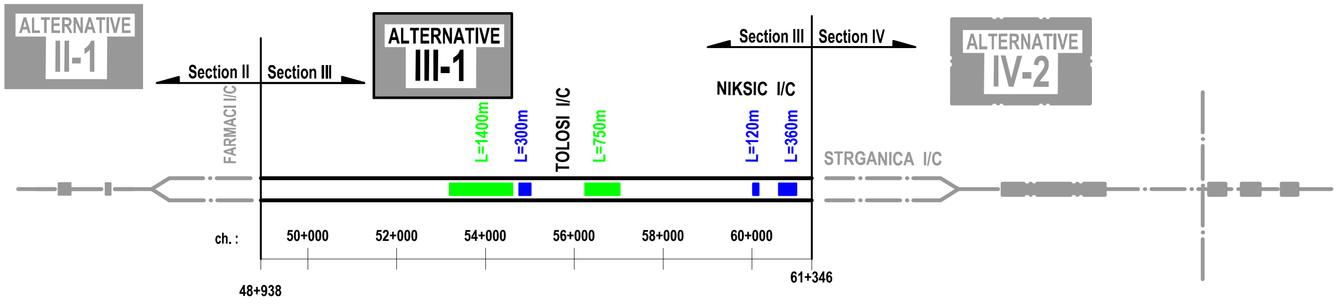
NOTES

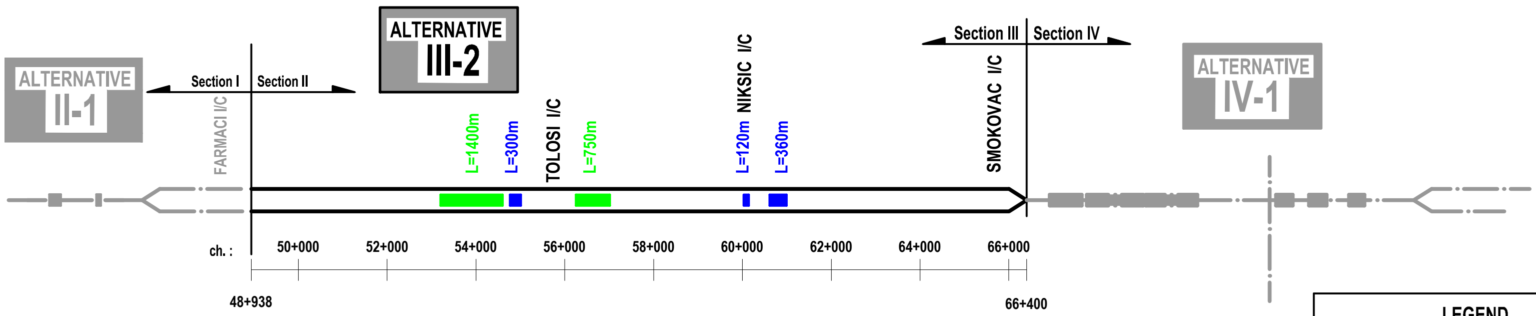
1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. II - 1	Alt. II - 2
"Single two-lane" (m) / (%)	4.900 / (18.6%)	9.180 / (32.4%)
" Dual two-lane" (m)	21.403	19.115
Total Length (m)	26.303	28.295

LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - III





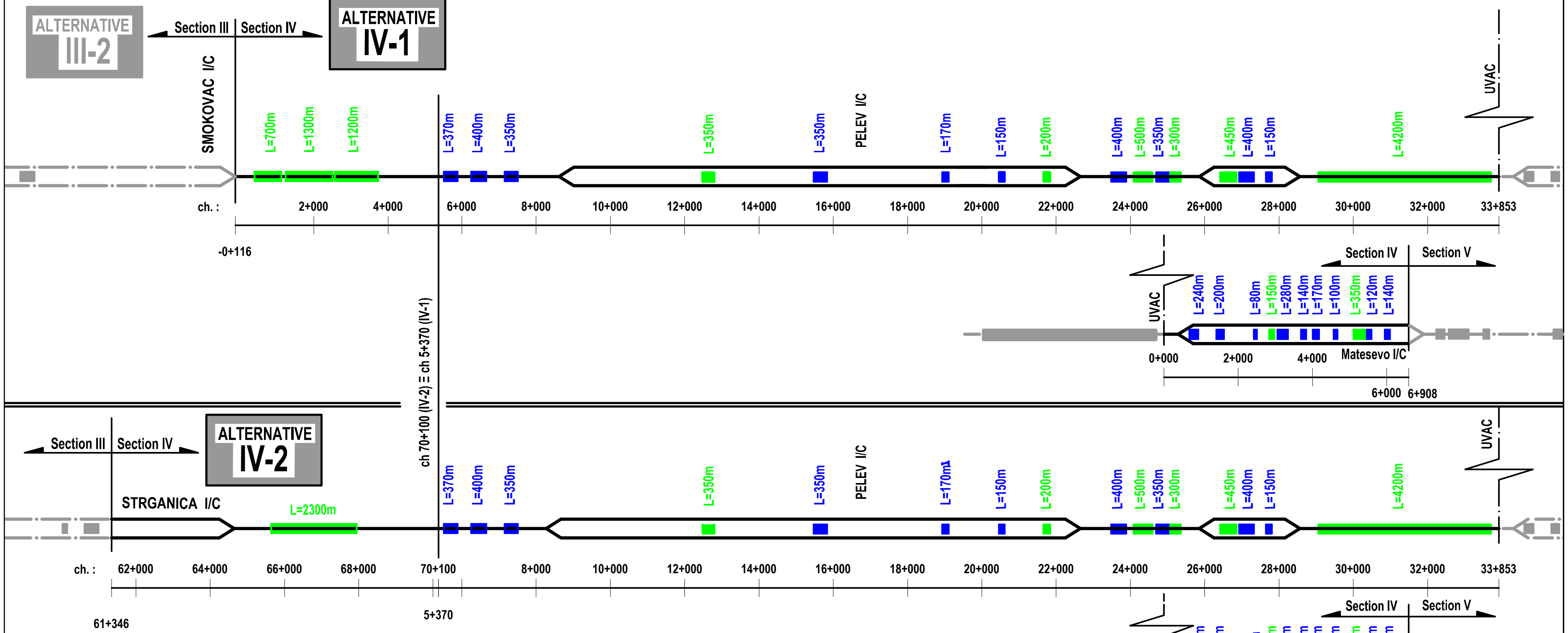
NOTES

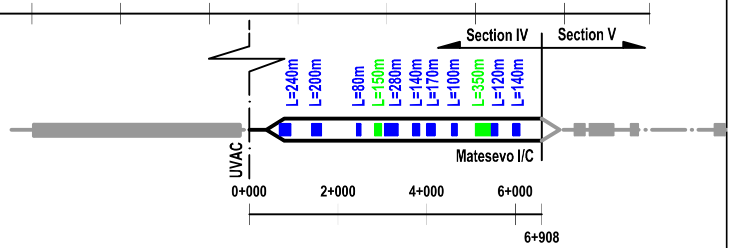
1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. III - 1	Alt. III - 2
"Single two-lane" (m) / (%)	0 / (0.0%)	0 / (0.0%)
" Dual two-lane" (m)	12.408	17.462
Total Length (m)	12.408	17.462

LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - IV





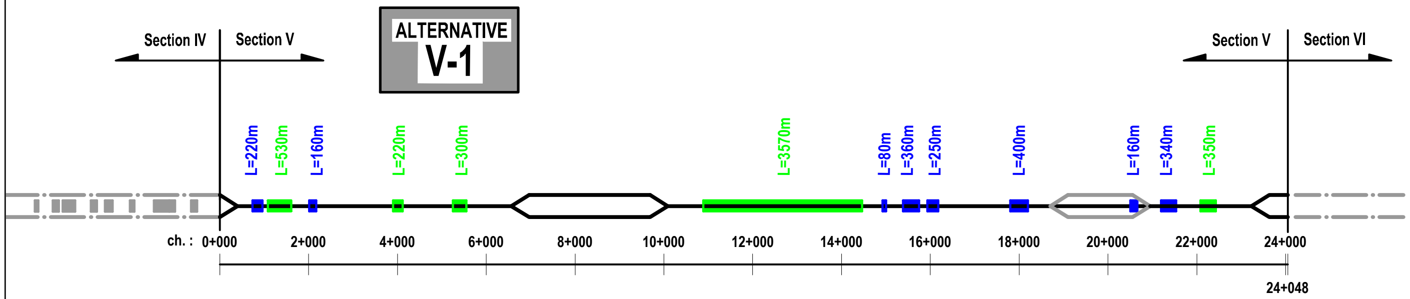
NOTES

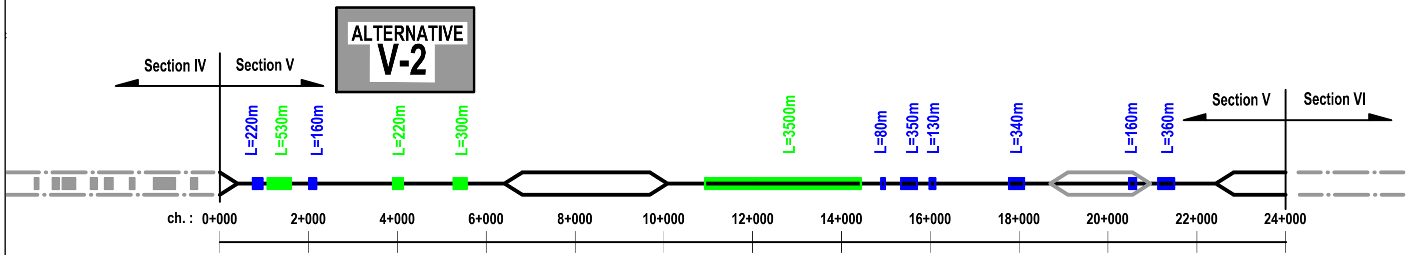
1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. IV - 1	Alt. IV - 2
"Single two-lane" (m) / (%)	17.645 / (43.2%)	17.345 / (39.3%)
" Dual two-lane" (m)	23.232	26.800
Total Length (m)	40.877	44.145

LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - V





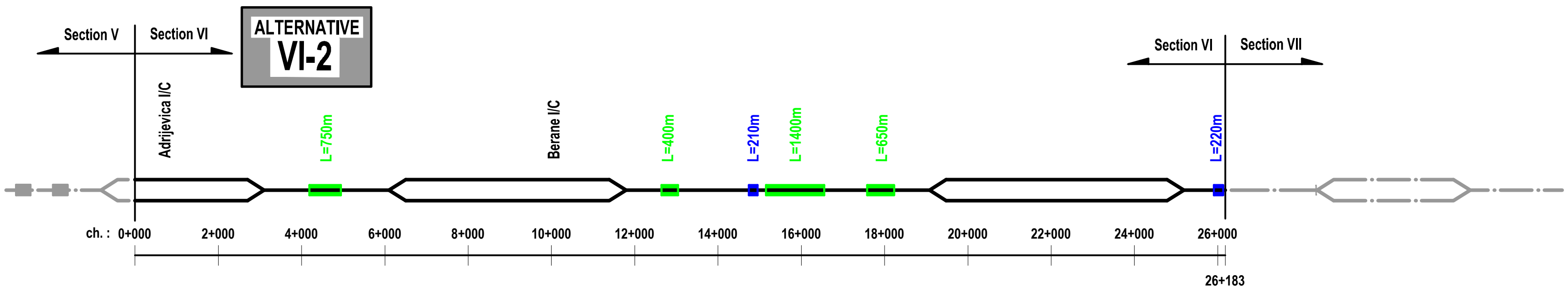
NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. V - 1	Alt. V-2
"Single two-lane" (m) / (%)	17.053 / (70.9%)	16.109 / (67.1%)
" Dual two-lane" (m)	6.995	7.891
Total Length (m)	24.048	24.000

LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - VI



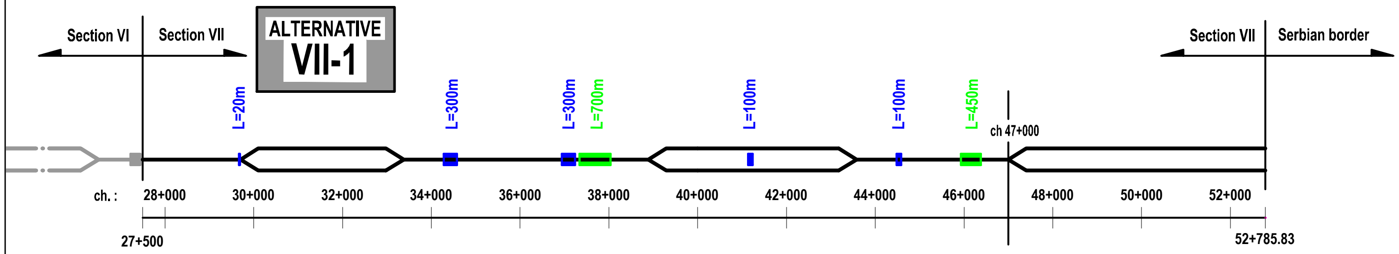
NOTES

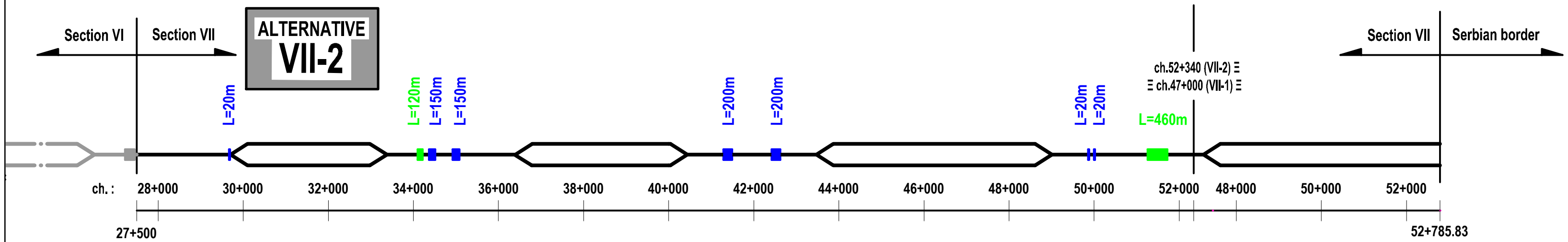
1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

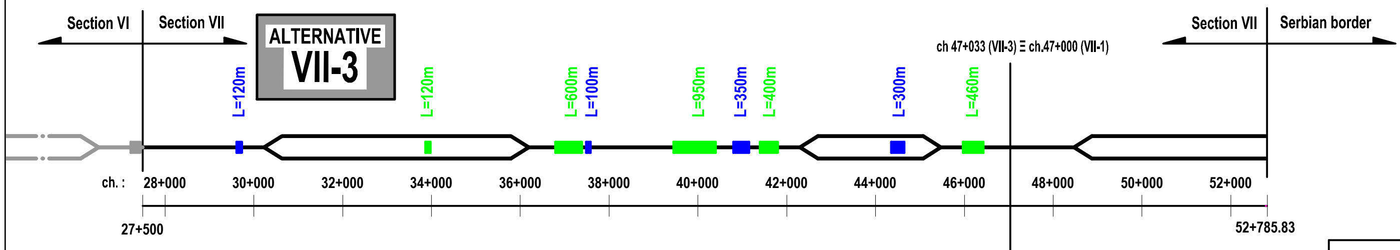
	Alt. VI- 2
"Single two-lane" (m) / (%)	11.300 / (43.2%)
" Dual two-lane" (m)	14.883
Total Length (m)	26.183

LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - VII







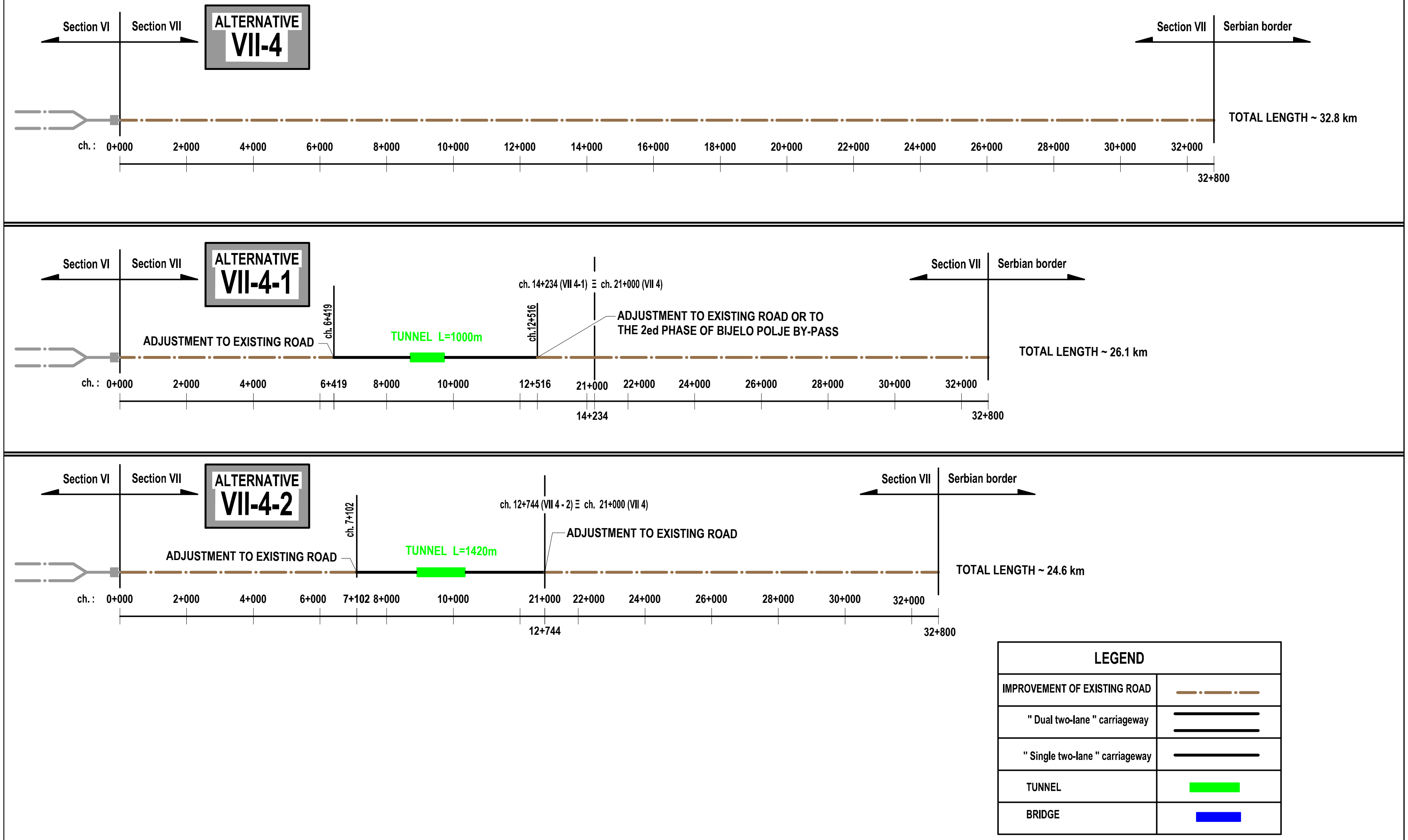
NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. VII - 1	Alt. VII - 2	Alt. VII - 3
"Single two-lane" (m) / (%)	11.130 / (44.0%)	11.760 / (38.4%)	11.840 / (46.8%)
" Dual two-lane" (m)	14.156	18.866	13.479
Total Length (m)	25.286	30.626	25.319

LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - VII



Section VI
Section VII
ALTERNATIVE
VII-4
Section VII
Serbian border
TOTAL LENGTH ~ 32.8 km
ch. :
0+000
2+000
4+000
6+000
8+000
10+000
12+000
14+000
16+000
18+000
20+000
22+000
24+000
26+000
28+000
30+000
32+000
32+800
Section VI
Section VII
ALTERNATIVE
VII-4-1
ch. 14+234 (VII 4-1) Ξ ch. 21+000 (VII 4)
ch. 6+419
ch. 12+516
ADJUSTMENT TO EXISTING ROAD
TUNNEL L=1000m
ADJUSTMENT TO EXISTING ROAD OR TO
THE 2ed PHASE OF BIJELO POLJE BY-PASS
Section VII
Serbian border
TOTAL LENGTH ~ 26.1 km
ch. :
0+000
2+000
4+000
6+419
8+000
10+000
12+516
21+000
22+000
24+000
26+000
28+000
30+000
32+000
14+234
32+800
Section VI
Section VII
ALTERNATIVE
VII-4-2
ch. 7+102
ch. 12+744 (VII 4 - 2) Ξ ch. 21+000 (VII 4)
ADJUSTMENT TO EXISTING ROAD
TUNNEL L=1420m
ADJUSTMENT TO EXISTING ROAD
Section VII
Serbian border
TOTAL LENGTH ~ 24.6 km
ch. :
0+000
2+000
4+000
6+000
7+102
8+000
10+000
21+000
22+000
24+000
26+000
28+000
30+000
32+000
12+744
32+800
LEGEND
IMPROVEMENT OF EXISTING ROAD
" Dual two-lane " carriageway
" Single two-lane " carriageway
TUNNEL
BRIDGE

7 COST ESTIMATIONS

7.1 Basis of estimating

Construction cost estimates have been based on the Consultant's knowledge of works in the Balkans region and with particular referece to the pricing offers for the 2008 Bar-Boljare DBFO scheme. The Consultant was directly involved with supporting one bidding consortium which reached the final stages of procurement and therefore there is reason to hold a high degree of confidence in the cost estimates used in this study. For this reason and in contrast to what might normally be expected, no Optimism Bias is included in the estimates,.

As described in the previous sections, emphasis has been placed on how to keep costs to a reasonable minimum by:

- Adopting single carriageway configuration at tunnel and bridge locations
- Adopting dual section configuration where it is economical to do so
- Envisaging efficient design/construction techniques for retaining walls, cuts, crossings etc
- Making a balanced provison for full dualisation at some time in the future

Bearing in mind that this study is conducted at general design level the estimation of land acquisition costs and social and environmental impact mitigation has been made on the basis of the land footprint of the scheme(s) on a percentage basis of the construction cost.

Operation and maintenance costs have been taken on per kilometre basis using regional experience.

7.2 Capital construction costs

Table 7.1 sets out the cost estimates of the selected alternatives by Section. Two costings are shown for each Alternative:

- The first column in orange highlight shows the cost of that Section for a full 2x2 dual carriageway
- The second column in green highlight shoes the cost of that Section for the chosen engineered solution adopting cost-saving measures as described above: the "mixed profile".

When looking at Section VII from Poda to the border, two Alternatives are presented as discussed in the earlier sections: Section VII corresponds to the Poda – Boljare alignment and Section VIIa represents upgrading of the existing road, with deviations, from Poda to the existing border crossing.

The summation of the first (orange) columns represents the total estimated cost of a full profile 2x2 motorway between Bar (Djurmani) and a new border crossing at Boljare. This is Euros 2,112 million and it compares with the preferred 2008 DBFO bid of around US$ 3 billion.

The option to connect by full 2x2 profile to the exisitng border crossing would reduce the cost to Euros 1,951 million.

The summation of the second (green) columns represents the total estimated cost of a mixed profile motorway between Bar (Djurmani) and either a new border crossing at Boljare or the exisitng border. These are Euros 1,461 and Euros 1,388 million respectively.

7.2 Comments on capital construction costs

Table 7.1 also shows average construction costs per kilometre by Section. It is useful to benchmark these estimated costs against actual out-turn costs in the Balkans region. Fig 7.1 shows graphically typical per-kilometre costs of 2x2 profile road construction. The 2008 DBFO scheme for Bar-Boljare (although not directly comparable with a conventional procurement) represented an average unit cost over the whole 170 km length of Euros 14.4 million/km. This figure is an average over the whole length and the unit costs in the difficult mountainous areas of Sections IV and V would be in the region of Euros 20 million/km.

Reference to Table 7.1 shows that for the scheme engineered in this study, unit costs for Sections IV and V are calculated to be between Euros 15 and 17.5 million/km for the full profile and by engineering a mixed profile this has been reduced to between Euros 8 and 11 million per km for Sections IV and V and a little over Euros 8 million/km for the whole 170 km length. These unit costs fit well on the the Fig 7.1 information and reinforce the degree of confidence in the estimating.

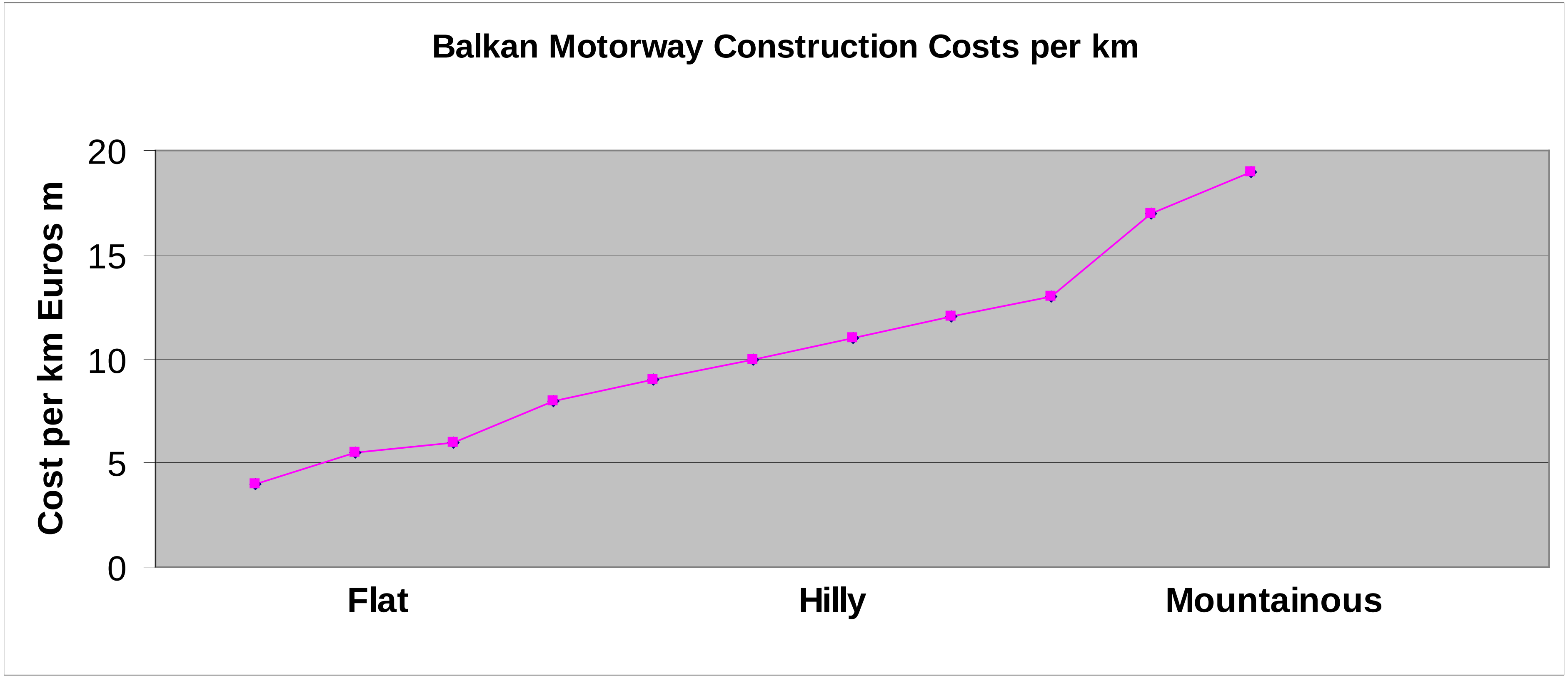
Fig 7.1 Estimates of Costs of Construction

SEETO 4 - DJURMANI TO SERBIAN BORDER - INVESTMENT COST CAPEX ESTIMATES

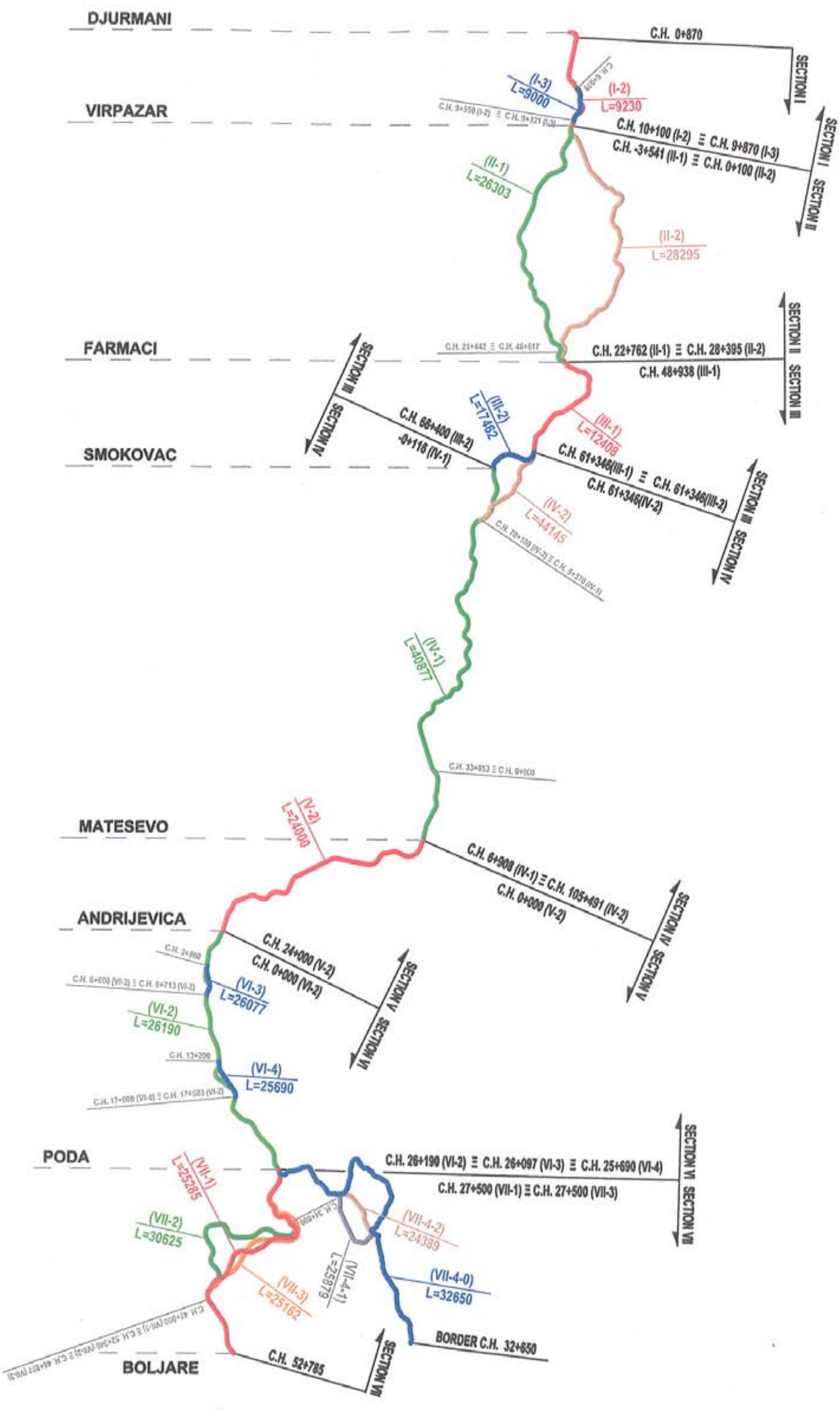
	Section I		Section II		Section III		Section IV		Section V		Section VI		Section VII (*Option Boljare*)		Section VIIa (*Option existing border*)	
	Djurmani-Virpazar		Virpazar-Farmaci		Farmaci-Straganica		Straganica-Matesevo		Matesevo-Andrijevica		Andrijevica-Poda		Poda-Boljare		Poda-Existing Border	
Euros million	Full 2 x 2	Selected scheme	Full 2 x 2	Selected scheme	Full 2 x 2	Selected scheme	Full 2 x 2	Selected scheme	Full 2 x 2	Selected scheme	Full 2 x 2	Selected scheme	Full 2 x 2	Selected scheme	Alternative VII-4-1	Selected scheme
TOTAL CAPEX	73.0	73.0	269.8	202.4	145.7	145.7	671.2	469.8	417.7	208.5	283.4	198.4	251.3	163.3	89.9	89.9
Section length km	9.0	9.0	28.3	28.3	12.4	12.4	44.1	44.1	24.0	24.0	26.2	26.2	25.3	25.3	32.8	32.8
CAPEX Cost - per km	8.1	8.1	9.5	7.2	11.8	11.8	15.2	10.7	17.4	8.7	10.8	7.6	9.9	6.5	2.7	2.7

SUMMARY CAPEX COSTS: Euros million	*Option*	*Option*
Proposed Scheme	*to Boljare*	*to Serbian Border*
Dual Two-Lane	2,112	1,951
Dual/Single Two-Lane (as appropriate)	1,461	1,388

Fig 7.2 Typical regional construction costs



Source: Consultant's research. Represents a 2x2 profile cross section


DJURMANI
C.H. 0+870
SECTION I
(I-3)
L=9000
(I-2)
L=9230
VIRPAZAR
C.H. 10+100 (I-2) ≡ C.H. 9+870 (I-3)
C.H. -3+541 (II-1) ≡ C.H. 0+100 (II-2)
SECTION I SECTION II
(II-1)
L=26303
(II-2)
L=28295
FARMACI
C.H. 22+762 (II-1) ≡ C.H. 28+395 (II-2)
C.H. 48+938 (III-1)
SECTION II SECTION III
SECTION III SECTION IV
(III-2)
L=17462
(III-1)
L=12408
C.H. 66+400 (III-2)
-0+118 (IV-1)
SMOKOVAC
C.H. 61+346(III-1) ≡ C.H. 61+346(III-2)
C.H. 61+346(IV-2)
SECTION III SECTION IV
(IV-2)
L=44145
(IV-1)
L=40877
(V-2)
L=24000
MATESEVO
C.H. 6+908 (IV-1) ≡ C.H. 105+491 (IV-2)
C.H. 0+000 (V-2)
SECTION IV SECTION V
ANDRIJEVICA
C.H. 24+000 (V-2)
C.H. 0+000 (VI-2)
SECTION V SECTION VI
(VI-3)
L=26077
(VI-2)
L=26190
(VI-4)
L=25690
PODA
C.H. 26+190 (VI-2) ≡ C.H. 26+097 (VI-3) ≡ C.H. 25+690 (VI-4)
C.H. 27+500 (VII-1) ≡ C.H. 27+500 (VII-3)
SECTION VI SECTION VII
(VII-1)
L=25285
(VII-2)
L=30625
(VII-3)
L=25162
(VII-4-1)
L=25879
(VII-4-2)
L=24389
(VII-4-0)
L=32650
BORDER C.H. 32+650
BOLJARE
C.H. 52+785
SECTION VII

APPENDIX

List of General Design Drawings

(included in a separate Volume)

SEETO ROAD ROUTE 4 INVESTMENT PLAN

TECHNICAL OPTIONS - GENERAL DESIGN

All Sections & Alternatives - List of Drawings

SECTION I: DJURMANI - VIRPAZAR

No.	Doc Type	Design Discipl.	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	Layout Plan - Longitudinal profile								
1	D W G	R D G	S Y S	I	0 0 1	ALTERNATIVE I - 2 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 0+870 - CH. 10+100	1:25000 1:25000/1:2500	00	JUNE 2012
2	D W G	R D G	S Y S	I	0 0 2	ALTERNATIVE I - 3 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 0+870 - CH. 9+870	1:25000 1:25000/1:2500	00	JUNE 2012
	General Plan								
3	D W G	R D G	S Y S	I	0 0 3	ALTERNATIVE I - 2 & I - 3 GENERAL LAYOUT PLAN CH. 0+870 - CH. 10+100	1:25000	00	JUNE 2012

SECTION II: VIRPAZAR - FARMACI

No.	Doc Type	Design Discipl.	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	Layout Plans - Longitudinal profiles								
1	D W G	R D G	S Y S	II	0 0 1	ALTERNATIVE II - 1 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. -3+541.19 - CH. 9+638.81	1:25000 1:25000/1:5000	00	JUNE 2012
2	D W G	R D G	S Y S	II	0 0 2	ALTERNATIVE II - 1 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 9+638.81 - CH. 48+937.51	1:25000 1:25000/1:5000	00	JUNE 2012
3	D W G	R D G	S Y S	II	0 0 3	ALTERNATIVE II - 2 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 0+100.00 - CH. 15+000.00	1:25000 1:25000/1:5000	00	JUNE 2012
4	D W G	R D G	S Y S	II	0 0 4	ALTERNATIVE II - 2 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 15+000.00 - CH. 28+395.00	1:25000 1:25000/1:5000	00	JUNE 2012

RDG: Road Geometrical Design-General
SYS: SYSTAS SA

No.	Doc Type	Design Discipl.	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	General Plan								
5	D W G	R D G	S Y S	II	0 0 5	ALTERNATIVE II-1 (1/2) GENERAL LAYOUT PLAN CH. -3+541.19 - CH. 9+638.81	1:25000	00	JUNE 2012
6	D W G	R D G	S Y S	II	0 0 6	ALTERNATIVE II-1 (2/2) GENERAL LAYOUT PLAN CH. 9+638.81 - CH. 48+937.51	1:25000	00	JUNE 2012
7	D W G	R D G	S Y S	II	0 0 7	ALTERNATIVE II-2 (1/2) GENERAL LAYOUT PLAN CH. 0+100.00 - CH. 15+000.00	1:25000	00	JUNE 2012
8	D W G	R D G	S Y S	II	0 0 8	ALTERNATIVE II-2 (2/2) GENERAL LAYOUT PLAN CH. 15+000.00 - CH. 28+395.00	1:25000	00	JUNE 2012

SECTION III: FARMACI - SMOKOVAC (STRGANICA)

No.	Doc Type	Design Discipl.	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	Layout Plan - Longitudinal profile								
1	D W G	R D G	S Y S	III	0 0 1	ALTERNATIVE III - 1 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 48+938- CH. 61+346	1:25000 1:25000/1:2500	00	JUNE 2012
2	D W G	R D G	S Y S	III	0 0 2	ALTERNATIVE III - 2 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 48+938 - CH. 66+400	1:25000 1:25000/1:2500	00	JUNE 2012
								00	
	General Plan							00	
3	D W G	R D G	S Y S	III	0 0 3	ALTERNATIVE III-1 GENERAL LAYOUT PLAN CH. 48+938- CH. 61+346	1:25000	00	JUNE 2012
4	D W G	R D G	S Y S	III	0 0 4	ALTERNATIVE III-2 GENERAL LAYOUT PLAN CH. 48+938 - CH. 66+400	1:25000	00	JUNE 2012

RDG: Road Geometrical Design-General
SYS: SYSTAS SA

SECTION IV: SMOKOVAC - MATESEVO

No.	Doc Type	Design Discipl.	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	Layout Plans - Longitudinal profiles								
1	D W G	R D G	S Y S	IV	0 0 1	ALTERNATIVE IV - 1 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. -0+116 - CH. 19+291	1:25000 1:25000/1:5000	00	JUNE 2012
2	D W G	R D G	S Y S	IV	0 0 2	ALTERNATIVE IV - 1 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 19+291 - CH. 6+908	1:25000 1:25000/1:5000	00	JUNE 2012
3	D W G	R D G	S Y S	IV	0 0 3	ALTERNATIVE IV - 2 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 61+346 - CH. 70+100	1:25000 1:25000/1:5000	00	JUNE 2012
	General Plan								
4	D W G	R D G	S Y S	IV	0 0 4	ALTERNATIVE IV - 1 (1/2) GENERAL LAYOUT PLAN CH. -0+116 - CH. 19+291	1:25000	00	JUNE 2012
5	D W G	R D G	S Y S	IV	0 0 5	ALTERNATIVE IV - 1 (2/2) GENERAL LAYOUT PLAN CH. 19+291 - CH. 6+908	1:25000	00	JUNE 2012
6	D W G	R D G	S Y S	IV	0 0 6	ALTERNATIVE IV - 2 GENERAL LAYOUT PLAN CH. 61+346 - CH. 70+100	1:25000	00	JUNE 2012

SECTION V: MATESEVO - ANDRIJEVICA

No.	Doc Type	Design Discipl.	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	Layout Plans - Longitudinal profiles								
1	D W G	R D G	S Y S	V	0 0 1	ALTERNATIVE V - 1 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 0+000 - CH. 12+022	1:25000 1:25000/1:2500	00	JUNE 2012
2	D W G	R D G	S Y S	V	0 0 2	ALTERNATIVE V - 1 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 12+022 - CH. 24+048	1:25000 1:25000/1:2500	00	JUNE 2012
3	D W G	R D G	S Y S	V	0 0 3	ALTERNATIVE V - 2 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 0+000 - CH. 12+051	1:25000 1:25000/1:2500	00	JUNE 2012
4	D W G	R D G	S Y S	V	0 0 4	ALTERNATIVE V - 2 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 12+051 - CH. 24+000	1:25000 1:25000/1:2500	00	JUNE 2012

RDG: Road Geometrical Design-General
SYS: SYSTAS SA

No	Doc Type			Design Discipl.			Originator			Section	Serial Number			Drawing title	Scale	Revision	Date
	General Plan																
5	D	W	G	R	D	G	S	Y	S	V	0	0	5	ALTERNATIVE V - 1 (1/2) GENERAL LAYOUT PLAN CH. 0+000 - CH. 12+022	1:25000	00	JUNE 2012
6	D	W	G	R	D	G	S	Y	S	V	0	0	6	ALTERNATIVE V - 1 (2/2) GENERAL LAYOUT PLAN CH. 12+022 - CH. 24+048	1:25000	00	JUNE 2012
7	D	W	G	R	D	G	S	Y	S	V	0	0	7	ALTERNATIVE V - 2 (1/2) GENERAL LAYOUT PLAN CH. 0+000 - CH. 12+051	1:25000	00	JUNE 2012
8	D	W	G	R	D	G	S	Y	S	V	0	0	8	ALTERNATIVE V - 2 (2/2) GENERAL LAYOUT PLAN CH. 12+051 - CH. 24+000	1:25000	00	JUNE 2012

SECTION VI: ANDRIJEVICA - PODA

No.	Doc Type			Design Discipl.			Originator			Section	Serial Number			Drawing title	Scale	Revision	Date
	Layout Plans - Longitudinal profiles																
1	D	W	G	R	D	G	S	Y	S	VI	0	0	1	ALTERNATIVE VI - 2 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 0+000 - CH. 12+579.36	1:25000 1:25000/1:2500	00	JUNE 2012
2	D	W	G	R	D	G	S	Y	S	VI	0	0	2	ALTERNATIVE VI - 2 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 12+579.36 - CH. 26+183.00	1:25000 1:25000/1:2500	00	JUNE 2012
3	D	W	G	R	D	G	S	Y	S	VI	0	0	3	ALTERNATIVE VI - 3 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 3+800.00 - CH. 6+600.00	1:25000 1:25000/1:2500	00	JUNE 2012
4	D	W	G	R	D	G	S	Y	S	VI	0	0	4	ALTERNATIVE VI - 4 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 13+200.00 - CH. 17+000.00	1:25000 1:25000/1:2500	00	JUNE 2012
	General Plan																
5	D	W	G	R	D	G	S	Y	S	VI	0	0	5	ALTERNATIVE VI - 2 (1/2) GENERAL LAYOUT PLAN CH. 0+000 - CH. 12+579.36	1:25000	00	JUNE 2012
6	D	W	G	R	D	G	S	Y	S	VI	0	0	6	ALTERNATIVE VI - 2 (2/2) GENERAL LAYOUT PLAN CH. 12+579.36 - CH. 26+183.00	1:25000	00	JUNE 2012
7	D	W	G	R	D	G	S	Y	S	VI	0	0	7	ALTERNATIVE VI - 3 GENERAL LAYOUT PLAN CH. 3+800.00 - CH. 6+600.00	1:25000	00	JUNE 2012
8	D	W	G	R	D	G	S	Y	S	VI	0	0	8	ALTERNATIVE VI - 4 GENERAL LAYOUT PLAN CH. 13+200.00 - CH. 17+000.00	1:25000	00	JUNE 2012

RDG: Road Geometrical Design-General
SYS: SYSTAS SA

SECTION VII: PODA - SERBIAN BORDERS

No	Doc Type	Design Discipl	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	Layout Plans - Longitudinal profiles								
1	D W G	R D G	S Y S	VII	0 0 1	ALTERNATIVE VII - 1 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 27+500 - CH. 40+000	1:25000 1:25000/1:5000	00	JUNE 2012
2	D W G	R D G	S Y S	VII	0 0 2	ALTERNATIVE VII - 1 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 40+000 - CH. 52+785.83	1:25000 1:25000/1:5000	00	JUNE 2012
3	D W G	R D G	S Y S	VII	0 0 3	ALTERNATIVE VII - 2 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 27+500 - CH. 44+000	1:25000 1:25000/1:5000	00	JUNE 2012
4	D W G	R D G	S Y S	VII	0 0 4	ALTERNATIVE VII - 2 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 44+000 - CH. 58+126.29	1:25000 1:25000/1:5000	00	JUNE 2012
5	D W G	R D G	S Y S	VII	0 0 5	ALTERNATIVE VII - 3 (1/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 27+500 - CH. 41+000	1:25000 1:25000/1:5000	00	JUNE 2012
6	D W G	R D G	S Y S	VII	0 0 6	ALTERNATIVE VII - 3 (2/2) LAYOUT PLAN & LONGITUDINAL PROFILE CH. 41+000 - CH. 52+734.09	1:25000 1:25000/1:5000	00	JUNE 2012
11	D W G	R D G	S Y S	VII	0 1 1	ALTERNATIVE VII - 4 - 1 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 6+419 - CH. 12+516	1:25000 1:25000/1:5000	00	JUNE 2012
12	D W G	R D G	S Y S	VII	0 1 2	ALTERNATIVE VII - 4 - 2 LAYOUT PLAN & LONGITUDINAL PROFILE CH. 7+102 - CH. 12+744	1:25000 1:25000/1:5000	00	JUNE 2012
	General Plan								
7	D W G	R D G	S Y S	VII	0 0 7	ALTERNATIVE VII - 1 GENERAL LAYOUT PLAN CH. 27+500 - CH. 52+785.83	1:25000	00	JUNE 2012
8	D W G	R D G	S Y S	VII	0 0 8	ALTERNATIVE VII - 2 GENERAL LAYOUT PLAN CH. 27+500 - CH. 58+126.29	1:25000	00	JUNE 2012
9	D W G	R D G	S Y S	VII	0 0 9	ALTERNATIVE VII - 3 GENERAL LAYOUT PLAN CH. 27+500 - CH. 52+734.09	1:25000	00	JUNE 2012
10	D W G	R D G	S Y S	VII	0 1 0	ALTERNATIVE VII - 4 GENERAL LAYOUT PLAN CH. 0+000 - CH. 32+645	1:25000	00	JUNE 2012

RDG: Road Geometrical Design-General
SYS: SYSTAS SA

SECTION: I, II, III, IV, V, VI & VII

No	Doc Type	Design Discipl	Originator	Section	Serial Number	Drawing title	Scale	Revision	Date
	Typical Cross Sections								
1	D W G	R D G	S Y S	-	4 0 1	**TYPICAL CROSS SECTIONS "Dual two-lane" carriageway and Phased Construction**	1:100	00	JUNE 2012
2	D W G	R D G	S Y S	-	4 0 2	**TYPICAL CROSS SECTIONS "Single two-lane" carriageway with additional lane**	1:100	00	JUNE 2012
3	D W G	R D G	S Y S	-	4 0 3	**TYPICAL CROSS SECTIONS "Dual two-lane" carriageway with additional lanes**	1:100	00	JUNE 2012

RDG: Road Geometrical Design-General
SYS: SYSTAS SA

URS

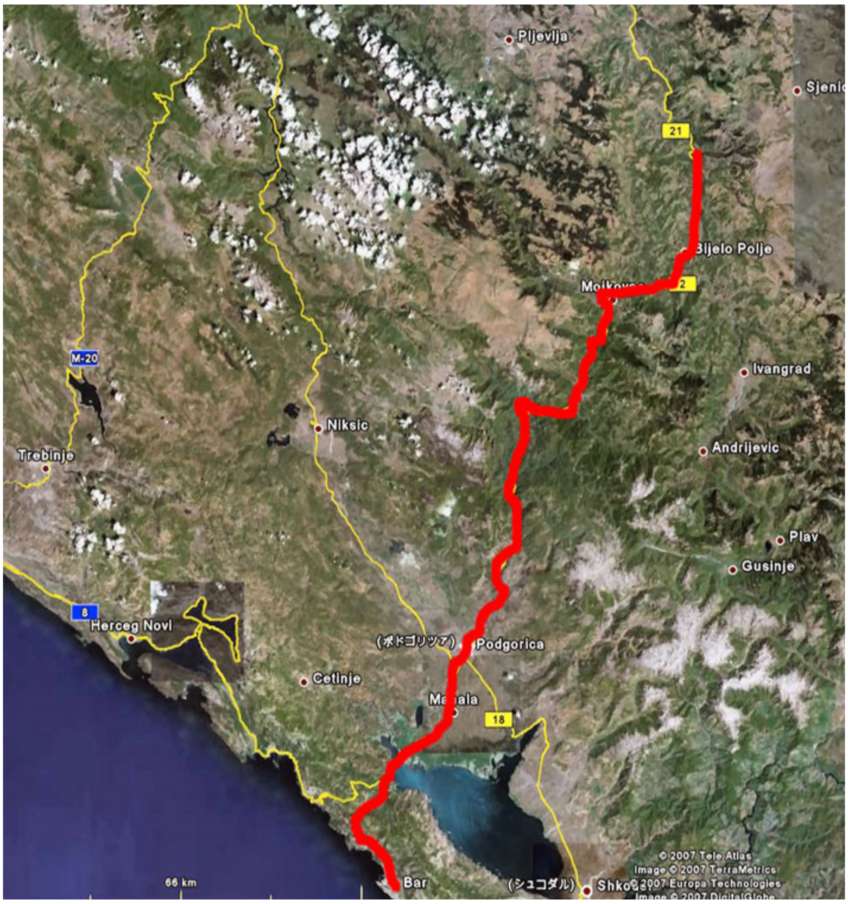
SEETO Road Route 4 Investment Plan

Final - Economics Report

August 2012

Prepared for: Ministry of Transport & Maritime Affairs, Montenegro

MONTENEGRO



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SYSTAS S.A. CONSULTING ENGINEERS

1	July 2012	Economics Report	John Miller Economist	George Rutt Project Manager	Martin Edge Project Director
2	August 2012	Final – Economics Report	John Miller Economist	George Rutt Project Manager	Martin Edge Project Director
			[Name] [Position]	[Name] [Position]	[Name] [Position]
			[Name] [Position]	[Name] [Position]	[Name] [Position]
			[Name] [Position]	[Name] [Position]	[Name] [Position]

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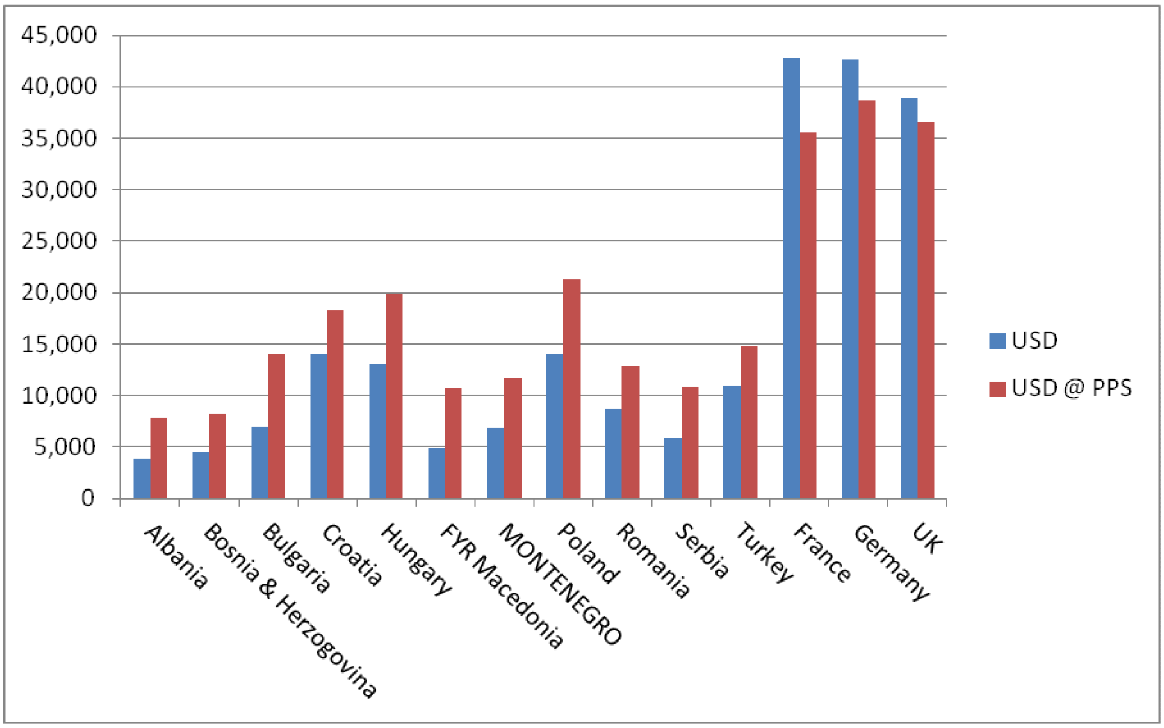
1. ECONOMIC CONTEXT

GDP/capita in Montenegro is estimated to be USD 6,877 in 2012, or USD 11,677 when adjusted to take into account purchasing power in the country (PPS). Figure 1 below shows how GDP/capita in Montenegro compares with various other countries. At PPS, Montenegro is slightly above Serbia but below most other countries in the region. It is at less than 33% of the level of France, Germany and the UK. **Unemployment** is estimated to be just under 12%[1].

Figure 1: Comparison of GDP/capita in various countries, 2012 (forecast)

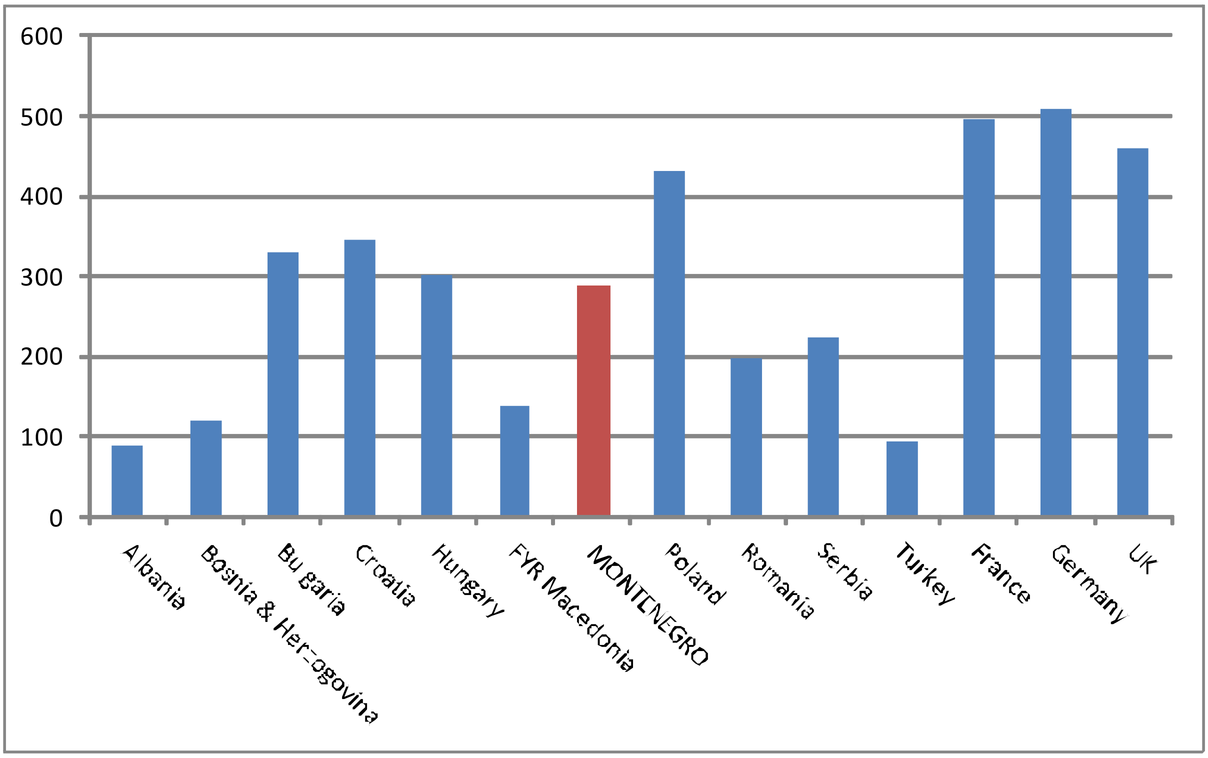


Source: www.imf.org

Passenger **car ownership** was estimated to be 266 cars per 1000 population in 2010. A comparison with various other countries is shown in the figure 2 below for 2009 (the latest available data for all the countries). It may be noted that the rate of car ownership in Montenegro in 2009 (289 cars per 1000 population) was apparently higher than in 2010. The rate of ownership is above that of most countries in the region, even at the lower rate observed in 2010.

[1] EU Candidate and Pre-accession Countries Economic Quarterly, April 2012

Figure 2: Comparison of passenger car ownership in various countries, 2009 (cars/1000 population)



Source: World Bank, EUROSTAT

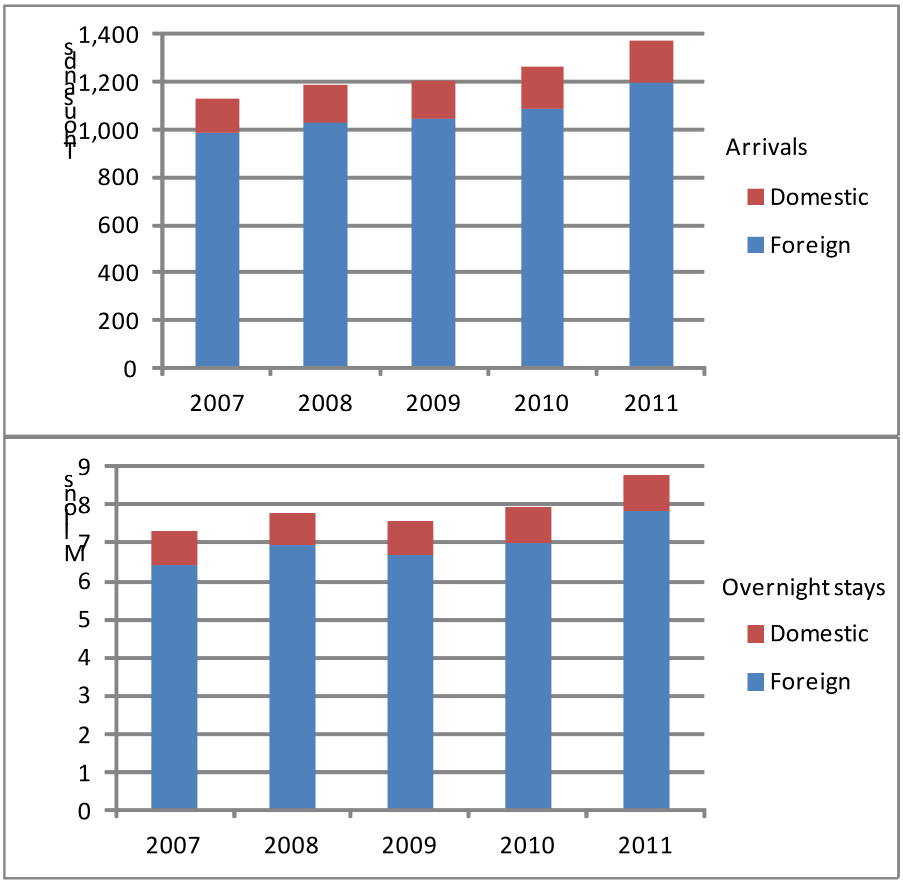
Since December 2009, Serb and Montenegrin **tourists** no longer require a visa to visit Schengen countries. The Montenegrin coast is a popular seaside destination for Serbs and Montenegrins, but it had been suggested that the change in the visa regime would result in many Serb holidaymakers going elsewhere, especially to Greek resorts.

Nevertheless, tourism in Montenegro has continued to grow (see in Figure 3 below). In 2010 (after the change in visa requirements), the numbers of both domestic and foreign tourists grew, although the number of overnight stays fell. 2011 saw a decline in domestic tourists but this was more than compensated for by an increase in foreign tourists. This is probably due to other events including:

- the current economic situation which encourages tourists from neighbouring countries to holiday closer to home
- the specific economic problems in Greece that have led to a reduction in tourism
- unrest in countries such as Egypt and Tunisia which have led to tourists (local and international) holidaying in Montenegro instead.

Tourism capacity (hotel space) is still very much under-used, in part due to under-investment and neglect. While the SEETO Route IV corridor does not serve directly the coastal areas with tourism potential, it would provide improved strategic access.

Figure 3: Tourist arrivals and overnight stays ('000 persons)



	Arrivals			Overnight stays		
	Foreign	Domestic	Total	Foreign	Domestic	Total
2007	984,138	149,294	1,133,432	6,442,485	851,045	7,293,530
2008	1,031,212	156,904	1,188,116	6,966,279	828,462	7,794,741
2009	1,044,014	163,680	1,207,694	6,695,674	856,332	7,552,006
2010	1,087,794	175,191	1,262,985	6,977,860	987,033	7,964,893
2011	1,201,099	172,355	1,373,454	7,818,803	965,368	8,784,171

Source: Monstat

The **Port of Bar** is a potential generator of traffic for the proposed road corridor. It currently handles about 1.6m tonnes of freight per year, an amount that has declined since 2007. In 2011 approximately 20 percent of freight was containerised; container traffic increased from 27,095 TEU in 2007 to 34,722 in 2011, but peaked at 43,708 TEU in 2008. RO-RO traffic constitutes about 3 percent of total freight traffic. In 2011, about 60,000 passengers used the port, down from 85,000 in 2007. The figures are summarised in table 1 below

Table 1: Port of Bar traffic 2003 - 2011

	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011
passengers	'000	80	65	66	80	85	87	73	68	60
frt. loaded	mln.ton	n/a	n/a	1.24	1.06	n/a	n/a	n/a	n/a	n/a
frt. unloaded	mln.ton	n/a	n/a	0.92	1.15	n/a	n/a	n/a	n/a	n/a
total freight	mln.ton	1.92	1.95	2.16	2.21	2.18	2.00	1.36	1.83	1.64
liquid bulk	mln.ton	0.37	0.46	0.39	0.39	0.45	0.45	0.22	0.25	0.20
dry bulk	mln.ton	1.03	0.98	1.04	0.79	0.54	0.52	0.39	0.73	0.67
general cargo	mln.ton	0.52	0.51	0.73	1.03	1.19	1.03	0.75	0.85	0.77
containers	TEU	8,633	11,434	12,258	17,854	27,095	43,708	34,692	30,477	34,722
containers	mln.ton	0.068	0.085	0.094	0.147	0.264	n/a	n/a	0.286	0.334
RO-RO traffic	mln.ton	0.118	0.095	0.080	0.090	0.092	0.093	0.072	0.064	0.054

Source: SEETO, MTMAT, Port of Bar

The current capacity of the port is about 5m tonnes per year. Restructuring of the organisation of the port was finished at the end of 2009. Formally, the decision was put into force on 1 October 2009. The restructuring process resulted in the forming of two terminal operators:

- Port of Bar (handling liquids, dry bulk, RO-RO and passenger traffic; managing some warehouses and cold storage facilities for general cargoes; and also operating the Free Zone)
- Container and General Cargo Terminal (handling containers and general cargoes).

Four daughter companies of the Port of Bar (Maritime Affairs, Security and Fire Fighting Service, IT, and Hotel Sidro) were also established. Maritime Affairs was privatised and is now operated by an Italian consortium. The plan is to continue the privatisation process and the tendering procedure for the Container and General Cargo Terminal is under preparation.

The last two years have seen the realisation of the first phase of planned investment in equipment and infrastructure. Newly acquired equipment includes seven wheel loaders and a mobile harbour crane for operations with dry bulk. Investment is planned to continue this year with the acquisition of three forklifts and two material handlers. Reconstruction of the cold storage facility is also planned. Investment in port infrastructure has not yet begun. However, given that the investment made so far has been directed towards the replacement of obsolete equipment, no significant increase in overall port capacity has occurred.

It can be assumed that without an improvement in the strategic road infrastructure, the development of the Port of Bar will be restricted. With improvement of the road infrastructure, development would be encouraged but would certainly not be guaranteed. For this reason, further development of the port is not included in the base assumptions of the current study. However, the assumptions of the sensitivity tests that relate to traffic are sufficient to take account of traffic resulting from any eventual development.

The **railway** in Montenegro consists of 250km of single track. The 160km main line from Bar to the Serbian border forms the backbone of the network and is electrified. The running speed along the line is 70-90 km/h, except between Podgorica and Kolasin where it drops to 40-50 km/h.

The remainder of the network is the unelectrified line from Niksic - Podgorica - Tuzi which is used for freight only at present.

There are two international passenger trains per day in the Bar - Serbian border corridor. In 2011 a total of 692,000 passengers were carried, down from 755,000 in 2010. This represents a significant decline from 10 years ago, largely due to a decline in international traffic which now constitutes about 50% of the total. The main cause of this decline is quoted by the railways as being due to poor maintenance on the Serbian side of the border, resulting in journey times that are longer than parallel journeys made by road.

In 2011, freight trains carried a total of 1.05 million tonnes on the network as a whole, down from 1.21 million tonnes in 2010. The decline is due to a reduction in the production of steel and a general downturn resulting from the economic situation.

The railway has significant spare capacity and there are various plans to improve the infrastructure. During the next two years, loans from IFIs including EIB and EBRD will be used to make speed improvements to 80 km/h and improve reliability (through slope stabilisation reducing landslides) on the line between Kolasin and Bijelo Polje. It is also expected that a customs agreement with Serbia will result in reduced border crossing delays from 2013.

Since the splitting up of the state owned railway company in 2008, rail transport has been operated by four separate companies, which independently handle railway infrastructure, passenger transport, freight transport and the maintenance of rolling stock. There are plans to privatise Montecargo, the rail freight transport company, which could potentially result in an increase in productivity.

While investment in and reorganisation of the rail sector could lead to an increase in rail passenger and rail freight traffic, investment in the road sector could have an inverse effect. However, the numbers above show that in either case, the overall impact would be rather small.

The number of rail passengers carried in the corridor in 2011 was 692,000, equivalent to an average of 1896 per day. If all of these passengers travelled by private car, they would add a maximum of 886 cars per day to the traffic. In reality, of course, this would only happen if the railway was closed. Furthermore, some passengers transferring to road would be likely to use buses rather than private cars.

It is not known how much of the total freight traffic on the railway is carried in the study corridor, but if it is assumed to be 50% then the 2011 tonnes of freight would be equivalent to an average of 1438 tonnes per day. This volume of freight could generate 144 truck journeys per day, assuming average truck loadings including trucks returning empty. This compares with 370 international truck journeys between Montenegro and Serbia and 0.2% of the overall traffic.

2. ECONOMIC INPUTS TO THE TRAFFIC MODEL

2.1 Population forecast

A census of population was carried out in 2011 and provides more recent population data than that used in previous studies. In the IFC study, the base population was derived from the census of 2003 and forecast on the basis of the Spatial Plan of Montenegro to 2020. This has been updated by introducing new base data for 2011 and adjusting the forecast data accordingly. The new forecast based on 2011 is shown in table 2 below.

Table 2: Population forecast by municipality adjusted to the census of 2011

	2003	2011	2012	2020	2035
Andrijevica	5785	5,071	5,072	5,078	5,251
Bar	40037	42,048	42,449	44,956	46,699
Berane	35068	33,970	34,429	37,418	38,967
Bijelo Polje	50284	46,051	46,584	49,991	51,997
Budva	15909	19,218	19,468	21,091	21,958
Danilovgrad	16523	18,472	18,536	18,870	19,526
Zabljak	4204	3,569	3,570	3,562	3,678
Kolasin	9949	8,380	8,384	8,366	8,640
Kotor	22947	22,601	22,710	23,321	24,152
Mojkovac	10066	8,622	8,695	9,146	9,494
Niksic	75282	72,443	73,183	77,852	80,906
Plav	13805	13,108	13,274	14,343	14,929
Pluzine	4272	3,246	3,248	3,243	3,349
Pljevlja	35806	30,786	30,935	31,771	32,904
Podgorica	169132	185,937	188,851	208,125	217,039
Rozaje	22693	22,964	23,516	27,354	28,677
Tivat	13630	14,031	14,122	14,659	15,197
Ulcinj	20290	19,921	20,100	21,209	22,024
Herceg Novi	33034	30,864	31,008	31,809	32,940
Cetinje	18482	16,657	16,670	16,675	17,225
Savnik	2947	2,070	2,064	2,015	2,077
Montenegro	**620,145**	**620,029**	**626,867**	**670,853**	**697,629**

Source: IFC study of Bar - Boljare Motorway, 2008, based on Spatial Plan of Montenegro until 2020, Table 11; population census of 2011 (http://www.monstat.org/eng/page.php?id=394&pageid=57); Consultant's analysis

Interpolating the data used previously between 2007 and 2016 resulted in a total population for the country of 662,239 in 2011. The census shows that in fact the population was 620,029 in 2011. The following differences between the estimated and observed 2011 populations may be noted:

- Overall, the population in 2011 was 94% of that previously estimated.
- The estimated populations of Bar, Podgorica and Tivat were very close to the observed population.
- The estimated populations of Budva and Danilovgrad were about 10% below the observed.
- The estimated populations of Pluzine and Savnik were 25% above the observed.
- The estimated populations of other municipalities were 5 - 20% above the observed.

2.2 GDP forecast

Table 3 below shows the forecast GDP/capita used in the IFC study and the latest forecasts available from the IMF[2]. While the actual growth in 2008 was higher than forecast, the data for subsequent years clearly reflects the recent economic downturn. Furthermore, it can be seen that the most recent IMF forecast (April 2012) is far more pessimistic than that made 6 months previously.

Table 3: GDP/capita annual % change in Montenegro

	IFC study	IMF forecast	
		Sept 2011	Apr 2012
2008	5.4	6.9	6.6
2009	2.0	-5.7	-6.1
2010	2.0	1.1	2.0
2011	4.0	2.0	6.6
2012	4.5	3.5	-0.1
2013	4.5	3.7	1.2
2014	4.0	3.7	1.7
2015	4.5	3.8	1.7
2016	4.5	3.8	1.7
2017	4.5	-	1.9

Source: IFC study of Bar - Boljare Motorway, 2008

www.imf.org

Beyond 2017, the IFC study forecast GDP/capita growth of 4.5% per year to 2026, 2.5% from 2027 to 2036 and 2.4% from 2037 to 2046. This has been revised downwards to a constant growth rate of 2.5% per year from 2018 for the current study.

In the traffic model, 60.7% of traffic to and from external zones is traffic to or from Albania, 21.7% is to or from Serbia and 11.2% is to or from Bosnia and Herzegovina. The IMF forecasts of GDP for these countries to 2017 is shown in the table below. The SEETO route IV is also expected to be important for traffic to and from Kosovo in the future. However, the IMF data does not include a GDP forecast for Kosovo and the forecast for Serbia is assumed. Forecasts of GDP/capita for all other countries, for which the traffic makes up less than 5% of the total, has been assumed to be 2.0% per year.

Beyond 2017, a constant growth rate of 2.5% per year has been assumed for all external zones.

[2] www.imf.org

Table 4: GDP/capita annual % change in neighbouring countries

	Albania	Bosnia	Serbia
2012	0.0	0.2	0.3
2013	1.2	1.2	2.8
2014	2.0	2.7	3.8
2015	2.0	3.7	3.8
2016	2.0	3.7	3.8
2017	2.0	3.8	3.3

Source: www.imf.org

In summary, the following average rates of growth of GDP/capita were used to produce forecasts of future travel demand shown in Table 5 below.

Table 5: Average GDP/capita growth (% per year)

	Montenegro	Albania	Bosnia	Serbia	Other
2013 - 2020	2.0	2.1	2.8	3.1	2.0
2021 - 2035	2.5	2.5	2.5	2.5	2.5
2036 - 2050	2.5	2.5	2.5	2.5	2.5

Source: Consultant's analysis

These translate into growth factors as shown in Table 6 below.

Table 6: GDP/capita growth factors

	Montenegro	Albania	Bosnia	Serbia	Other
2020 : 2012	1.168	1.179	1.249	1.278	1.168
2035 : 2020	1.448	1.448	1.448	1.448	1.448
2050 : 2035	1.448	1.448	1.448	1.448	1.448

Source: Consultant's analysis

2.3 Regional growth

In the IFC study, the traffic zones were categorised according to four regions. For each region, variations around the national rate of growth of GDP were proposed based on observations in other countries. The regional differentials are shown in Table 7 below. From this table it can be seen that Podgorica is assumed to experience economic growth 30 percent above the average for the country as a whole, while the coastal region is assumed to have growth 15 percent above the average. The central region is assumed to grow at the average rate for the country as a whole and the northern region is assumed to grow at a slower rate. These differential growth rates were retained for the current update.

Table 7: Assumed regional differentials in economic development: percentage growth in relation to the national average

-15%	0%	+15%	+30%
Northern region: • Pluzine • Savnik • Kolašin • Andrijevica • Plav • Žabljak • Mojkovac • Berane • Rozaje • Pljevlja • Bijelo Polje	Central region: • Niksic • Danilovgrad	Coastal region: • Herceg Novi • Tivat • Kotor • Budva • Bar • Ulcinj • Cetinje	Capital area: • Podgorica

Source: Consultant's analysis

2.4 Income elasticity of demand

Economic growth tends to lead to increased travel and transport of goods. In a more rapidly growing economy, a greater proportion of the population is likely to be working, has more disposable income and more products are produced which must be transported and for which raw materials must be supplied.

Growth in real income may result in additional passenger trips being made, given that trips have a positive elasticity in relation to income. This is because once all essential expenditure is taken into account, any additional income can be regarded as an increase in disposable income. However, increased disposable income may also be used for moving up to a more comfortable mode of transport, rather than extra trips. This could mean, for example, investing in a private car.

In the previous study an elasticity of 1.2 was assumed for passenger trips and 1.0 for freight traffic. The same elasticities have been used in the current study.

3. ECONOMIC EVALUATION MODEL

3.1 Introduction

The cost-benefit analysis considers the economic viability of the operation of the transport system from the point of view of the Montenegrin economy.

Economic evaluations of the proposed investments were carried out using normal cost benefit techniques. The procedures are consistent with the guidelines set out in the following documents:

- the updated EC guide to cost-benefit analysis[3]
- the TINA guide to cost-benefit analysis[4]
- the EC guide to cost-benefit analysis for Cohesion Fund projects to be implemented during the period 2007 to 2013[5], and
- the recommendations of HEATCO[6].

3.2 Evaluation Methodology

The following sections present the evaluation methodology, a summary of the input data and the results that were obtained.

3.2.1 General approach

The economic evaluation compares a "Do Something" (DS) option against a "Do Minimum" (DM) option.

The DM option is the situation in which no investment is made, other than that necessary to maintain the existing infrastructure in its existing condition (hence the terminology "Do Minimum" rather than "Do Nothing"). Thus, the DM option represents the situation in which no project is implemented.

Conversely, the DS option represents the situation in which a project is implemented e.g. the construction of a new road or motorway.

The economic evaluation compares, on the one hand:

- the additional economic costs incurred by Montenegrin society compared with the economic costs of the DM option

and on the other hand:

- the economic benefits that infrastructure users (i.e. car and bus passengers, freight transport companies) gain from using the project compared with the DM option

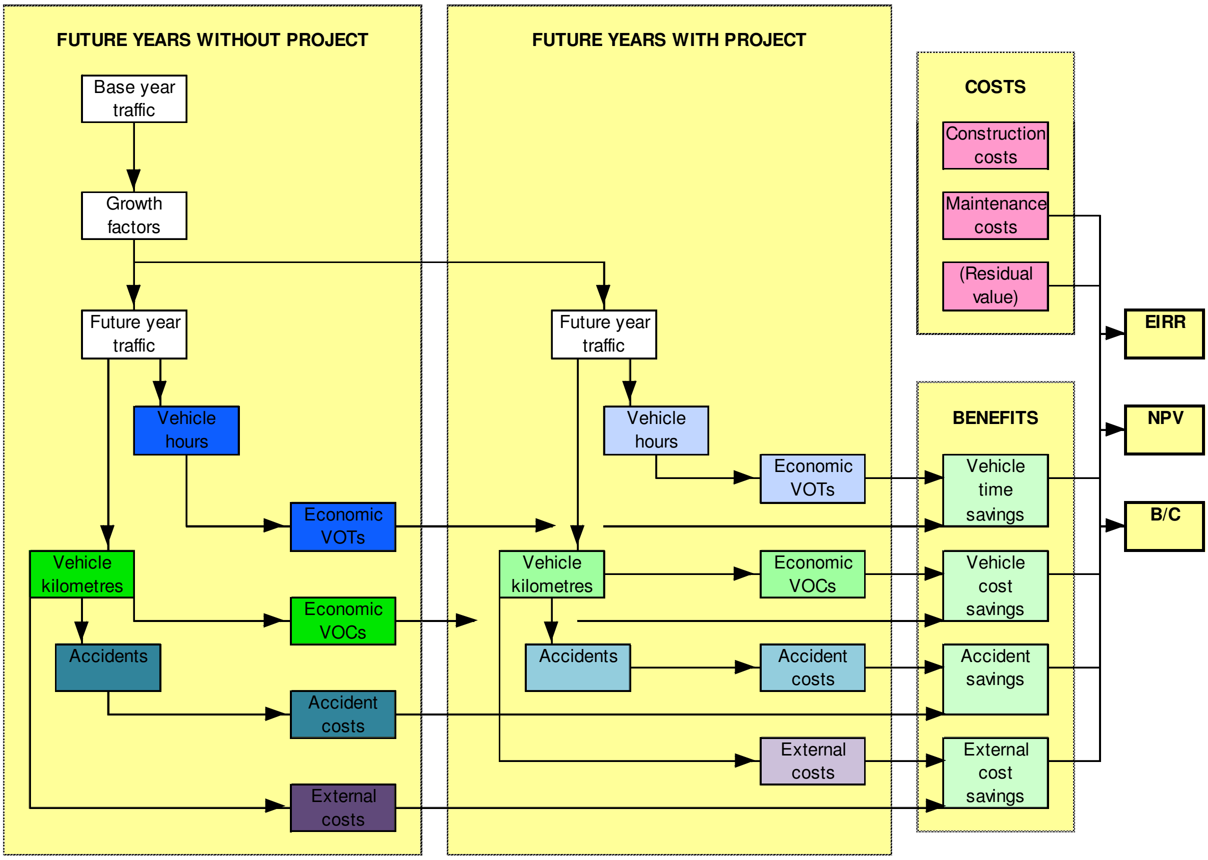
and in addition:

- external effects.

[3] EC Evaluation Unit DG Regional Policy "Guide to Cost Benefit of Investment Projects"
[4] TINA (1999) "Socio-Economic Cost Benefit Analysis in the context of Project Appraisals for developing a Trans-European Transport Network"
[5] EC "Guidance on the methodology for carrying out Cost-Benefit Analysis", a methodological working document for the New Programming period 2007-2013
[6] EC (2006) Developing Harmonised European Approaches for Transport Costing and Project Assessment

A schematic representation of the approach is shown in Figure 4 below.

Figure 4: Approach to economic evaluation



The economic **cost** of a project is the difference between the total economic **investment cost** of the DS project incurred by Montenegrin society and the economic investment cost necessary in the DM. There may also be additional **maintenance costs**, and infrastructure that has a lifespan greater than the evaluation period will have a **residual value**.

Do Something		**Do Minimum**		**Do Something**
investment cost maintenance cost residual value	-	investment cost maintenance cost residual value	=	net investment cost net maintenance cost net residual value

The economic **benefits** come from various savings in costs that infrastructure users may enjoy as a result of the construction of the project. In the following diagram, the example user benefits come from savings in vehicle operating costs, travel time and accidents. Additional benefits come from savings in external costs such as noise reduction and climate change.

Do Something		Do Minimum		Do Something
				Changes in cost of:
vehicle operation travel time accidents external effects	-	vehicle operation travel time accidents external effects	=	vehicle operation travel time accidents external effects

The economic evaluation compares the costs and the benefits to establish whether or not the project is worthwhile i.e. whether or not the benefits outweigh the costs.

Costs (to society)	? <>	**Benefits** (to users)

Economic costs and benefits are defined as resource costs i.e. all costs and benefits are expressed in monetary units net of all taxes, duties and transfer payments (fiscal corrections). On this basis passenger fares, freight transport charges, subsidies and taxes are excluded from the economic analysis.

Primary economic benefits relate to benefits that accrue directly to the project and the associated transport sector. Comparing the DS option against the DM option, the following primary economic benefits are considered:

- savings in road vehicle operating and maintenance costs
- value of time savings of passengers
- value of tonne / hour savings of freight
- savings in road accident costs
- value of benefits to generated traffic (if any).

In addition, some secondary economic benefits are considered. Secondary benefits are benefits that result from the implementation of the project but are external to the associated transport sector. The external costs considered include:

- noise costs
- pollution costs
- climate change costs.

Benefits come about through the effects of reductions in the amount of road traffic noise, air pollution due to road traffic and climate change due to road traffic.

The benefits are calculated separately for **existing traffic** and **generated traffic,** with benefits to generated traffic being valued at half of those attributable to existing traffic, as dictated by consumer surplus theory and the 'rule of a half'. (A simplified explanation of this is set out in the footnote below[7].)

7

3.2.2 Evaluation indicators

The economic evaluation is based on a cash flow analysis of the economic costs and benefits of the project over a 30 year evaluation period after project opening. The outputs are the following economic indicators:

- economic internal rate of return (EIRR)
- net present value (NPV)
- benefit / cost ratio (B/C).

For a project to be considered economically viable, the following criteria should be met:

- EIRR greater than the discount rate (a discount rate of 8% has been used)
- NPV greater than €0.00
- B/C greater than 1.

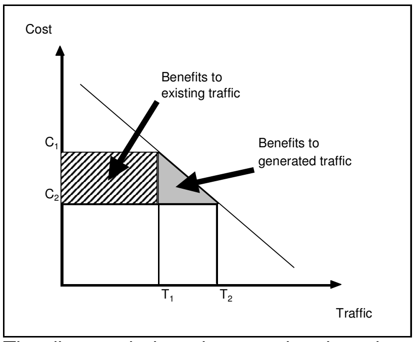
When evaluating several projects the NPV should be determined first. All projects with a positive NPV should be retained as they are all, in principle, worthwhile. However, NPV tends to favour large projects, so the retained projects should then be ranked on the basis of their B/Cs. The same ranking may be produced on the basis of EIRR, which has the advantage that it does not depend on a predetermined discount rate.

3.3 Project Costs

3.3.1 Investment costs

The construction costs used in the evaluations are based on the cost estimates described in the Technical Option Report Costs were estimated for each scenario tested in the traffic model - the scenarios are shown in the figure below and the costs in the following table 8.

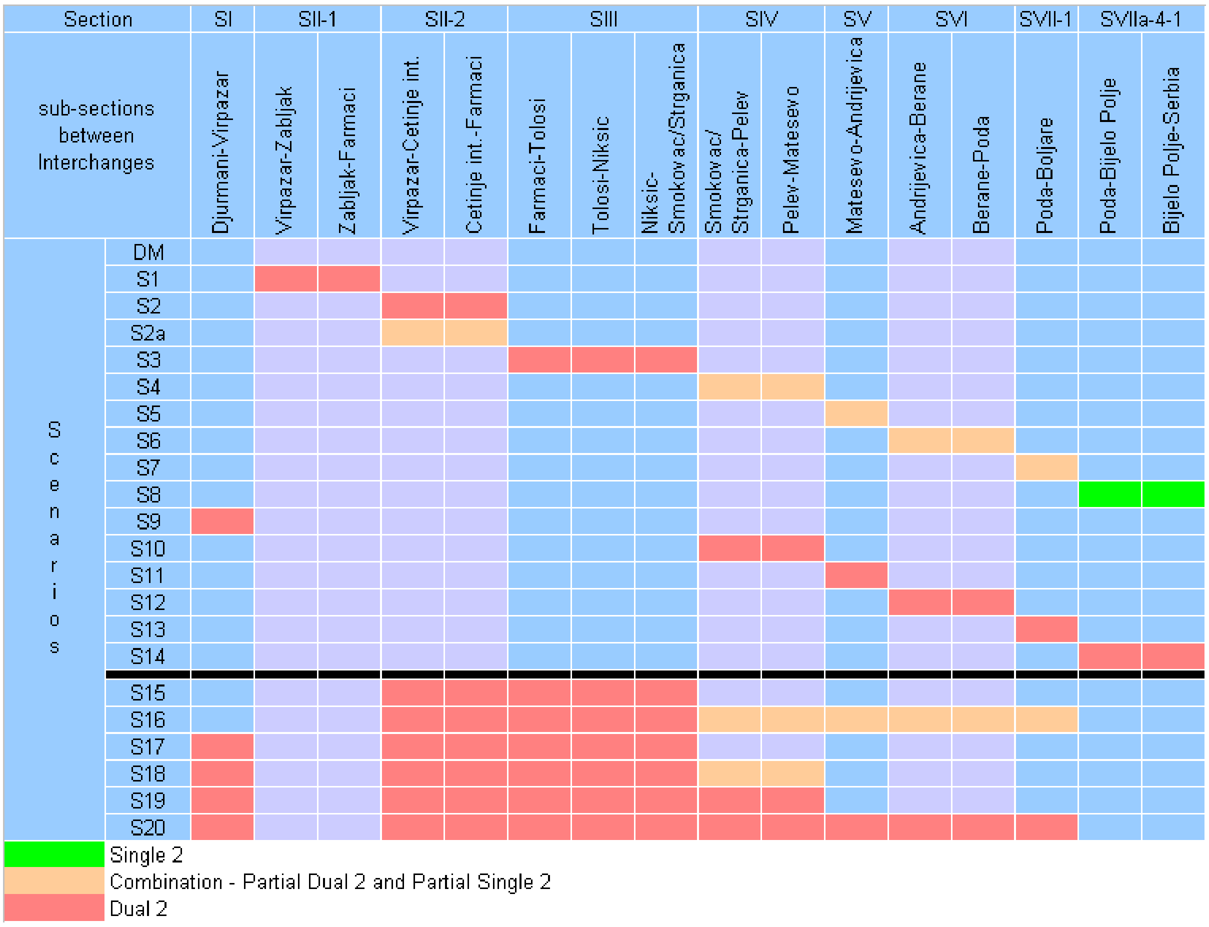
Table 8: Scenario definitions



The diagram below shows a situation where demand (e.g. road traffic) increases as cost (e.g. travel cost or journey time) decreases. At cost C_1 (Do Minimum), the volume of traffic is T_1. If the cost decreases to C_2 (with project), traffic increases to T_2 i.e. there is **generated** traffic of (T_2 - T_1).

The value of benefits to **existing** traffic is indicated by the shaded rectangle and is calculated by multiplying the change in cost by the volume of traffic i.e. (C_1 - C_2) * T_1.

The value of benefits to **generated** traffic is indicated by the shaded triangle and is calculated by multiplying the change in cost by the change in traffic volume and taking 50% of the result i.e. ((C_1 - C_2) * (T_2 - T_1)) / 2.



Notes on Scenario definitions:

1. The Scenarios are based on the Route segmentation shown in Fig 1.1 of the Technical Options Report.

2. Each of scenarios S1 to S14 represents a single construction project for one Section of the Route.

   a. From Djurmani to the Smokovac or Strganica interchange (Section I, Section II and Section III) upgrading to full dual (2x2) carriageway is considered. These are Scenarios S1, S2, S3 and S9.

   b. From Smokovac or Strganica to the Serbian border (Section IV, Section V, Section VI and Section VII), upgrading to full dual (2x2) carriageway is considered in Scenarios S10, S11, S12, S13 and S14. Upgrading to partial dual (2x2) and partial single carriageway is considered in Scenarios S4, S5, S6, S7 and S8.

3. In Scenarios S15 through to S20 various rolling programmes of the whole Route or major parts of the Route are considered.

4. A variant Scenario S2a was subsequently added to the economic analysis. This Scenario is a reduced engineering option of a single carriageway through the tunnel and bridge sections between Virpazar and Farmaci.

5. Scenario 14 was dropped from further analysis as constructing to dual carriageway standard produces no additional benefits.

Table 9: Project construction costs (2012 financial prices, EURm)

	Preliminaries	Earthworks	Roadworks / pavement	Slope stabilisation	Safety / signage	Bridges / viaducts	Culverts / hydraulics	Tunnels	Interchanges	M&E / buildings	Environmental measures	PU relocations	**TOTAL**	Design / planning / supervision	Land acquisition
S1	5.43	36.95	26.03	71.48	11.61	84.71	6.31	52.66	8.23	24.06	6.01	3.01	**336.49**	10.09	3.94
S2	4.35	30.44	17.91	32.84	8.46	72.60	5.77	65.46	5.49	19.26	4.82	2.41	**269.82**	8.09	2.74
S2a	3.26	22.83	13.43	24.63	6.34	54.45	4.33	49.10	4.12	14.45	3.61	1.81	**202.36**	6.07	2.06
S3	2.35	18.90	12.29	19.09	4.44	31.20	3.36	34.20	5.49	10.43	2.61	1.30	**145.66**	4.37	17.03
S4	7.58	58.94	27.84	54.44	11.58	106.75	7.98	139.82	8.97	33.39	8.35	4.17	**469.82**	14.09	17.69
S5	3.37	19.46	10.94	42.78	4.39	36.41	4.50	63.82	2.74	14.84	3.71	1.86	**208.83**	6.26	2.28
S6	3.20	15.09	19.08	40.51	7.56	12.39	2.54	74.78	3.84	14.11	3.53	1.76	**198.40**	5.95	2.44
S7	2.64	23.14	19.34	52.25	8.28	21.06	6.45	12.44	1.78	11.63	2.91	1.45	**163.37**	4.90	8.14
S8	1.45	49.86	0.00	10.14	0.00	0.00	0.00	19.64	0.00	6.37	1.59	0.80	**89.85**	2.70	1.15
S9	1.18	3.82	2.75	6.69	1.29	4.94	1.34	43.90	0.00	5.18	1.29	0.65	**73.04**	2.19	0.36
S10	10.83	84.20	39.78	77.78	16.54	152.49	11.41	199.74	12.81	47.70	11.93	5.96	**671.17**	20.13	25.27
S11	6.74	38.93	21.89	85.56	8.79	72.81	8.99	127.64	5.49	29.69	7.42	3.71	**417.65**	12.53	4.55
S12	4.57	21.56	27.26	57.87	10.80	17.71	3.62	106.83	5.49	20.16	5.04	2.52	**283.42**	8.50	3.49
S13	4.05	35.60	29.75	80.39	12.74	32.40	9.93	19.14	2.74	17.89	4.47	2.24	**251.34**	7.54	12.52
S14	1.45	49.86	0.00	10.14	0.00	0.00	0.00	19.64	0.00	6.37	1.59	0.80	**89.85**	2.70	1.15
S15	6.70	49.34	30.20	51.94	12.90	103.80	9.13	99.67	10.98	29.70	7.42	3.71	**415.48**	12.46	19.77
S16	23.48	165.98	107.40	241.92	44.71	280.41	30.60	390.53	28.32	103.67	25.92	12.96	**1455.90**	43.68	50.32
S17	7.88	53.16	32.95	58.63	14.18	108.74	10.47	143.57	10.98	34.88	8.72	4.36	**488.52**	14.66	20.13
S18	15.46	112.10	60.79	113.08	25.76	215.49	18.45	283.39	19.95	68.27	17.07	8.53	**958.34**	28.75	37.82
S19	18.70	137.36	72.73	136.41	30.72	261.24	21.87	343.31	23.79	82.58	20.64	10.32	**1159.69**	34.79	45.40
S20	34.07	233.45	151.62	360.22	63.06	384.16	44.42	596.92	37.52	150.32	37.58	18.79	**2112.12**	63.36	65.96

Source: Consultants analysis

The evaluation model includes a facility to add an optimism bias uplift to the costs, to compensate for the systematic tendency for project appraisers to underestimate construction costs. HEATCO suggests that an optimism bias of about 20% should be tested. The costs shown above already include a contingency of 5-7% and no further uplift has been introduced. However, the effect of an additional 20% can be observed in the sensitivity analysis.

The model also provides a facility to convert financial construction costs to economic costs. The construction costs shown in Table 9 include an estimated tax element to take account of importation taxes on fuel and construction materials and on local engineering costs. This is estimated to be 2% of the financial construction costs and the economic prices have been adjusted accordingly.

The initial investment programmes assumed for each Scenario are shown in Table 10 in terms of the number of years required for construction and the first year of operation, assuming construction begins in 2014. For the combined Scenarios (S15 - S20), which envisage a rolling construction programme, an overlap of 40% of the shorter construction period is assumed. It is assumed that the costs of preliminaries, public utility relocations, design and land acquisition are incurred at the commencement of construction, while the costs of environmental measures are assumed to be incurred in the final construction year. The remaining investment is assumed to be split equally per year during the investment period.

Table 10: Assumed investment programmes (year of commencement of construction is 2014)

Scenario	Section	Standard	Construction years	First year of operation
S1	Virpazar - Zabljak - Farmaci	Dual	3	2017
S2	Virpazar - Cetinje - Farmaci	Dual	3	2016
S2a	Virpazar - Cetinje - Farmaci	Mixed	3	2016
S3	Farmaci - Smokovac	Dual	2	2016
S4	Smokovac - Matesevo	Mixed	4	2018
S5	Matesevo - Andrijevica	Mixed	3	2017
S6	Andrijevica - Poda	Mixed	3	2017
S7	Poda - Boljare	Mixed	3	2017
S8	Poda - Bijelo Poleje - border	Single	3	2017
S9	Djurmani - Virpazar	Dual	1.5	2016
S10	Smokovac - Matesevo	Dual	4	2018
S11	Matesevo - Andrijevica	Dual	3	2017
S12	Andrijevica - Poda	Dual	3	2017
S13	Poda - Boljare	Dual	3	2017
S14	Poda - Bijelo Poleje - border	Dual	Not analysed	
S15	S2 + S3	Dual	4	2018
S16	S2 + S3 + S4 + S5 + S6 + S7	Mixed	10	2024
S17	S2 + S3 + S9	Dual	5	2019
S18	S2 + S3 + S4 + S9	Mixed	8	2022
S19	S2 + S3 + S9 + S10	Dual	8	2022
S20	S2 + S3 + S9 + S10 + S11 + S12 + S13	Dual	10	2024

Source: Consultant's analysis

3.3.2 Residual value

The evaluations include estimates of the residual value of the infrastructure at the end of the 30 year evaluation period. In the cost-benefit analysis the capital cost of the infrastructure is reduced by the net present value of the residual value of the infrastructure. The residual value was estimated by:

- determining the fixed lifetime of the infrastructure
- determining a depreciation profile.

A range of recommended lifetimes of different elements of infrastructure is provided in the HEATCO documentation. In the current review it is assumed that tunnels and bridges have a lifetime of 75 years while the roadway has a lifetime of 20 years. These lifetimes assume that appropriate routine and periodic maintenance are carried out.

A summary of the residual values of each scenario is shown in the table below. The overall residual value was estimated to be around 50 percent of the total investment cost (excluding design, planning supervision and land acquisition).

Table 11: Project scenario residual values (2012 prices)

Scenario	Section	EURm	% of total
S1	Virpazar - Zabljak - Farmaci	161.27	47.9
S2	Virpazar - Cetinje - Farmaci	131.62	48.8
S2a	Virpazar - Cetinje - Farmaci	98.72	48.8
S3	Farmaci - Smokovac	69.54	47.7
S4	Smokovac - Matesevo	233.19	49.6
S5	Matesevo - Andrijevica	104.96	50.3
S6	Andrijevica - Poda	92.47	46.6
S7	Poda - Boljare	72.73	44.5
S8	Poda - Bijelo Poleje - border	49.13	54.7
S9	Djurmani - Virpazar	37.52	51.4
S10	Smokovac - Matesevo	333.13	49.6
S11	Matesevo - Andrijevica	209.92	50.3
S12	Andrijevica - Poda	132.10	46.6
S13	Poda - Boljare	111.90	44.5
S14	Poda - Bijelo Poleje - border	Not analysed	
S15	S2 + S3	201.16	48.4
S16	S2 + S3 + S4 + S5 + S6 + S7 + S8	704.52	48.4
S17	S2 + S3 + S9	238.68	48.9
S18	S2 + S3 + S4 + S9	471.87	49.2
S19	S2 + S3 + S9 + S10	571.81	49.3
S20	S2 + S3 + S9 + S10 + S11 + S12 + S13	1025.73	48.6

Source: Consultant's analysis

3.3.3 Operation and maintenance costs (O & M)

The O&M costs used in the evaluations are based on the cost estimates described in the Technical Options Report. Costs were estimated for each scenario tested in the traffic model and are shown in the following table.

The rates result in O&M costs that range from 11.7 percent of the construction cost to 63.6 percent. The overall rate for the whole corridor from Djurmani to the Serbian border is 18.9 percent.

Table 12: O&M costs over 30 years as percentage of construction costs (excluding land acquisition and management costs)

Scenario	Section	EURm / year	EURm over 30 years % of construction cost
S1	Virpazar - Zabljak - Farmaci	2.209	19.7
S2	Virpazar - Cetinje - Farmaci	2.158	24.0
S2a	Virpazar - Cetinje - Farmaci	1.618	24.0
S3	Farmaci - Smokovac	0.986	20.3
S4	Smokovac - Matesevo	2.933	18.7
S5	Matesevo - Andrijevica	1.062	15.3
S6	Andrijevica - Poda	1.241	18.8
S7	Poda - Boljare	0.636	11.7
S8	Poda - Bijelo Poleje - border	0.979	0.33
S9	Djurmani - Virpazar	1.089	44.7
S10	Smokovac - Matesevo	4.190	18.7
S11	Matesevo - Andrijevica	2.124	15.3
S12	Andrijevica - Poda	1.773	18.8
S13	Poda - Boljare	0.979	11.7
S14	Poda - Bijelo Poleje - border	Not analysed	
S15	S2 + S3	3.144	22.7
S16	S2 + S3 + S4 + S5 + S6 + S7 + S8	9.016	18.6
S17	S2 + S3 + S9	4.233	26.0
S18	S2 + S3 + S4 + S9	7.165	22.4
S19	S2 + S3 + S9 + S10	8.422	21.8
S20	S2 + S3 + S9 + S10 + S11 + S12 + S13	13.299	18.9

Source: Consultant's analysis

3.4 Value of benefits

3.4.1 Vehicle operating costs

Benefits from vehicle operating costs (VOCs) result from savings due to the lower costs of driving a vehicle along the new infrastructure compared with the old infrastructure. Lower costs may result from a shorter route, a better surface quality, a more consistent speed, less stopping and starting etc. (If the costs of driving on the new infrastructure are higher, for example because the route is longer, then the VOC benefits may in fact be negative.) VOCs include such elements as the cost of:

- fuel
- tyres
- lubricants
- maintenance (parts and labour)
- crew (salaries of drivers and other staff in the case of commercial vehicles)
- depreciation and interest charges
- overheads.

VOCs for use in the economics model were derived based on the total economic costs of operating each vehicle type over 1 kilometre. It may be noted that these are different from the VOCs used in the traffic model which are essentially behavioural (as opposed to economic) costs. Behavioural VOCs typically include only out of pocket expenses, such as fuel and tolls, and do not include elements such as maintenance, insurance, depreciation etc. Furthermore, the economic costs used in the economics model exclude taxes and duties.

Tables of updated VOCs were calculated using HDM-4 for different categories of:

- road
    - D2 motorway / expressway standard (dual 2-lane, 100 km/h, International Roughness Index (IRI) 2)
    - S2 road new (single carriageway 2-lane, 80 km/h, IRI 2)
    - main road (single carriageway 2-lane, 80 km/h, IRI 5)
    - regional road (single carriageway 2-lane, 60 km/h, IRI 7).
- terrain
    - flat
    - rolling
    - mountainous.
- and speed
    - 0 - 20km/h (assumed speed in HDM: 20km/h, the lowest speed that can be modelled)
    - 20 - 40km/h (assumed speed in HDM: 30km/h, the mid-point of the range)
    - 40 - 80km/h (assumed speed in HDM: 60km/h, the mid-point of the range)
    - > 80km/h (assumed speed in HDM: 100km/h).

It may be noted that the assumed IRIs of each road category were changed slightly from those used in the IFC study in order to produce a more realistic range of VOCs.

The unit VOCs were calculated separately for the three modelled vehicle types:

- cars
- light commercial vehicles (vans, minibuses and light trucks)
- heavy commercial vehicles (medium trucks, heavy trucks and buses).

The economic characteristics of the three vehicle types were updated from the IFC study as required. The characteristics of the three vehicle types as defined for HDM-4 were based on the LB study, updated on the basis of observed fuel costs, the CPI and reported wage rates. Changes in the CPI and wage rates since 2007 are shown in Table 13 below.

Table 13: CPI and wages: % change per year since 2007

	CPI	Wages
2008	7.4	22.8
2009	3.4	5.7
2010	0.5	11.0
2011	3.1	1.0
2012 (forecast)	2.6	3.7
Total	18.1	50.9

Source: EU Candidate and Pre-accession Countries Economic Quarterly, April 2012

The revised vehicle characteristics and economic costs are shown in Table 14 below.

The economic cost of fuel was revised based on the current pump prices of EUR 1.39/litre for 95 octane petrol, EUR 1.43/litre for 98 octane petrol and EUR 1.30/litre for diesel. For petrol, a pump price of about EUR 1.40/litre equates to an economic cost of EUR 0.74/litre. This is based on a current cost per barrel of crude oil of USD 84 plus a manufacturing cost of 27.75 percent, excise duty of EUR 0.46 per litre, and an inland distribution cost and retailer margin of EUR 0.20. In addition, the pump price includes VAT at 17%.

At USD 120 per barrel of crude oil, the corresponding economic cost in Montenegro would be EUR 0.97/litre and the pump price would be about EUR 1.67/litre.

Table 14: Vehicle fleet characteristics and economic costs

	Passenger car	LCV	HCV
Economic unit costs			
New vehicle cost (EUR / veh.)	13,200	24,900	99,200
Fuel cost (EUR / litre)	0.74	0.76	0.76
Lubricant cost (EUR / litre)	7.06	7.06	7.06
New tyre cost (EUR / tyre)	92	113	295
Number of tyres	4	6	8
Maintenance labour cost (EUR / hr)	9.00	9.50	13.60
Crew cost (EUR / hour)	0.00	6.80	6.80
Annual overhead (EUR)	200	350	1050
Interest rate (%)	8	8	8
Utilisation			
Kms driven per year	16,000	35,000	54,000
Annual work hours	500	1,100	1,500
Service life (years)	12	12	13
Private use (%)	91	0	0
Unladen vehicle weight (tonnes)	1.1	3.0	16.0

Source: LB, Consultant's analysis

Using these input values, the VOCs were calculated in HDM-4. The results are shown in Table 15.

Table 15: VOC unit values (EUR/km, 2012 economic costs)

		Flat terrain				Rolling terrain				Mountainous terrain			
Speed	km/h	20	30	60	100	20	30	60	100	20	30	60	100
Motorway													
Car	EUR/veh.km	0.27	0.23	0.19	0.19	0.28	0.23	0.19	0.19	0.28	0.23	0.19	0.19
LCV	EUR/veh.km	0.66	0.52	0.39	0.38	0.67	0.52	0.39	0.38	0.67	0.54	0.41	0.40
HCV	EUR/veh.km	1.48	1.25	1.07	1.15	1.50	1.27	1.09	1.10	1.55	1.33	1.17	1.17
S2 new													
Car	EUR/veh.km	0.27	0.23	0.19	0.19	0.28	0.23	0.19	0.19	0.28	0.23	0.19	0.19
LCV	EUR/veh.km	0.66	0.52	0.39	0.38	0.67	0.52	0.39	0.38	0.67	0.54	0.41	0.40
HCV	EUR/veh.km	1.48	1.25	1.07	1.15	1.50	1.27	1.09	1.10	1.55	1.33	1.17	1.17
Main road													
Car	EUR/veh.km	0.28	0.24	0.20	0.20	0.28	0.24	0.20	0.20	0.29	0.24	0.20	0.20
LCV	EUR/veh.km	0.69	0.55	0.42	0.41	0.70	0.55	0.43	0.41	0.70	0.56	0.44	0.43
HCV	EUR/veh.km	1.58	1.35	1.17	1.23	1.60	1.37	1.19	1.20	1.64	1.43	1.27	1.27
Regional road													
Car	EUR/veh.km	0.29	0.25	0.21	0.21	0.29	0.25	0.21	0.21	0.30	0.25	0.21	0.21
LCV	EUR/veh.km	0.72	0.58	0.45	0.44	0.72	0.58	0.46	0.44	0.73	0.59	0.47	0.46
HCV	EUR/veh.km	1.67	1.44	1.26	1.27	1.69	1.46	1.28	1.28	1.73	1.52	1.37	1.36

Source: Consultant's analysis using HDM-4

3.4.2 Values of time

As with VOCs, a distinction may be made between economic values of time (VOT) used in the economics model and the behavioural VOTs that determine route choice in the traffic model.

The economic VOT of the IFC study was based on average wage rates, adjusted according to employers' overheads, taxes, vehicle occupancies and percentage of travel undertaken for business.

The unit VOTs represent the cost to the economy of spending an hour of time travelling. The values were derived following advice such as that contained in the TINA and HEATCO documentation.

The value of working time is assumed to be directly related to the hourly wage rate. This assumes that wage rates are a measure of the value of the output produced in one hour and all savings in working time can be used for the production of additional output by the employee. In order to obtain values per vehicle, VOTs are associated with average passenger occupancies for each type of vehicle or mode.

VOTs were calculated initially for 2010, the latest year for which wage rate data was available. They were then increased in line with GDP/capita and an appropriate VoT elasticity (0.7 as recommended by HEATCO) to obtain values for 2012 (the base year for monetary values). The 2012/2010 factor thus applied was 1.045.

For trips made on business in working time, the value per person was set to the 2010 average gross monthly salary of EUR 715[8] plus employers' overheads of 65 percent (based on the percent estimated by the Highway Institute in Serbia) i.e. EUR 1180. This is equivalent to EUR 7.37 per hour. This could be seen as a conservative assumption because road users on business trips in a transitional economy like that of Montenegro might have higher-than-average salaries or income.

For other trips (i.e. trips made in non-productive time), a value per person of 30 percent of the average net 2010 income of EUR 479[9] per month was used. This is equivalent to EUR 0.90 per hour.

The traffic surveys carried out by LB showed that 9.1 percent of private cars were being used for business trips. The surveys also showed that the average occupancy of private cars was 2.14. The average value of time for all passengers was therefore calculated to be EUR 1.49 per person and EUR 3.18 per passenger car in 2010. Applying the 2012/2010 growth factor, these become EUR 1.55 per person and EUR 3.33 per passenger car in 2012.

No explicit VOTs were included for drivers of commercial vehicles since crew costs are included in the VOCs. Instead, a nominal time value based on the value of the locked-up capital in the freight being transported was used.

On average, products transported by road in CEEC had a value of EUR 2300 per tonne[10] in 2003. At an interest rate appropriate for Montenegro of about 7 percent, road freight would have a VOT of about EUR 18.38 per 1000 tonne hours[11] (2003). Updated to 2012 this becomes EUR 26.62 per 1000 tonne hours. A summary of the derived VOTs is presented in Table 16 below.

Table 16: Summary of values of time for 2012 (per hour)

Vehicle type	Occupancy/loading	EUR	EUR / vehicle
Car	2.14 persons	1.55 / person	3.33
LCV	3.6 tonnes	0.02662 / tonne	0.096
HCV	12.5 tonnes	0.02662 / tonne	0.333

Source: Consultant's analysis

[8] Statistical Yearbook of Montenegro
[9] Statistical Yearbook of Montenegro
[10] Source: www.euractiv.com/en/enlargement/expansion-logistics-sector-ceec/article-135995
[11] At 7 percent interest, assume EUR 161 would be paid on the capital sum of EUR 2300 in a year, the average value of a tonne of road freight. If the freight is delayed for a day, it may be assumed that this is equivalent to EUR 161 / 365 = EUR 0.44 per tonne in interest that must be paid. The amount per hour would be EUR 0.44 / 24 = EUR 0.01838.

VOTs for future years were increased by applying the VOT elasticity to forecast growth in GDP/capita.

Assumed growth in GDP as set out in section 2.2 of this report, and with an elasticity of 0.7 applied, is shown in the following table.

Table 17: VOT growth factors 2012 - 2050 (percent per year)

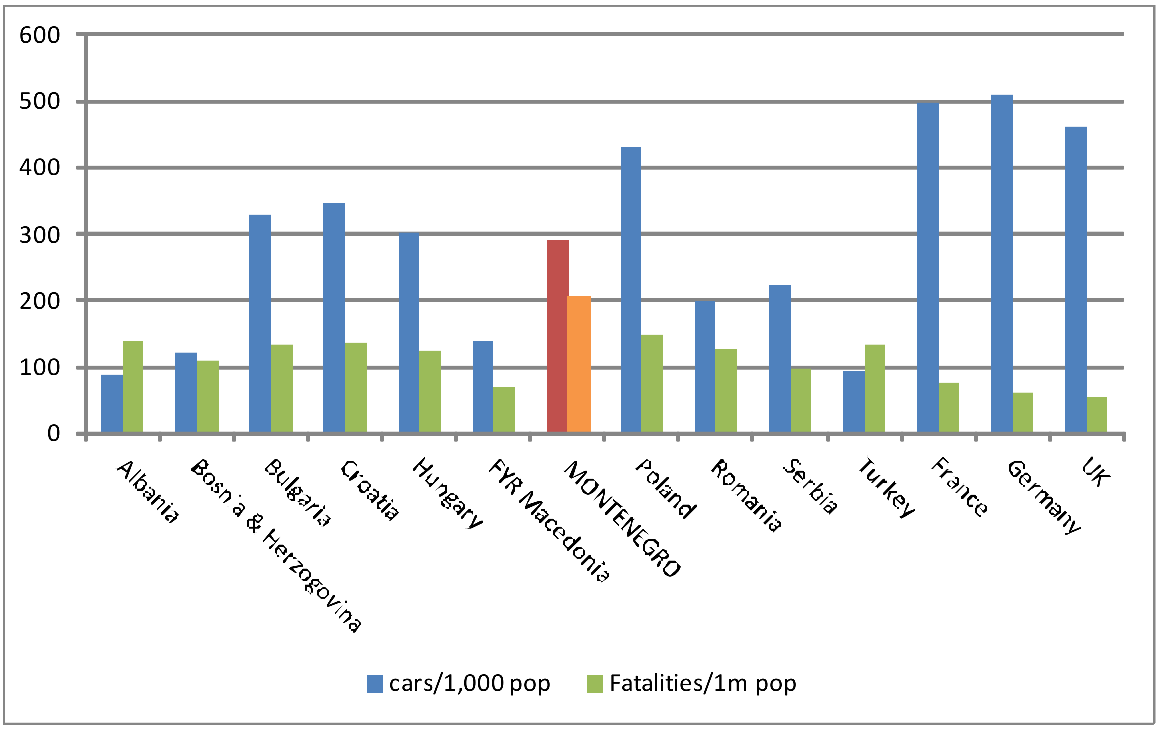
Year	GDP/capita	VOT
2012 - 2020	2.0%	1.4%
2021 - 2035	2.5%	1.75%
2036 - 2050	2.5%	1.75%

Source: Consultant's analysis

3.4.3 Accident rates and costs

Among European countries, Montenegro has one of the highest rates of road fatalities. A comparison of fatality rates in various countries is shown in the figure below. This can be explained in part by the higher level of motorisation compared with certain countries in the region. Nevertheless, countries such as Bulgaria, Croatia and Hungary have higher levels of motorisation but lower fatality rates. It may be that the high level of fatalities in Montenegro is due, at least in part, to the nature of the terrain and the standard and condition of the existing infrastructure.

Figure 5: Road fatalities in various countries 2009



Source: WHO

Tables 18 and 19 show the total number of reported accidents and the total number of reported casualties in the SEETO Route IV corridor. The data is presented by severity and section for the period 2009-2011.

Table 18: Reported accidents in the corridor by section and severity, 2009-2011

	Fatal	Serious	Slight	Damage only	Total
Bar-Virpazar	2	9	8	35	54
Sozina Tunnel	0	2	3	12	17
Podgorica	23	49	85	386	543
Kolasin	10	35	72	389	506
Mojkovac	4	19	33	106	162
Bijelo Polje	5	15	24	78	122
Dobrakove	3	31	83	194	311
Berane	2	8	35	57	102
Rozaje	7	7	46	77	137

Source: police records

Table 19: Reported casualties in the corridor by section and severity, 2009-2011

	Fatalities	Seriously injured	Slightly injured	Total
Bar-Virpazar	2	13	28	43
Sozina Tunnel	0	2	4	6
Podgorica	27	24	207	258
Kolasin	14	46	167	227
Mojkovac	7	33	102	142
Bijelo Polje	6	26	67	99
Dobrakove	3	44	168	215
Berane	2	12	58	72
Rozaje	11	9	67	87

Source: police records

However, under-reporting is a well recognised problem in official road accident statistics. This is particularly true of damage-only accidents, but may also occur because of poor reporting, recording and coordinating of data. HEATCO recommends applying correction factors for unreported accidents. Table 20 on the following page shows suggested average correction values. It should be noted that under-reporting may be higher in Montenegro than the European average, meaning that potential benefits may be under-estimated.

Table 20 Recommended European average correction values for under-reporting of road accidents

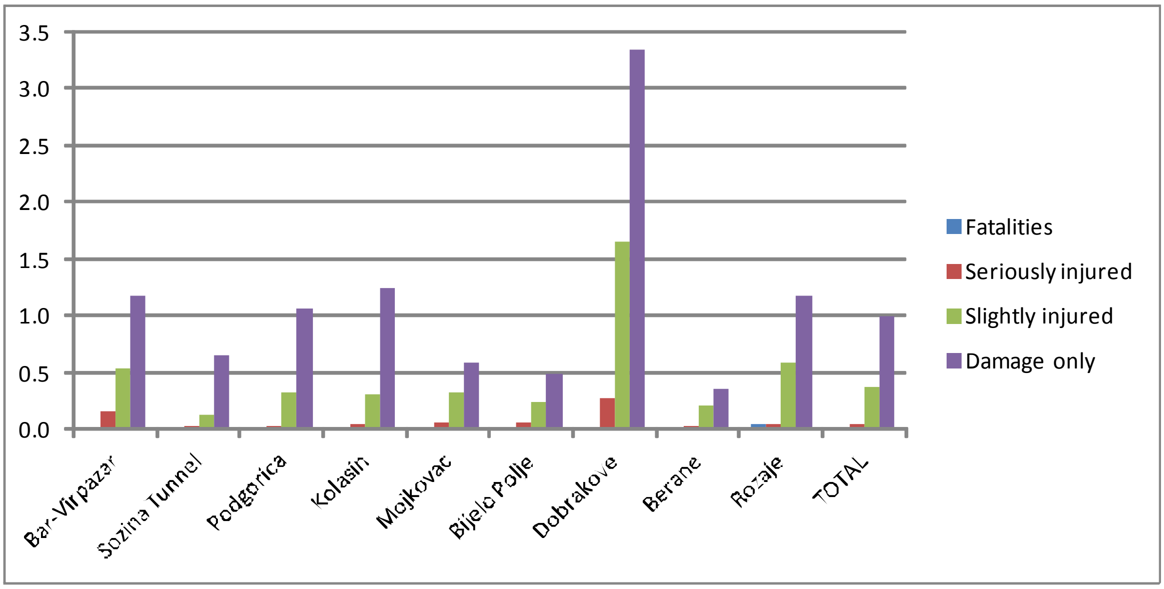
	Fatality	Serious injury	Slight injury	Damage only
Average	1.02	1.50	3.00	6.00
Car	1.02	1.25	2.00	3.50
Motorcycle	1.02	1.55	3.20	6.50
Bicycle	1.02	2.75	8.00	18.50
Pedestrian	1.02	1.35	2.40	4.50

Source: HEATCO

The correction factor of 1.02 for fatalities takes into account the fact that a few victims die after the recording period of 30 days.

For each section traffic volumes were extracted from the traffic model to calculate casualty rates per million veh.km. The resulting rates (adjusted for under-reporting) are shown below.

Table 21: Casualty and accident rates in the corridor by section, 2009-2011 (casualties/accidents per mln.veh.km adjusted for under-reporting)



	Fatalities	Seriously injured	Slightly injured	Damage only
Bar-Virpazar	0.020	0.157	0.541	1.184
Sozina Tunnel	0.000	0.039	0.126	0.659
Podgorica	0.022	0.024	0.325	1.062
Kolasin	0.013	0.053	0.307	1.253
Mojkovac	0.011	0.066	0.325	0.592
Bijelo Polje	0.011	0.058	0.239	0.487
Dobrakove	0.015	0.271	1.655	3.344
Berane	0.004	0.027	0.205	0.353
Rozaje	0.049	0.049	0.589	1.185
TOTAL	0.016	0.055	0.369	0.991

Source: Consultant's analysis

In order to estimate a possible reduction in accident rates due to the construction of a new road, accident rates by type of road in other countries were analysed from various sources[12]. Although

[12] Accident trends by road type, RAC Foundation, 2009
Interurban accident rates by road type and geometric elements, O'Cinneide et al, 2004
Road design factors affecting death and serious injury, EuroRAP, 2002
iRAP/EuroRAP Working Paper 504.2, 2011.

differing significantly, some general trends could be observed. These are typified by the accident rates observed in Ireland and shown in table 22 below.

Table 22: Irish accident rates by type of road (accidents per 10^8 veh.km)

	Accident rates			Relative to unimproved 2-lane		
	Fatal	Serious	All[1]	Fatal	Serious	All
Motorway	0.19	0.70	5.25	0.15	0.11	0.20
Dual carriageway	0.61	2.39	16.52	0.50	0.39	0.63
3-lane undivided	1.53	5.59	17.82	1.24	0.90	0.68
Improved wide 2-lane	1.23	5.68	22.33	1.00	0.92	0.85
Improved 2-lane	1.67	5.77	22.32	1.36	0.93	0.85
Unimproved 2-lane	1.23	6.18	26.32	1.00	1.00	1.00

[1] All accidents include slight injury accidents

Source: Interurban accident rates by road type and geometric elements, O'Cinneide et al, 2004

There are certain inconsistencies in the above table, and there is no guarantee that the experience in Ireland is transferable to Montenegro. Furthermore, the table presents accident rates rather than casualty rates.

In view of the lack of data available in Montenegro, it is hypothesised that similar orders of magnitude of relative rates could be appropriate. Therefore, the relative rates shown in the table below have been used to estimate the possible accident reduction benefits as a result of constructing the proposed new road. These rates are broadly comparable with rates produced by EuroRAP and by the Handbook of Road Safety Measures[13] across a wider range of countries.

Table 23: Assumed relative accident rates

Motorway and grade separated dual carriageway	0.20 (EuroRAP 0.20)
Dual carriageway with at-grade intersections	0.65 (EuroRAP 0.40)
3-lane undivided	0.70 (EuroRAP 0.60)
Improved 2-lane	0.85 (EuroRAP 1.00)
Existing road	1.00 (EuroRAP 1.00)

Source: Consultant's analysis, EuroRAP

3.4.4 Accident costs

The accident costs per casualty used in the previous study were updated to 2012 by increasing them in line with growth in GDP/capita (a factor of 1.088), as recommended by HEATCO.

Table 24: Estimated cost per casualty 2012 (rounded EUR)

	Damage only	**Slight**	**Serious**	**Fatal**
Total	1,500	3,300	35,500	290,500

Source: Faculty of Transport and Traffic Engineering at the University of Belgrade, HEATCO and Consultant's analysis

[13] Elvik, R. et al (2009), Handbook of Road Safety Measures, second edition

3.4.5 External costs

The external costs include the following environmental effects:

- noise
- air pollution
- climate change.

In the previous study, the external costs were based on work carried out by INFRAS/IWW[14]. These previously calculated values have been updated to 2012 in line with change in GDP/capita. The resulting unit costs are shown below. The costs are expressed in euros per 1000 passenger kilometres or 1000 tonne kilometres. Total external costs in the DM and DS scenarios are calculated by multiplying these unit costs by the average number of passengers per vehicle (or tonnes per truck) and by the number of vehicle kilometres.

Table 25: Aggregate external costs: 2012 factor costs

Passenger modes (EUR/1000 pass.km)	Freight modes (EUR/1000 tonne.km)	
Car	**Light Commercial Vehicle**	**Heavy Commercial Vehicle**
27.6	106.1	28.0

Source: INFRAS/IWW and Consultant's estimate

[14] INFRAS/IWW (2004) External Costs of Transport, Update Study

3.5 Evaluation model

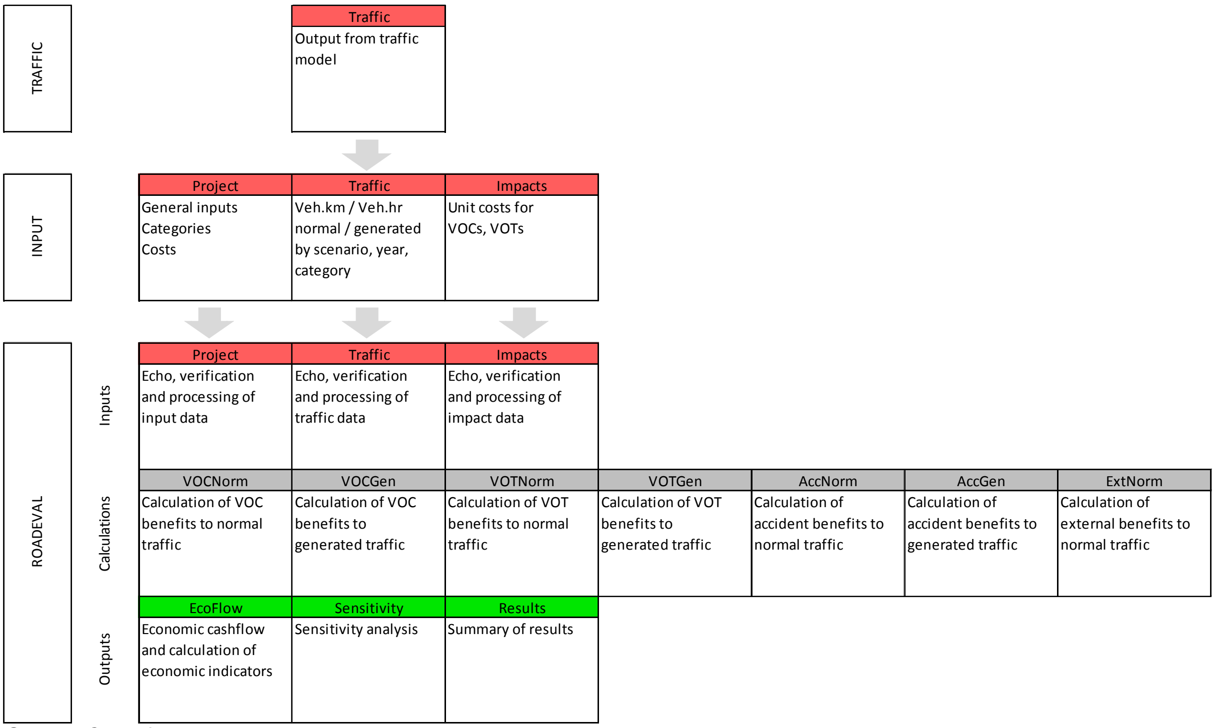
The Consultant's RoadEval[15] model was used to carry out the economic evaluations. The model is set up in Excel and is structured according to best practice techniques. The model consists of two linked workbooks:

- a workbook of three worksheets (data input) for each project option, and
- a single workbook of 16 worksheets (the model) that process the input data, perform calculations and present results.

This structure facilitates changes to be made to the model without the need to modify the workbook for every project option. To run, the model simply requires the name of the data input workbook.

For the current project, the structure of the model was altered slightly so that the traffic data output from the traffic model could be loaded from a separate workbook into the input data workbook. The structure is shown in the figure below.

Figure 6: Structure of the evaluation model RoadEval



Source: Consultant

3.5.1 Basic input parameters

This section reports the basic input parameters used in the economic evaluations that apply to all projects (ie. those costs that are not project specific). The list of parameters follows the format of RoadEval.

[15] RoadEval is the road evaluation model developed by AJ Miller: jmiller@poczta.onet.pl.

General parameters:

- base year for costs: 2012
- appraisal period: 30 years
- discount rate: 8%
- contingencies: set to 0% for the initial evaluations. See 3.3.1 above.
- works cost optimism bias: set to 0% for the initial evaluations. See 3.3.1 above.
- financial / economic factor: set to 98% . See 3.3.1 above.

Traffic modes: set to the modes of the traffic model:

- cars, taxis, motor cycles
- light trucks, vans
- heavy trucks, buses

Road types: set to the road types of the traffic model:

- motorway / new 2x2 dual carriageway
- new 2 lane single carriageway
- existing main road
- existing regional road

Road speed categories: set to the speed categories output by the traffic model:

- 0.0 - 20.0 km/h
- 20.1 - 40.0 km/h
- 40.1 - 80.0 km/h
- more than 80 km/h

3.5.2 Project costs

Project costs for each project option as described in section 3.3 above are input including:

- investment costs
- management costs
- land acquisition costs
- operation and maintenance costs
- expected physical life of assets for the calculation of a residual value (which may be over-ridden by an explicitly entered value).

3.5.3 Traffic data

Traffic data is output directly from the traffic model and includes:

- vehicle kilometres and vehicle hours
- for normal and generated traffic
- for the DM and DS scenarios
- by type of vehicle, category of road, type of terrain and category of speed
- for each year modelled in the traffic model.

For the situation where the final year of the appraisal period is beyond the final year of data output from the traffic model, the user is able to choose whether to extrapolate benefits or to hold them constant.

3.5.4 Impact data

The impact data includes the unit values applied to the various categories of benefit. These are described in section 3.4 above. The impact data also includes growth factors to be applied during the appraisal period and ranges of values to be used in the sensitivity analysis.

3.5.5 Model outputs

The model outputs include:

- an economic cash flow
- a sensitivity analysis, and
- a summary of results.

The economic cashflow calculates the detailed costs and benefits per year during the construction and appraisal periods. It calculates the present value of the costs and benefits and reports the main economic indicators (EIRR, NPV and B/C). It also calculates the proportion of benefits derived from each benefit category.

The sensitivity analysis reports the EIRR and NPV for percentage variations in:

- traffic volume (50-150%)
- generated traffic (0-100%)
- VOC benefits (50-150%)
- VOT benefits (50-150%)
- Investment cost (75-150%)
- O&M costs (75-150%)
- residual value (0-100%)
- accident benefits (50-150%).

The analysis identifies critical variables on the basis of a threshold specified by the user. The threshold has been set to 1% for the current investigation, so that a critical variable is one for which a change in value of 1% results in a change in NPV of 1% or more.

The results sheet reports the key input data, presents the economic indicators and shows the source of benefits. It also includes graphic representations of the undiscounted and discounted economic cashflows and of the sensitivity analysis. An example is shown below.

4. COST BENEFIT ANALYSIS AND PRIORITISATION PLAN

As outlined previously, a project may be considered viable on economic grounds if it has an EIRR of at least the discount rate - in this case 8 percent - an NPV greater than €0.00 and a B/C greater than 1.00.

4.1 Evaluation of scenarios

The results of the economic evaluations of scenarios are set out in the table below. Scenarios S1 to S14 relate to the construction of individual sections in isolation from other sections while scenarios S15 to S20 relate to combinations of individual sections. It should be noted that these results relate to evaluations where benefits have been extrapolated (rather than held constant) beyond the final year of traffic data. If the benefits are held constant, the results are slightly lower (see section 4.3). Scenario 14 (Poda - Bijelo Poleje - Serbian border) was dropped from further analysis as it is identical in terms of costs and benefits to S8.

Table 26: Economic evaluation results

Scenario	Section	EIRR (%)	NPV (EURm)	B/C
S1	Virpazar - Zabljak - Farmaci	1.9	-197.61	0.29
S2	Virpazar - Cetinje - Farmaci	5.2	-78.90	0.65
S2a	Virpazar - Cetinje - Farmaci	7.0	-22.11	0.87
S3	Farmaci - Smokovac	-5.6	-172.39	-ve
S4	Smokovac - Matesevo	4.5	-158.61	0.59
S5	Matesevo - Andrijevica	2.2	-110.45	0.35
S6	Andrijevica - Poda	1.3	-116.68	0.29
S7	Poda - Boljare	1.7	-94.04	0.32
S8	Poda - Bijelo Poleje - border	10.2	22.71	1.29
S9	Djurmani - Virpazar	0.9	-47.86	0.29
S10	Smokovac - Matesevo	3.1	-307.90	0.44
S11	Matesevo - Andrijevica	-0.1	-280.81	0.18
S12	Andrijevica - Poda	0.1	-186.28	0.21
S13	Poda - Boljare	0.3	-167.36	0.21
S14	Poda - Bijelo Poleje - border	Not analysed		
S15	S2 + S3	1.5	-247.00	0.29
S16	S2 + S3 + S4 + S5 + S6 + S7 + S8	1.5	-726.12	0.25
S17	S2 + S3 + S9	1.2	-291.35	0.27
S18	S2 + S3 + S4 + S9	2.2	-462.49	0.33
S19	S2 + S3 + S9 + S10	1.7	-592.22	0.29
S20	S2 + S3 + S9 + S10 + S11 + S12 + S13	0.7	-1128.96	0.20

Source: Consultant's analysis

These results suggest that only the improvement of the road from Poda to the Serbian border (S8) constitutes a viable project at a discount rate of 8%. It may be noted, however, that the benefits are accruing largely to local traffic bypassing Bijelo Poleje, rather than to long distance traffic.

Improvement of the road from Virpazar to Farmaci via Cetinje (S2) has the next best rate of return at 5.2%, and becomes viable at a discount rate of 8% if construction begins in 2024. Constructing this section to a lower standard of combined single and dual carriageway sections (S2a) improves the EIRR to 7%. If the commencement of construction is delayed until 2017, S2a becomes viable at a discount rate of 8%. (Note that it is assumed that the maintenance costs are also reduced for this option. Thus, the result is slightly different from the sensitivity test of 75% of investment cost.)

The single carriageway road from Smokovac to Matesevo (S4) has an EIRR of 4.5%. Under the assumptions currently employed, it is still not a viable project at a discount rate of 8% in 2030.

4.2 Source of benefits

The sources of benefits for each scenario are shown in the table below. Overall, benefits from savings in VOCs constitute from 35 to 65 percent of the total, savings in VOTs 30 to 55 percent, accident savings up to about 25 percent and external costs less than 5 percent. Actually, external cost savings are often negative, due to the longer distances of the new infrastructure.

Table 27: Source of benefits for each scenario (%)

Scenario	Section	VOC	VOT	Accidents	External costs	Generated traffic
S1	Virpazar - Zabljak - Farmaci	47	46	13	-6	30
S2	Virpazar - Cetinje - Farmaci	57	32	9	2	19
S2a	Virpazar - Cetinje - Farmaci	57	32	9	2	19
S3	Farmaci - Smokovac	-	-	-	-	-
S4	Smokovac - Matesevo	64	29	3	4	18
S5	Matesevo - Andrijevica	49	42	7	2	22
S6	Andrijevica - Poda	39	53	9	-1	27
S7	Poda - Boljare	37	52	16	-5	22
S8	Poda - Bijelo Poleje - border	49	43	6	2	20
S9	Djurmani - Virpazar	39	31	26	4	20
S10	Smokovac - Matesevo	60	30	6	4	18
S11	Matesevo - Andrijevica	49	41	8	2	22
S12	Andrijevica - Poda	38	53	10	-1	27
S13	Poda - Boljare	36	51	17	-4	21
S14	Poda - Bijelo Poleje - border	Not analysed				
S15	S2 + S3	45	51	14	-10	31
S16	S2 + S3 + S4 + S5 + S6 + S7 + S8	54	42	7	-3	24

Scenario	Section	VOC	VOT	Accidents	External costs	Generated traffic
S17	S2 + S3 + S9	44	52	14	-10	32
S18	S2 + S3 + S4 + S9	58	38	7	-3	24
S19	S2 + S3 + S9 + S10	55	38	9	-2	24
S20	S2 + S3 + S9 + S10 + S11 + S12 + S13	49	44	10	-3	24

Source: Consultant's analysis

4.3 Sensitivity analysis

The sensitivity tests outlined in section 3.5 were run for each scenario. The EIRR and NPV for each test and each scenario is shown in the table below, along with an identification of critical variables. The detailed results are included in the economic evaluation summary sheets in Annex 1.

From this table it can be seen that in the sensitivity analysis:

- the viable scenario (S8) becomes unviable under all tests except O&M, residual value and accident benefits.
- the only further scenario that becomes viable is S2a. The EIRR for S2a is above 8% if traffic, VOC benefits or VOT benefits are 50% higher, or if the investment cost is 25% lower.
- investment cost is a critical variable in all scenarios.
- traffic is a critical variable in scenarios S2, S2a, S4 and S8.
- VOC and VOT are critical variables in scenarios S2a and 8.
- the approximate switching values of the critical variables of scenario S2a are +20% for traffic, +30% for VOC benefits, +40% for VOT benefits and -20% for investment cost.

Table 28: Sensitivity analysis: EIRR (%), NPV EURm and critical variables

Scenario	Indicator	Base	Traffic		Generated traffic	VOC		VOT		Investment cost		O&M		Residual value	Accidents	
			-50%	+50%	0%	-50%	+50%	-50%	+50%	-25%	+50%	-25%	+50%	0%	-50%	+50%
S1	EIRR %	1.9%	0.5%	3.1%	0.7%	1.0%	2.7%	1.0%	2.8%	2.7%	0.8%	2.1%	1.6%	0.6%	1.7%	2.2%
	NPV (EURm)	-197.61	-223.73	-171.49	-227.91	-211.62	-183.59	-220.95	-174.26	-145.16	-328.72	-194.02	-206.56	-209.15	-205.15	-190.06
	Critical?		N		N	N		N		Y		N		N	N	
S2	EIRR %	5.2%	2.6%	7.3%	4.0%	3.5%	6.6%	4.2%	6.2%	6.8%	3.3%	5.4%	4.9%	4.6%	4.9%	5.5%
	NPV (EURm)	-78.90	-136.94	-20.87	-111.18	-116.62	-41.19	-105.62	-52.19	-26.47	-183.78	-74.53	-87.65	-88.33	-86.92	-70.89
	Critical?		Y		N	N		N		Y		N		N	N	
S2a	EIRR %	7.0%	4.0%	9.4%	5.5%	5.1%	8.6%	5.8%	8.2%	8.9%	4.8%	7.2%	6.7%	6.6%	6.7%	7.4%
	NPV (EURm)	-22.11	-80.14	35.93	-54.38	-59.82	15.61	-48.82	4.61	17.23	-100.77	-18.82	-28.67	-29.17	-30.12	-14.09
	Critical?		Y		N	Y		Y		Y		N		N	N	
S3	EIRR %	-5.6%														
	NPV (EURm)	-172.39														
	Critical?															
S4	EIRR %	4.5%	2.0%	6.7%	3.5%	2.6%	6.2%	3.7%	5.3%	5.8%	2.7%	4.6%	4.3%	3.8%	4.5%	4.6%
	NPV (EURm)	-158.61	-251.28	-65.94	-200.12	-231.57	-85.65	-191.14	-126.08	-85.92	-340.33	-154.21	-169.62	-174.07	-162.16	-155.06
	Critical?		Y		N	N		N		Y		N		N	N	
S5	EIRR %	2.2%	0.5%	3.7%	1.3%	1.1%	3.1%	1.3%	3.0%	3.1%	0.9%	2.3%	1.9%	0.7%	2.0%	2.3%
	NPV (EURm)	-110.45	-133.76	-87.13	-124.25	-124.54	-96.36	-123.46	-97.43	-77.99	-191.58	-108.72	-114.75	-117.96	-112.80	-108.09
	Critical?		N		N	N		N		Y		N		N	N	
S6	EIRR %	1.3%	-0.2%	2.6%	0.2%	0.5%	2.0%	0.2%	2.2%	2.0%	0.2%	1.4%	0.9%	-0.6%	1.1%	1.4%
	NPV (EURm)	-116.68	-134.14	-99.21	-130.04	-125.41	-107.94	-129.94	-103.41	-85.70	-194.13	-114.67	-121.71	-123.30	-119.01	-114.35
	Critical?		N		N	N		N		Y		N		N	N	
S7	EIRR %	1.7%	0.0%	3.1%	0.8%	0.9%	2.4%	0.6%	2.7%	2.5%	0.4%	1.8%	1.5%	0.2%	1.4%	2.0%
	NPV (EURm)	-94.04	-111.13	-76.94	-103.92	-101.28	-86.79	-105.93	-82.14	-67.45	-160.52	-93.00	-96.62	-99.24	-97.86	-90.21
	Critical?		N		N	N		N		Y		N		N	N	
S8	EIRR %	10.0%	5.9%	13.4%	7.9%	7.6%	12.1%	7.9%	11.9%	12.0%	6.9%	10.1%	9.6%	9.7%	9.7%	10.3%
	NPV (EURm)	19.86	-18.56	58.29	-0.76	-3.37	43.10	-1.29	41.01	33.80	-14.97	21.45	15.89	16.35	16.61	23.11
	Critical?		Y		N	Y		Y		Y		N		N	N	
S9	EIRR %	0.9%	-0.9%	2.4%	0.0%	0.0%	1.6%	0.2%	1.5%	1.5%	0.0%	1.2%	0.1%	-1.4%	0.3%	1.4%
	NPV (EURm)	-47.86	-55.63	-40.09	-51.56	-51.29	-44.43	-50.75	-44.97	-36.34	-76.64	-45.95	-52.63	-50.76	-50.81	-44.90
	Critical?		N		N	N		N		Y		N		N	N	
S10	EIRR %	3.0%	0.9%	4.9%	2.2%	1.5%	4.4%	2.3%	3.7%	4.1%	1.5%	3.2%	2.8%	1.9%	2.9%	3.2%
	NPV (EURm)	-307.90	-407.09	-208.72	-352.28	-381.97	-233.84	-343.42	-272.39	-204.07	-567.50	-301.61	-323.63	-329.98	-315.12	-300.69
	Critical?		N		N	N		N		Y		N		N	N	

Scenario	Indicator	Base	Traffic		Generated traffic	VOC		VOT		Investment cost		O&M		Residual value	Accidents	
			-50%	+50%	0%	-50%	+50%	-50%	+50%	-25%	+50%	-25%	+50%	0%	-50%	+50%
S11	EIRR %	-0.1%	-1.1%	0.9%	-0.6%	-0.7%	0.5%	-0.6%	0.4%	0.4%	-0.8%	0.0%	-0.4%	-3.2%	-0.2%	0.0%
	NPV (EURm)	-280.81	-304.36	-257.25	-294.61	-294.90	-266.71	-293.83	-267.79	-215.91	-443.05	-277.36	-289.42	-295.83	-283.40	-278.21
	Critical?		N		N	N		N		Y		N		N	N	
S12	EIRR %	0.1%	-1.1%	1.2%	-0.7%	-0.5%	0.7%	-0.7%	0.9%	0.7%	-0.7%	0.3%	-0.2%	-2.6%	0.0%	0.3%
	NPV (EURm)	-186.28	-204.24	-168.32	-199.75	-195.05	-177.51	-199.73	-172.84	-142.02	-296.93	-183.41	-193.47	-195.74	-188.94	-183.62
	Critical?		N		N	N		N		Y		N		N	N	
S13	EIRR %	0.3%	-1.0%	1.4%	-0.4%	-0.3%	0.8%	-0.5%	1.0%	0.9%	-0.6%	0.4%	0.0%	-2.1%	0.0%	0.5%
	NPV (EURm)	-167.36	-184.97	-149.76	-177.28	-174.62	-160.11	-179.30	-155.42	-126.45	-269.63	-165.77	-171.33	-175.37	-171.66	-163.06
	Critical?		N		N	N		N		Y		N		N	N	
S14	EIRR %															
	NPV (EURm)															
	Critical?															
S15	EIRR %	1.5%	0.1%	2.7%	0.2%	0.6%	2.3%	0.5%	2.4%	2.2%	0.4%	1.6%	1.1%	-0.1%	1.2%	1.8%
	NPV (EURm)	-247.00	-279.66	-214.35	-283.90	-265.45	-228.56	-276.20	-217.80	-181.88	-409.80	-242.28	-258.81	-260.34	-255.17	-238.84
	Critical?		N		N	N		N		Y		N		N	N	
S16	EIRR %	1.5%	0.0%	2.7%	0.6%	0.5%	2.4%	0.7%	2.2%	2.2%	0.4%	1.6%	1.2%	0.0%	1.4%	1.6%
	NPV (EURm)	-726.12	-817.97	-634.28	-788.42	-791.17	-661.08	-779.15	-673.10	-540.23	-1190.85	-717.59	-747.45	-755.55	-735.80	-716.45
	Critical?		N		N	N		N		Y		N		N	N	
S17	EIRR %	1.2%	-0.2%	2.3%	-0.1%	0.3%	1.9%	0.2%	2.1%	1.9%	0.2%	1.3%	0.8%	-0.6%	0.9%	1.4%
	NPV (EURm)	-291.35	-325.04	-257.66	-329.40	-310.09	-272.61	-321.71	-260.98	-217.88	-475.02	-285.46	-306.06	-306.00	-299.72	-282.98
	Critical?		N		N	N		N		Y		N		N	N	
S18	EIRR %	2.2%	0.5%	3.6%	1.2%	1.0%	3.3%	1.4%	2.9%	3.0%	1.0%	2.3%	1.9%	1.0%	2.1%	2.4%
	NPV (EURm)	-462.49	-548.95	-376.03	-520.58	-527.74	-397.24	-506.84	-418.14	-331.70	-789.47	-454.58	-482.26	-485.48	-470.76	-454.23
	Critical?		N		N	N		N		Y		N		N	N	
S19	EIRR %	1.7%	0.1%	3.0%	0.8%	0.6%	2.7%	1.0%	2.4%	2.5%	0.6%	1.9%	1.4%	0.3%	1.6%	1.9%
	NPV (EURm)	-592.22	-684.43	-500.02	-653.07	-658.49	-525.95	-639.51	-544.94	-434.02	-987.72	-582.93	-615.46	-620.08	-603.47	-580.98
	Critical?		N		N	N		N		Y		N		N	N	
S20	EIRR %	0.7%	-0.5%	1.7%	-0.1%	-0.1%	1.4%	0.0%	1.3%	1.2%	-0.2%	0.8%	0.4%	-1.3%	0.5%	0.8%
	NPV (EURm)	-1128.96	-1231.64	-1026.28	-1199.88	-1194.85	-1063.07	-1190.49	-1067.43	-860.50	-1800.12	-1116.37	-1160.42	-1171.80	-1144.09	-1113.83
	Critical?		N		N	N		N		Y		N		N	N	

Source: Consultant's analysis

A further test shows the effect of holding benefits constant after the last year for which traffic data is available, rather than extrapolating benefits.

Table 29: Economic evaluation results with benefits held constant after final year of traffic data

Scenario	Section	Extraplated benefits		Constant benefits	
		EIRR (%)	NPV (EURm)	EIRR (%)	NPV (EURm)
S1	Virpazar - Zabljak - Farmaci	1.9	-197.61	1.4	-204.09
S2	Virpazar - Cetinje - Farmaci	5.2	-78.90	4.8	-85.64
S2a	Virpazar - Cetinje - Farmaci	7.0	-22.11	6.7	-28.84
S3	Farmaci - Smokovac	-5.6	-172.39	-ve	-173.82
S4	Smokovac - Matesevo	4.5	-158.61	4.3	-165.82
S5	Matesevo - Andrijevica	2.2	-110.45	1.9	-112.62
S6	Andrijevica - Poda	1.3	-116.68	1.0	-118.32
S7	Poda - Boljare	1.7	-94.04	1.4	-95.56
S8	Poda - Bijelo Poleje - border	10.2	22.71	10.0	19.86
S9	Djurmani - Virpazar	0.9	-47.86	0.5	-48.67
S10	Smokovac - Matesevo	3.1	-307.90	2.8	-315.86
S11	Matesevo - Andrijevica	-0.1	-280.81	-0.3	-282.98
S12	Andrijevica - Poda	0.1	-186.28	-0.1	-187.95
S13	Poda - Boljare	0.3	-167.36	0.0	-168.91
S14	Poda - Bijelo Poleje - border	Not analysed			
S15	S2 + S3	1.5	-247.00	1.1	-252.54
S16	S2 + S3 + S4 + S5 + S6 + S7 + S8	1.5	-726.12	1.0	-746.15
S17	S2 + S3 + S9	1.2	-291.35	0.7	-297.97
S18	S2 + S3 + S4 + S9	2.2	-462.49	1.7	-476.81
S19	S2 + S3 + S9 + S10	1.7	-592.22	1.3	-607.57
S20	S2 + S3 + S9 + S10 + S11 + S12 + S13	0.7	-1128.96	0.6	-1151.71

Source: Consultant's analysis

4.4 Costs and benefits per kilometre

A concern regarding the conventional cost benefit analysis was that the high cost of some of the major sections would result in lower cost sections (but with lower benefits) achieving a higher ranking. Further analysis of the costs and benefits of each Scenario was carried out, comparing the costs and benefits per kilometre. Table 30 shows the total costs and benefits and the costs and benefits per kilometre, undiscounted and discounted.

Table 30: Summary of economic costs and benefits, undiscounted and discounted

		Undiscounted		Undiscounted / km		Discounted		Discounted / km	
Scenario	Section	Investment cost	Benefits	Investment cost	Benefits	Investment cost	Benefits	Investment cost	Benefits
S1	Virpazar - Zabljak - Farmaci	343.51	454.42	13.06	17.28	273.78	82.54	10.41	3.14
S2	Virpazar - Cetinje - Farmaci	275.03	699.18	9.72	24.71	219.18	148.35	7.74	5.24
S2a	Virpazar - Cetinje - Farmaci	206.29	699.18	7.29	24.71	164.40	148.35	5.81	5.24
S3	Farmaci - Smokovac	163.72	-80.90	13.20	-6.52	135.77	-33.36	10.95	-2.69
S4	Smokovac - Matesevo	491.56	1048.22	11.15	23.77	378.89	226.85	8.59	5.14
S5	Matesevo - Andrijevica	213.03	273.36	8.88	11.39	169.77	60.43	7.07	2.52
S6	Andrijevica - Poda	202.66	216.45	7.89	8.42	161.53	48.30	6.29	1.88
S7	Poda - Boljare	172.89	198.00	6.83	7.83	138.16	44.08	5.46	1.74
S8	Poda - Bijelo Poleje - border	91.82	405.50	3.52	15.54	73.19	97.47	2.80	3.73
S9	Djurmani - Virpazar	74.09	86.80	8.23	9.64	60.47	19.25	6.72	2.14
S10	Smokovac - Matesevo	702.24	1126.83	15.92	25.55	541.27	242.75	12.27	5.50
S11	Matesevo - Andrijevica	426.03	275.28	17.75	11.47	339.52	60.91	14.15	2.54
S12	Andrijevica - Poda	289.52	221.03	11.27	8.60	230.75	49.40	8.98	1.92
S13	Poda - Boljare	265.98	202.47	10.51	8.00	212.56	45.12	8.40	1.78
S14	Poda - Bijelo Poleje - border	Not analysed							
S15	S2 + S3	438.76	519.95	10.78	12.78	338.93	102.20	8.33	2.51
S16	S2 + S3 + S4 + S5 + S6 + S7 + S8	1518.90	1795.26	9.50	11.23	958.88	245.99	6.00	1.54
S17	S2 + S3 + S9	512.84	576.67	10.32	11.60	382.00	105.43	7.69	2.12
S18	S2 + S3 + S4 + S9	1004.41	1449.70	10.71	15.46	676.94	231.00	7.22	2.46
S19	S2 + S3 + S9 + S10	1215.08	1541.38	12.95	16.43	818.86	245.26	8.73	2.61
S20	S2 + S3 + S9 + S10 + S11 + S12 + S13	2196.61	2019.78	13.01	11.96	1385.16	276.28	8.20	1.64

Source: Consultant’s analysis

NB. the costs in this table are economic costs and exclude the residual value and O&M costs. They are therefore not directly comparable with the costs used in other tables.

4.5 Summary of Findings

Table 29 shows that the economic appraisal produces generally poor economic results. Looking at the Route overall (Scenarios S15 to S20), the low current traffic volumes and the weak economic forecasts mean that the economic benefits of the proposed Route do not provide adequate return on the investment. All the NPVs are heavily negative with EIRRs below 2%. This is the case even if the engineering of the Sections is reduced such that the road is of single carriageway construction in the tunnel and bridge sections and dual sections are constructed only where safety considerations dictate and where it is economically sensible.

When analysing the corridor by Section, Table 31 shows Scenarios for all Sections ranked on the basis of EIRR and NPV. Using this conventional method ranking,.the only section of the Route that offers an acceptable economic return is Section VII-2 (S8), a single carriageway road designed to motorway geometry between Poda and the existing Serbia border post north of Bijelo Polje. However, it is clear that construction of this section alone makes little sense in the vision or function of the overall corridor.

The remainder of the Route from Virpazar - Farmaci – Smokovac – Matesevo – Andrejevica to Poda, and the option from Poda to Boljare do not offer acceptable returns within the time horizon to year 2030.

Table 31: Ranking of Sections by EIRR

Ranking	Scenario	Section	Invest. cost (EURm)	EIRR (%)	NPV (EURm)
1	**S8 – single 1x2 option**	**Section VII-2 Poda - Bijelo Poleje - border**	**93.70**	**10.2**	**22.71**
2	S2a – mixed option	Section II-2 Virpazar - Cetinje - Farmaci	210.49	7.0	-22.11
3	S4 – single 1x2 option	Section IV Smokovac - Matesevo	501.60	4.5	-158.61
4	S5 – single 1x2 option	Section V Matesevo - Andrijevica	217.38	2.2	-110.45
5	S1 – dual 2x2 option	Section II-1 Virpazar - Zabljak - Farmaci	350.52	1.9	-197.61
6	S6 – single 1x2 option	Section VI Andrijevica - Poda	206.80	1.3	-116.68
7	S9 – dual 2x2 option	Djurmani – Virpazar second carriageway	75.6	0.9	-47.86
8	S3 – dual 2x2 option	Section III Farmaci - Smokovac	167.06	-5.6	-172.39

Source: Consultant's analysis

It is possible to re-rank the sections according to the benefits per kilometre, as presented in Table 30. Using this alternative methodology Table 32, below, shows the ranking based on the discounted benefits per km.

Table 32: Alternative ranking

	Scenario	Section	Invest. cost (EURm)	EIRR (%)	NPV (EURm)	Discounted benefits per km (EURm)
1	**S2a – mixed option**	**Section II-2 Virpazar - Cetinje – Farmaci 28.3 km**	**210.49**	**7.0**	**-22.11**	**5.24**
2	**S4 – mixed option**	**Section IV Smokovac – Matesevo 44.1 km**	**501.60**	**4.5**	**-158.61**	**5.14**
3	S8 – single 1x2 option	Section VII-2 Poda - Bijelo Poleje – border 26.1 km	93.70	10.2	22.71	3.73
4	S5 – single 1x2 option	Section V Matesevo – Andrijevica 24.0 km	217.38	2.2	-110.45	2.52
5	S9 – dual 2x2 option	Section I Djurmani – Virpazar 2nd carriageway - 9km	75.6	0.9	-47.86	2.14
6	S6 – single 1x2 option	Section VI Andrijevica – Poda 25.7 km	206.80	1.3	-116.68	1.88
7	S3 – dual 2x2 option	Section III Farmaci – Smokovac 12,4 km	167.06	-5.6	-172.39	-2.69

Source: Consultant's analysis

Table 32 would lead to the possible re-consideration of the "priority section" Section IV Smokovac – Matesevo, as a mixed single/dual carriageway link at an estimated cost of EUR 501m with benefits/km of EUR 5.14 as a candidate for investment.

Section II-2 Virpazar to Farmaci via the Cetinje Road (EUR 210m cost with benefits of 5.24/km) could also be considered: it has a marginally sub-optimal EIRR of 7%.

Section III, the Podgorica Bypass from Farmaci to Smokovac does not offer economic returns from any analytical viewpoint,

Sections V, VI and VII north of Matesevo do not offer returns

Dualling of the coastal Section I from Djurmani to Virpazar also remains without economic justification.

5. THE WAY FORWARD AND TENTATIVE INVESTMENT PLAN

At this stage any investment planning can only be tentative because the results of the economic appraisal are such that the development banks will require further justification to participate in construction of the new motorway corridor. With the intention of assisting further exploration of the project possibilities, this section offers options for the way forward.

Option 1 – Upgrading of the existing route north of Podgorica

Whilst carrying out the current study the Consultant has concluded that no feasibility assessment has been made of improving the existing road from Podgorica (Smokovac) via Kolasin and Mojkovac to the Serbian border. Any improvements would have the objectives of improving safety, reducing transit time and increasing road capacity. Improving this route by a mixture of widening, realignment and dualling is obviously a challenging engineering task owing to the terrain. Nevertheless, it appears that no comprehensive study has been carried out.

As an initial assessment, it is likely that improvements to the first section of this route through the Moraca River canyon would prove impractical to engineer economically. It is for this reason that the "priority section" Smokovac to Matesevo, which avoids the canyon, is regarded by the Government of Montenegro as essential. This therefore leads to consideration of a second option.

Option 2 – Construction of the "priority section" north of Podgorica with a link to Kolasin

This option would involve

- construction of the 44 km section from Smokovac to Matesevo as part single and part dual motorway standard road
- upgrading of the existing 10 km between Matesevo and Kolasin
- upgrading of the existing E65 road from Kolasin through Mojkovac and using the Bijelo Polje bypass to the Serbian border: approximately 60 km.

To proceed with this option the Government would need to put in place the following preliminary actions, all of which may be done in parallel:

- Preparation of detailed designs and procurement documentation for the 44 km Smokovac to Matesevo section using the work of this study as a start point, supplemented by relevant work already carried out by the Montenegro design institutions
- Public consultation and resettlement action planning for affected persons along the Smokovac to Matesevo route
- Engineering study, economic appraisal and environmental/social impact study of improvements to the existing 10 km link road between Matesevo and Kolasin followed by public consultation and design of improvements
- Engineering study, economic appraisal and environmental/social impact study of improvements to the existing 60 km road between Kolasin and the border followed by public consultation and design of improvements

Terms of Reference would need to be prepared for all the above assignments.

The investment costs of the Smokovac to Matesevo section have been estimated in this study to be Euros 501.6 million[16]: that is Euros 11.3 million per kilometre with a construction period of 4 years.

It is not within the scope of this study to assess improvements to the Matesevo – Kolasin – Bijelo Polje route but on the basis of the work done in the assessing Section VIIa from Poda to the Serbian border, an investment cost of Euros 2.8 million per kilometre[17] can be used as an estimate of the cost of upgrading/improvement. For the route length of 70km (excluding Bijelo Polje bypass) this amounts to Euros 196 million cost. An initial estimate of the improvement period would also be 4 years, as for the priority section although the start date is likely to be later, say 2015.

Thus, a cashflow profile for investment in the corridor north of Podgorica could be as in Table 33.

Table 33: Tentative capital investment programme: Podgorica to Serbian border

	2014	2015	2016	2017	2018	Total costs Euros million
Smokovac to Matesevo 44km new road	145	112	115	115	15	502
Upgrade of existing roads 70km	25	40	50	50	31	196
Total Capex	170	152	165	165	46	698

Further options south of Podgorica

Discussion of the way forward for the corridor south of Podgorica: ie Djurmani – Virpazar – Farmaci – Smokovac is reserved pending discussion of the “priority section”.

[16] Including allowance for designs, construction management and land acquisition
[17] ditto

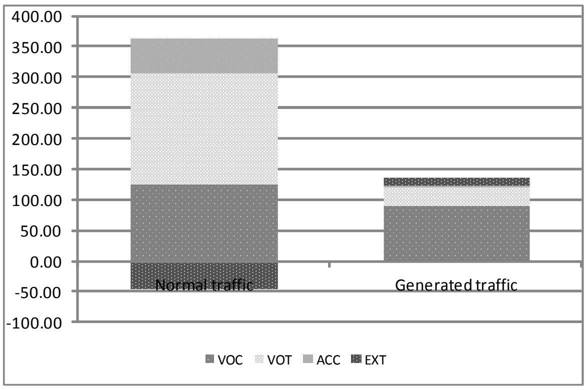
ANNEX 1: SUMMARY RESULTS FOR ECONOMIC EVALUATION

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S1

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	26.3 km

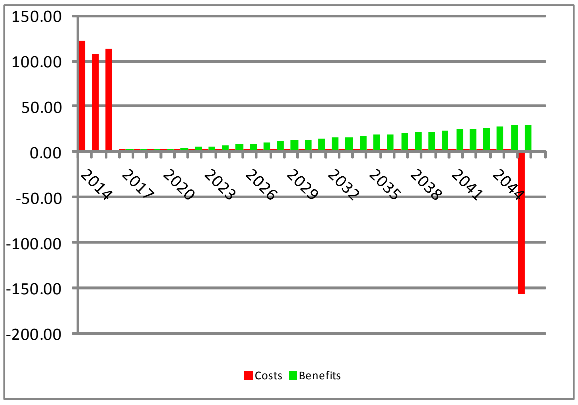
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	125.18	88.86	214.05	39.4%	65.2%	47.1%
VOT	179.99	31.06	211.05	56.6%	22.8%	46.4%
Accidents	58.40	2.01	60.41	18.4%	1.5%	13.3%
External costs	-45.48	14.39	-31.09	-14.3%	10.6%	-6.8%
TOTAL	318.10	136.32	454.42	70.0%	30.0%	100.0%
Total / km	12.09	5.18	17.28			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	336.49	329.76
Management costs	10.09	9.89
Land acquisition	3.94	3.86
Contingencies	0.00	0.00
Total	350.52	343.51
Cost / km	13.33	13.06
Residual value	161.27	158.04
Net O&M over 30 years	66.28	64.95

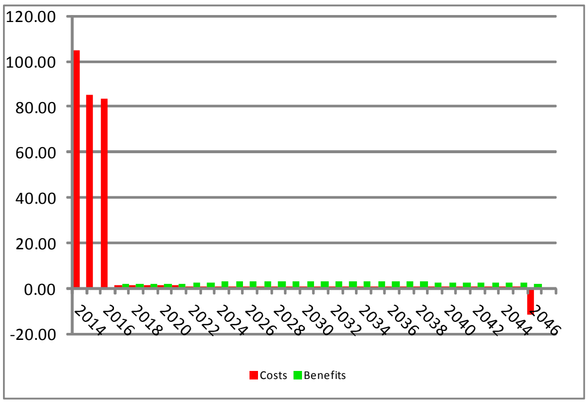


Economic indicators	
EIRR	1.9%
NPV 2012 EURm @ 8%	-197.61
B/C	1:0.29

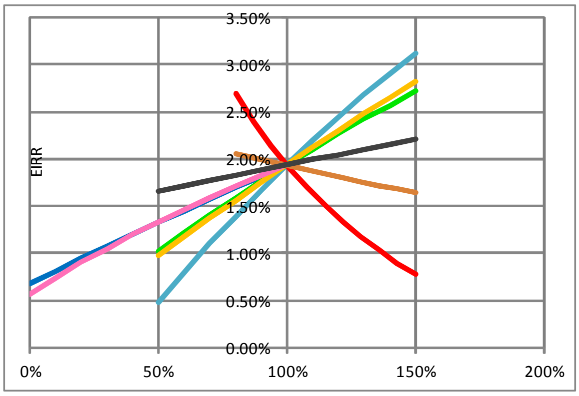
Cashflow: undiscounted



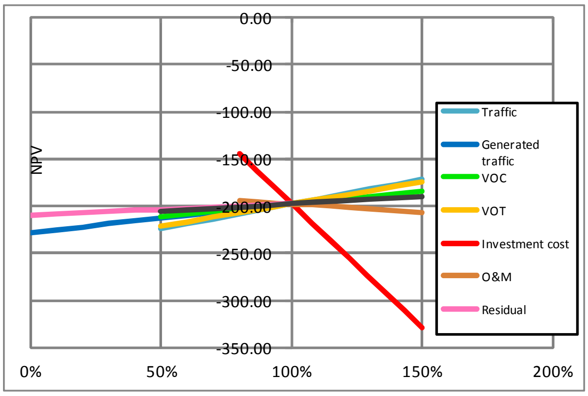
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	1.94%	-197.61
50%	0.48%	-223.73
60%	0.80%	-218.50
70%	1.10%	-213.28
80%	1.39%	-208.05
90%	1.67%	-202.83
100%	1.94%	-197.61
110%	2.19%	-192.38
120%	2.44%	-187.16
130%	2.68%	-181.93
140%	2.90%	-176.71
150%	3.12%	-171.49
Critical?		N

Generated traffic

	EIRR	NPV
100%	1.94%	-197.61
0%	0.68%	-227.91
10%	0.81%	-224.88
20%	0.94%	-221.85
30%	1.07%	-218.82
40%	1.20%	-215.79
50%	1.33%	-212.76
60%	1.45%	-209.73
70%	1.58%	-206.70
80%	1.70%	-203.67
90%	1.82%	-200.64
100%	1.94%	-197.61
Critical?		N

VOC

	EIRR	NPV
100%	1.94%	-197.61
50%	1.01%	-211.62
60%	1.21%	-208.82
70%	1.40%	-206.02
80%	1.59%	-203.21
90%	1.77%	-200.41
100%	1.94%	-197.61
110%	2.10%	-194.80
120%	2.26%	-192.00
130%	2.42%	-189.20
140%	2.57%	-186.39
150%	2.72%	-183.59
Critical?		N

VOT

	EIRR	NPV
100%	1.94%	-197.61
50%	0.98%	-220.95
60%	1.18%	-216.28
70%	1.37%	-211.61
80%	1.56%	-206.94
90%	1.75%	-202.28
100%	1.94%	-197.61
110%	2.12%	-192.94
120%	2.30%	-188.27
130%	2.48%	-183.60
140%	2.65%	-178.93
150%	2.82%	-174.26
Critical?		N

Investment cost

	EIRR	NPV
100%	1.94%	-197.61
80%	2.69%	-145.16
87%	2.40%	-163.52
94%	2.14%	-181.87
101%	1.91%	-200.23
108%	1.70%	-218.58
115%	1.51%	-236.94
122%	1.33%	-255.30
129%	1.18%	-273.65
136%	1.03%	-292.01
143%	0.90%	-310.37
150%	0.77%	-328.72
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	1.94%	-197.61
80%	2.06%	-194.02
87%	2.02%	-195.28
94%	1.97%	-196.53
101%	1.93%	-197.79
108%	1.89%	-199.04
115%	1.85%	-200.29
122%	1.81%	-201.55
129%	1.76%	-202.80
136%	1.72%	-204.06
143%	1.68%	-205.31
150%	1.64%	-206.56
Critical?		N

Residual

	EIRR	NPV
100%	1.94%	-197.61
0%	0.57%	-209.15
10%	0.74%	-208.00
20%	0.90%	-206.84
30%	1.05%	-205.69
40%	1.20%	-204.53
50%	1.34%	-203.38
60%	1.47%	-202.22
70%	1.59%	-201.07
80%	1.71%	-199.91
90%	1.83%	-198.76
100%	1.94%	-197.61
Critical?		N

Accidents

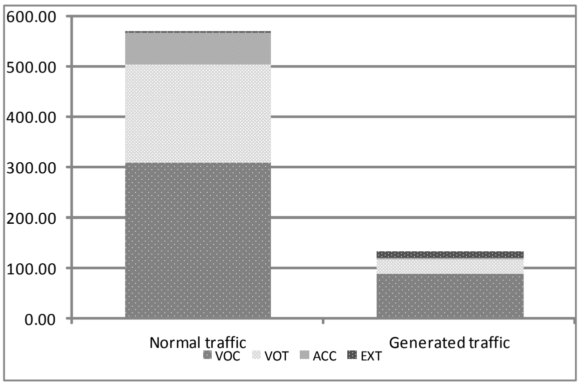
	EIRR	NPV
100%	1.94%	-197.61
50%	1.66%	-205.15
60%	1.72%	-203.64
70%	1.77%	-202.13
80%	1.83%	-200.62
90%	1.88%	-199.11
100%	1.94%	-197.61
110%	1.99%	-196.10
120%	2.05%	-194.59
130%	2.10%	-193.08
140%	2.15%	-191.57
150%	2.21%	-190.06
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S2

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	28.3 km

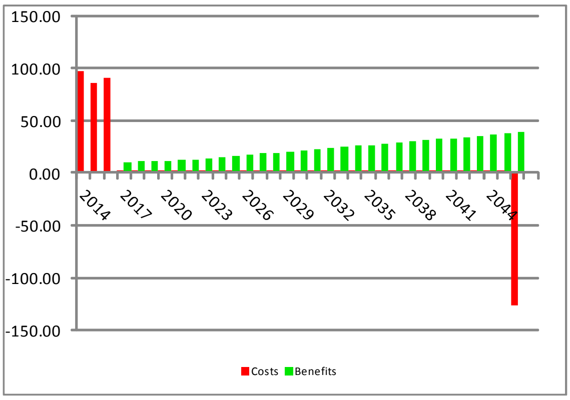
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	307.52	88.95	396.47	54.2%	67.3%	56.7%
VOT	194.84	28.21	223.05	34.4%	21.3%	31.9%
Accidents	62.96	1.99	64.96	11.1%	1.5%	9.3%
External costs	1.65	13.05	14.71	0.3%	9.9%	2.1%
TOTAL	566.98	132.21	699.18	81.1%	18.9%	100.0%
Total / km	20.03	4.67	24.71			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	269.82	264.42
Management costs	8.09	7.93
Land acquisition	2.74	2.69
Contingencies	0.00	0.00
Total	280.65	275.03
Cost / km	9.92	9.72
Residual value	131.62	128.99
Net O&M over 30 years	64.74	63.44

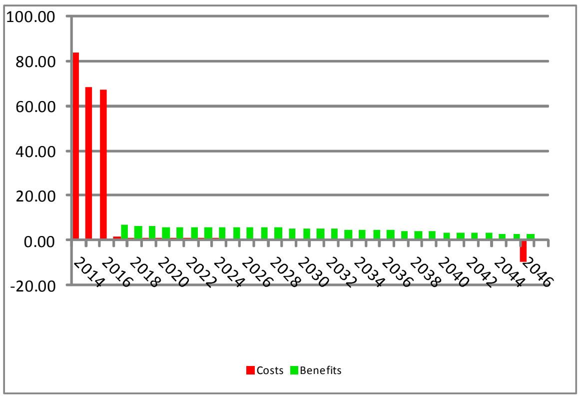


Economic indicators	
EIRR	5.2%
NPV 2012 EURm @ 8%	-78.90
B/C	1:0.65

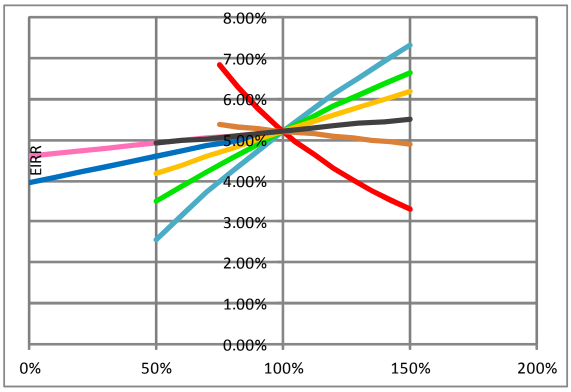
Cashflow: undiscounted



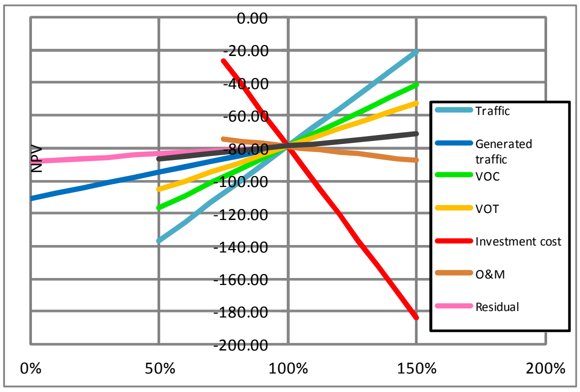
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	5.22%	-78.90
50%	2.56%	-136.94
60%	3.16%	-125.33
70%	3.71%	-113.73
80%	4.24%	-102.12
90%	4.74%	-90.51
100%	5.22%	-78.90
110%	5.67%	-67.30
120%	6.11%	-55.69
130%	6.53%	-44.08
140%	6.93%	-32.48
150%	7.33%	-20.87
Critical?		Y

Generated traffic

	EIRR	NPV
100%	5.22%	-78.90
0%	3.96%	-111.18
10%	4.09%	-107.96
20%	4.22%	-104.73
30%	4.34%	-101.50
40%	4.47%	-98.27
50%	4.60%	-95.04
60%	4.72%	-91.82
70%	4.85%	-88.59
80%	4.97%	-85.36
90%	5.09%	-82.13
100%	5.22%	-78.90
Critical?		N

VOC

	EIRR	NPV
100%	5.22%	-78.90
50%	3.50%	-116.62
60%	3.87%	-109.08
70%	4.23%	-101.53
80%	4.57%	-93.99
90%	4.90%	-86.45
100%	5.22%	-78.90
110%	5.52%	-71.36
120%	5.82%	-63.82
130%	6.10%	-56.28
140%	6.38%	-48.73
150%	6.65%	-41.19
Critical?		N

VOT

	EIRR	NPV
100%	5.22%	-78.90
50%	4.17%	-105.62
60%	4.38%	-100.28
70%	4.60%	-94.94
80%	4.81%	-89.59
90%	5.01%	-84.25
100%	5.22%	-78.90
110%	5.42%	-73.56
120%	5.62%	-68.22
130%	5.81%	-62.87
140%	6.01%	-57.53
150%	6.20%	-52.19
Critical?		N

Investment cost

	EIRR	NPV
100%	5.22%	-78.90
75%	6.84%	-26.47
83%	6.27%	-42.20
90%	5.78%	-57.93
98%	5.35%	-73.66
105%	4.96%	-89.39
113%	4.62%	-105.12
120%	4.30%	-120.86
128%	4.02%	-136.59
135%	3.76%	-152.32
143%	3.52%	-168.05
150%	3.30%	-183.78
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	5.22%	-78.90
75%	5.37%	-74.53
83%	5.33%	-75.84
90%	5.28%	-77.16
98%	5.23%	-78.47
105%	5.18%	-79.78
113%	5.14%	-81.09
120%	5.09%	-82.40
128%	5.04%	-83.72
135%	4.99%	-85.03
143%	4.95%	-86.34
150%	4.90%	-87.65
Critical?		N

Residual

	EIRR	NPV
100%	5.22%	-78.90
0%	4.59%	-88.33
10%	4.66%	-87.38
20%	4.72%	-86.44
30%	4.79%	-85.50
40%	4.86%	-84.56
50%	4.92%	-83.62
60%	4.98%	-82.67
70%	5.04%	-81.73
80%	5.10%	-80.79
90%	5.16%	-79.85
100%	5.22%	-78.90
Critical?		N

Accidents

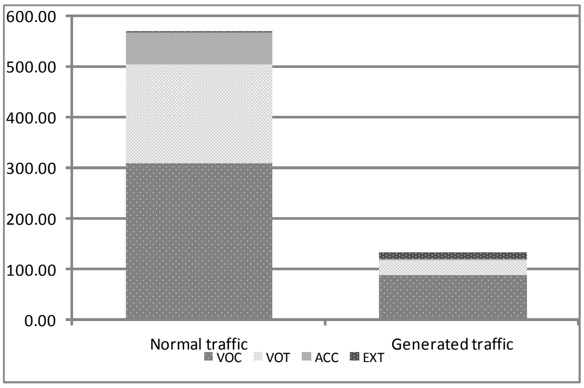
	EIRR	NPV
100%	5.22%	-78.90
50%	4.91%	-86.92
60%	4.97%	-85.31
70%	5.03%	-83.71
80%	5.09%	-82.11
90%	5.16%	-80.51
100%	5.22%	-78.90
110%	5.28%	-77.30
120%	5.34%	-75.70
130%	5.40%	-74.10
140%	5.46%	-72.50
150%	5.51%	-70.89
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S2a

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	28.3 km

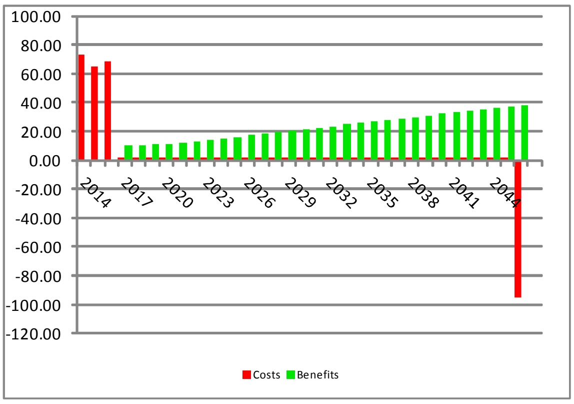
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	307.52	88.95	396.47	54.2%	67.3%	56.7%
VOT	194.84	28.21	223.05	34.4%	21.3%	31.9%
Accidents	62.96	1.99	64.96	11.1%	1.5%	9.3%
External costs	1.65	13.05	14.71	0.3%	9.9%	2.1%
TOTAL	566.98	132.21	699.18	81.1%	18.9%	100.0%
Total / km	20.03	4.67	24.71			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	202.36	198.31
Management costs	6.08	5.96
Land acquisition	2.06	2.02
Contingencies	0.00	0.00
Total	210.50	206.29
Cost / km	7.44	7.29
Residual value	98.72	96.74
Net O&M over 30 years	48.55	47.58

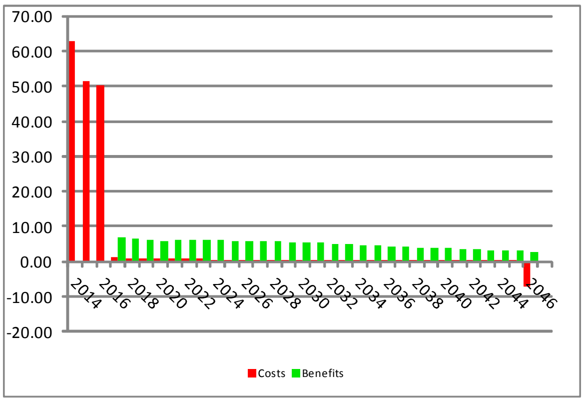


Economic indicators	
EIRR	7.0%
NPV 2012 EURm @ 8%	-22.11
B/C	1:0.87

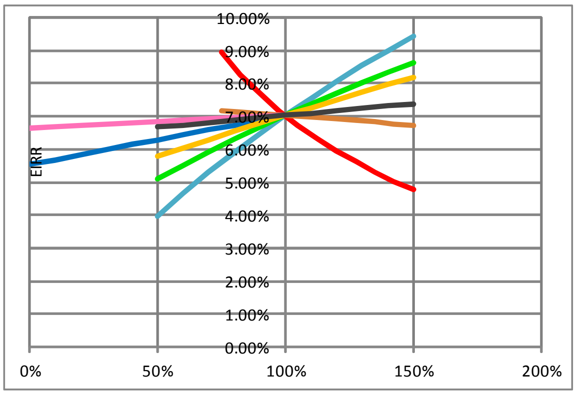
Cashflow: undiscounted



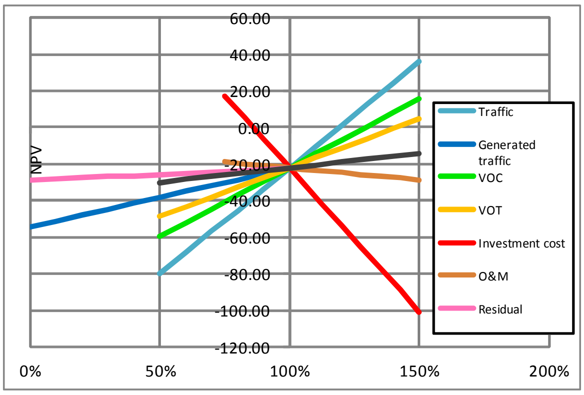
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	7.03%	-22.11
50%	3.99%	-80.14
60%	4.67%	-68.53
70%	5.31%	-56.93
80%	5.91%	-45.32
90%	6.49%	-33.71
100%	7.03%	-22.11
110%	7.55%	-10.50
120%	8.05%	1.11
130%	8.53%	12.72
140%	8.99%	24.32
150%	9.44%	35.93
Critical?		Y

Generated traffic

	EIRR	NPV
100%	7.03%	-22.11
0%	5.54%	-54.38
10%	5.69%	-51.16
20%	5.84%	-47.93
30%	5.99%	-44.70
40%	6.14%	-41.47
50%	6.29%	-38.24
60%	6.44%	-35.02
70%	6.59%	-31.79
80%	6.74%	-28.56
90%	6.88%	-25.33
100%	7.03%	-22.11
Critical?		N

VOC

	EIRR	NPV
100%	7.03%	-22.11
50%	5.10%	-59.82
60%	5.52%	-52.28
70%	5.92%	-44.74
80%	6.30%	-37.19
90%	6.67%	-29.65
100%	7.03%	-22.11
110%	7.37%	-14.56
120%	7.70%	-7.02
130%	8.02%	0.52
140%	8.33%	8.07
150%	8.63%	15.61
Critical?		Y

VOT

	EIRR	NPV
100%	7.03%	-22.11
50%	5.79%	-48.82
60%	6.05%	-43.48
70%	6.30%	-38.14
80%	6.54%	-32.79
90%	6.79%	-27.45
100%	7.03%	-22.11
110%	7.27%	-16.76
120%	7.50%	-11.42
130%	7.74%	-6.07
140%	7.97%	-0.73
150%	8.20%	4.61
Critical?		Y

Investment cost

	EIRR	NPV
100%	7.03%	-22.11
75%	8.94%	17.23
83%	8.28%	5.43
90%	7.70%	-6.37
98%	7.19%	-18.17
105%	6.73%	-29.97
113%	6.32%	-41.77
120%	5.95%	-53.57
128%	5.62%	-65.37
135%	5.31%	-77.17
143%	5.02%	-88.97
150%	4.76%	-100.77
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	7.03%	-22.11
75%	7.17%	-18.82
83%	7.13%	-19.81
90%	7.09%	-20.79
98%	7.04%	-21.78
105%	7.00%	-22.76
113%	6.96%	-23.75
120%	6.91%	-24.73
128%	6.87%	-25.71
135%	6.83%	-26.70
143%	6.78%	-27.68
150%	6.74%	-28.67
Critical?		N

Residual

	EIRR	NPV
100%	7.03%	-22.11
0%	6.63%	-29.17
10%	6.67%	-28.47
20%	6.71%	-27.76
30%	6.75%	-27.05
40%	6.80%	-26.35
50%	6.84%	-25.64
60%	6.88%	-24.93
70%	6.91%	-24.23
80%	6.95%	-23.52
90%	6.99%	-22.81
100%	7.03%	-22.11
Critical?		N

Accidents

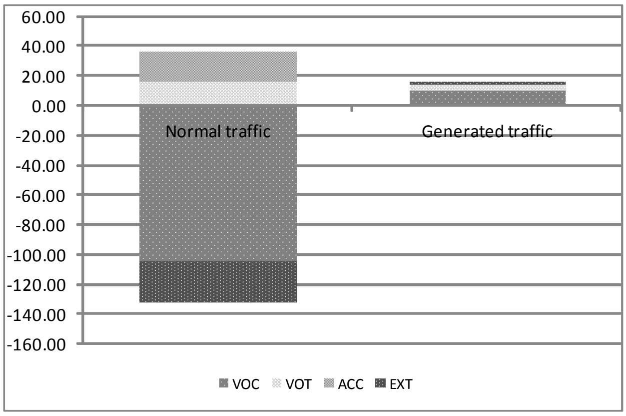
	EIRR	NPV
100%	7.03%	-22.11
50%	6.67%	-30.12
60%	6.74%	-28.51
70%	6.81%	-26.91
80%	6.89%	-25.31
90%	6.96%	-23.71
100%	7.03%	-22.11
110%	7.10%	-20.50
120%	7.17%	-18.90
130%	7.24%	-17.30
140%	7.31%	-15.70
150%	7.39%	-14.09
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S3

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2015
Construction period:	2 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	12.4 km

Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	-104.20	10.15	-94.05	107.6%	63.7%	116.3%
VOT	16.00	3.77	19.77	-16.5%	23.7%	-24.4%
Accidents	19.51	0.34	19.85	-20.2%	2.1%	-24.5%
External costs	-28.14	1.67	-26.47	29.1%	10.5%	32.7%
TOTAL	-96.82	15.93	-80.90	119.7%	-19.7%	100.0%
Total / km	-7.81	1.28	-6.52			

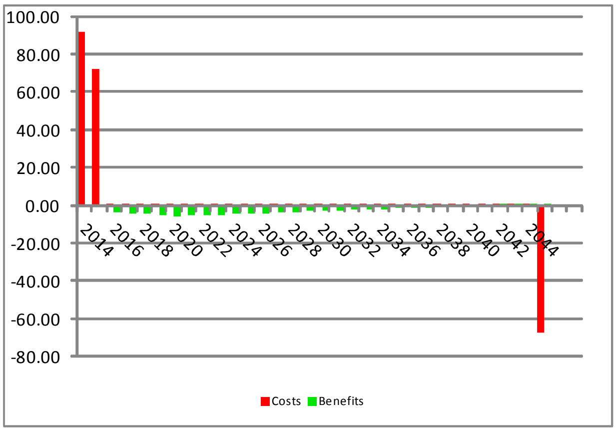
Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	145.66	142.75
Management costs	4.37	4.28
Land acquisition	17.03	16.69
Contingencies	0.00	0.00
Total	167.06	163.72
Cost / km	13.47	13.20
Residual value	69.54	68.15
Net O&M over 30 years	29.57	28.98



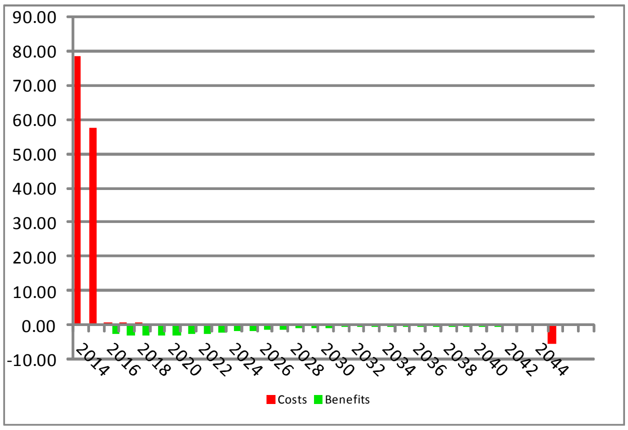
Economic indicators

EIRR	-5.6%
NPV 2012 EURm @ 8%	-172.39
B/C	1:-0.24

Cashflow: undiscounted



Cashflow: discounted



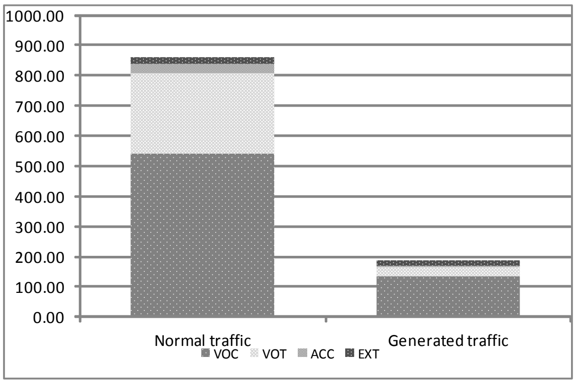
SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S4

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2017
Construction period:	4 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	44.1 km

Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	538.63	132.41	671.04	62.5%	71.2%	64.0%
VOT	270.07	33.77	303.84	31.3%	18.1%	29.0%
Accidents	27.51	3.39	30.90	3.2%	1.8%	2.9%
External costs	25.92	16.52	42.44	3.0%	8.9%	4.0%
TOTAL	862.13	186.09	1048.22	82.2%	17.8%	100.0%
Total / km	19.55	4.22	23.77			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	469.82	460.42
Management costs	14.09	13.81
Land acquisition	17.69	17.34
Contingencies	0.00	0.00
Total	501.60	491.56
Cost / km	11.37	11.15

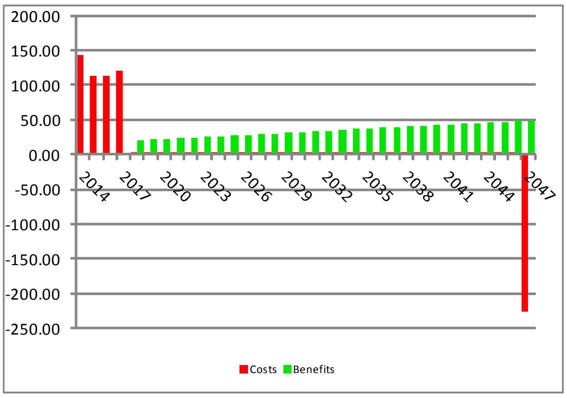
Residual value	233.19	228.53
Net O&M over 30 years	87.98	86.22



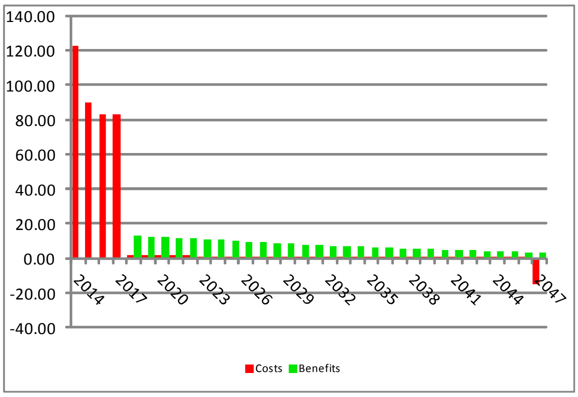
Economic indicators

EIRR	4.5%
NPV 2012 EURm @ 8%	-158.61
B/C	1:0.59

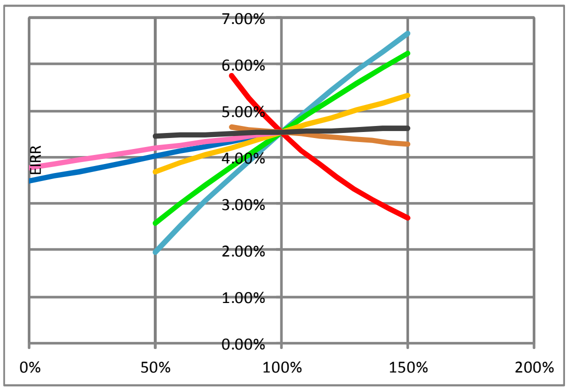
Cashflow: undiscounted



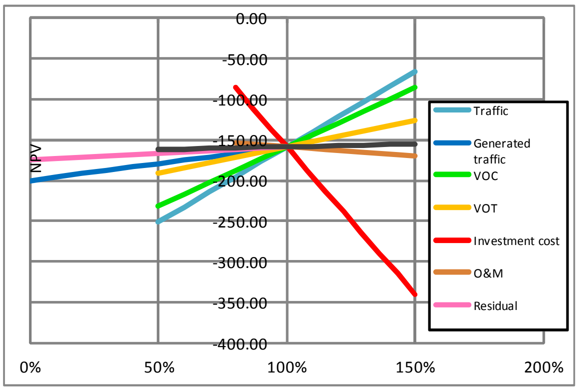
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	4.54%	-158.61
50%	1.97%	-251.28
60%	2.53%	-232.74
70%	3.06%	-214.21
80%	3.58%	-195.68
90%	4.07%	-177.14
100%	4.54%	-158.61
110%	4.99%	-140.08
120%	5.43%	-121.54
130%	5.86%	-103.01
140%	6.27%	-84.48
150%	6.66%	-65.94
Critical?		Y

Generated traffic

	EIRR	NPV
100%	4.54%	-158.61
0%	3.48%	-200.12
10%	3.59%	-195.97
20%	3.70%	-191.82
30%	3.81%	-187.67
40%	3.91%	-183.52
50%	4.02%	-179.37
60%	4.13%	-175.22
70%	4.23%	-171.06
80%	4.33%	-166.91
90%	4.44%	-162.76
100%	4.54%	-158.61
Critical?		N

VOC

	EIRR	NPV
100%	4.54%	-158.61
50%	2.58%	-231.57
60%	3.00%	-216.98
70%	3.40%	-202.39
80%	3.79%	-187.79
90%	4.17%	-173.20
100%	4.54%	-158.61
110%	4.90%	-144.02
120%	5.24%	-129.43
130%	5.58%	-114.84
140%	5.91%	-100.24
150%	6.24%	-85.65
Critical?		N

VOT

	EIRR	NPV
100%	4.54%	-158.61
50%	3.70%	-191.14
60%	3.87%	-184.63
70%	4.04%	-178.13
80%	4.21%	-171.62
90%	4.38%	-165.12
100%	4.54%	-158.61
110%	4.70%	-152.11
120%	4.86%	-145.60
130%	5.02%	-139.10
140%	5.17%	-132.59
150%	5.33%	-126.08
Critical?		N

Investment cost

	EIRR	NPV
100%	4.54%	-158.61
80%	5.76%	-85.92
87%	5.28%	-111.36
94%	4.86%	-136.80
101%	4.49%	-162.24
108%	4.15%	-187.69
115%	3.85%	-213.13
122%	3.58%	-238.57
129%	3.32%	-264.01
136%	3.09%	-289.45
143%	2.88%	-314.89
150%	2.69%	-340.33
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	4.54%	-158.61
80%	4.64%	-154.21
87%	4.61%	-155.75
94%	4.57%	-157.29
101%	4.53%	-158.83
108%	4.50%	-160.37
115%	4.46%	-161.91
122%	4.43%	-163.45
129%	4.39%	-165.00
136%	4.35%	-166.54
143%	4.32%	-168.08
150%	4.28%	-169.62
Critical?		N

Residual

	EIRR	NPV
100%	4.54%	-158.61
0%	3.77%	-174.07
10%	3.86%	-172.52
20%	3.95%	-170.98
30%	4.03%	-169.43
40%	4.11%	-167.88
50%	4.19%	-166.34
60%	4.26%	-164.79
70%	4.33%	-163.25
80%	4.40%	-161.70
90%	4.47%	-160.16
100%	4.54%	-158.61
Critical?		N

Accidents

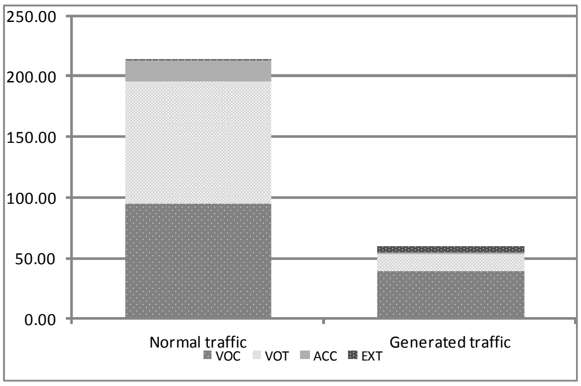
	EIRR	NPV
100%	4.54%	-158.61
50%	4.45%	-162.16
60%	4.47%	-161.45
70%	4.49%	-160.74
80%	4.50%	-160.03
90%	4.52%	-159.32
100%	4.54%	-158.61
110%	4.56%	-157.90
120%	4.57%	-157.19
130%	4.59%	-156.48
140%	4.61%	-155.77
150%	4.62%	-155.06
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S5

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	24 km

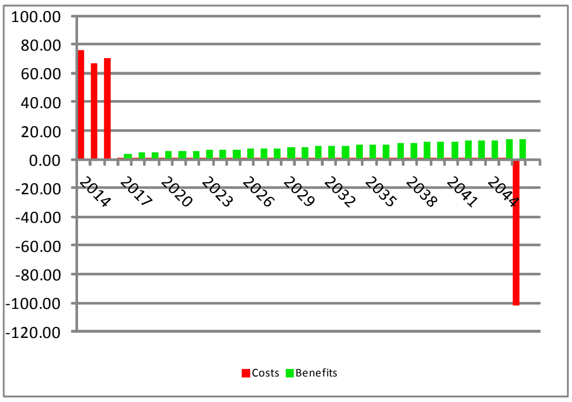
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	95.16	39.10	134.25	44.5%	65.7%	49.1%
VOT	99.65	13.85	113.49	46.6%	23.3%	41.5%
Accidents	17.94	1.13	19.06	8.4%	1.9%	7.0%
External costs	1.14	5.40	6.54	0.5%	9.1%	2.4%
TOTAL	213.88	59.47	273.36	78.2%	21.8%	100.0%
Total / km	8.91	2.48	11.39			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	208.83	204.65
Management costs	6.27	6.14
Land acquisition	2.28	2.23
Contingencies	0.00	0.00
Total	217.38	213.03
Cost / km	9.06	8.88
Residual value	104.96	102.86
Net O&M over 30 years	31.86	31.22

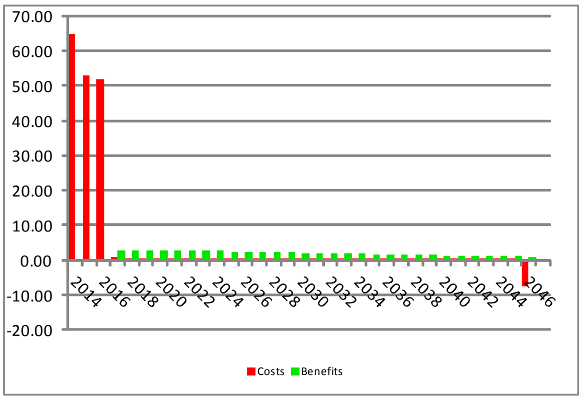


Economic indicators	
EIRR	2.2%
NPV 2012 EURm @ 8%	-110.45
B/C	1:0.35

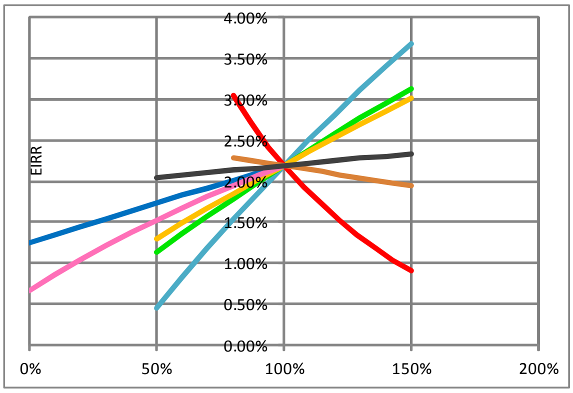
Cashflow: undiscounted



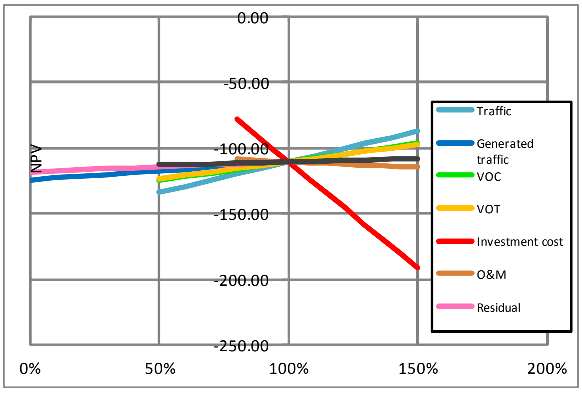
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	2.19%	-110.45
50%	0.45%	-133.76
60%	0.83%	-129.10
70%	1.18%	-124.43
80%	1.53%	-119.77
90%	1.87%	-115.11
100%	2.19%	-110.45
110%	2.50%	-105.78
120%	2.81%	-101.12
130%	3.11%	-96.46
140%	3.40%	-91.80
150%	3.68%	-87.13
Critical?		N

Generated traffic

	EIRR	NPV
100%	2.19%	-110.45
0%	1.25%	-124.25
10%	1.35%	-122.87
20%	1.45%	-121.49
30%	1.54%	-120.11
40%	1.64%	-118.73
50%	1.73%	-117.35
60%	1.82%	-115.97
70%	1.92%	-114.59
80%	2.01%	-113.21
90%	2.10%	-111.83
100%	2.19%	-110.45
Critical?		N

VOC

	EIRR	NPV
100%	2.19%	-110.45
50%	1.14%	-124.54
60%	1.36%	-121.72
70%	1.57%	-118.90
80%	1.78%	-116.08
90%	1.99%	-113.26
100%	2.19%	-110.45
110%	2.39%	-107.63
120%	2.58%	-104.81
130%	2.77%	-101.99
140%	2.95%	-99.17
150%	3.13%	-96.36
Critical?		N

VOT

	EIRR	NPV
100%	2.19%	-110.45
50%	1.30%	-123.46
60%	1.48%	-120.86
70%	1.66%	-118.26
80%	1.84%	-115.65
90%	2.02%	-113.05
100%	2.19%	-110.45
110%	2.36%	-107.84
120%	2.53%	-105.24
130%	2.69%	-102.64
140%	2.86%	-100.03
150%	3.02%	-97.43
Critical?		N

Investment cost

	EIRR	NPV
100%	2.19%	-110.45
80%	3.05%	-77.99
87%	2.71%	-89.35
94%	2.42%	-100.71
101%	2.15%	-112.07
108%	1.92%	-123.43
115%	1.71%	-134.78
122%	1.52%	-146.14
129%	1.35%	-157.50
136%	1.19%	-168.86
143%	1.04%	-180.22
150%	0.91%	-191.58
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	2.19%	-110.45
80%	2.29%	-108.72
87%	2.25%	-109.33
94%	2.22%	-109.93
101%	2.19%	-110.53
108%	2.15%	-111.13
115%	2.12%	-111.74
122%	2.08%	-112.34
129%	2.05%	-112.94
136%	2.01%	-113.55
143%	1.98%	-114.15
150%	1.94%	-114.75
Critical?		N

Residual

	EIRR	NPV
100%	2.19%	-110.45
0%	0.66%	-117.96
10%	0.86%	-117.21
20%	1.04%	-116.46
30%	1.21%	-115.71
40%	1.38%	-114.95
50%	1.53%	-114.20
60%	1.68%	-113.45
70%	1.81%	-112.70
80%	1.94%	-111.95
90%	2.07%	-111.20
100%	2.19%	-110.45
Critical?		N

Accidents

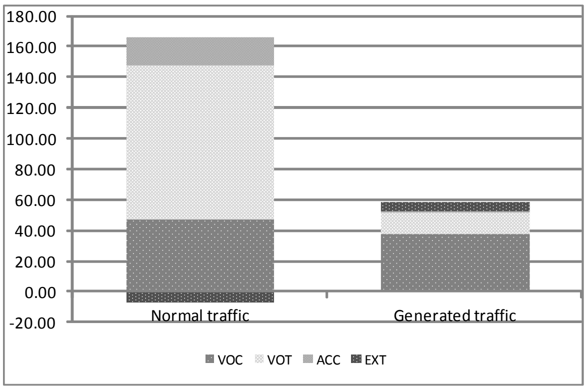
	EIRR	NPV
100%	2.19%	-110.45
50%	2.04%	-112.80
60%	2.07%	-112.33
70%	2.10%	-111.86
80%	2.13%	-111.39
90%	2.16%	-110.92
100%	2.19%	-110.45
110%	2.22%	-109.98
120%	2.25%	-109.51
130%	2.28%	-109.03
140%	2.31%	-108.56
150%	2.34%	-108.09
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S6

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	25.7 km

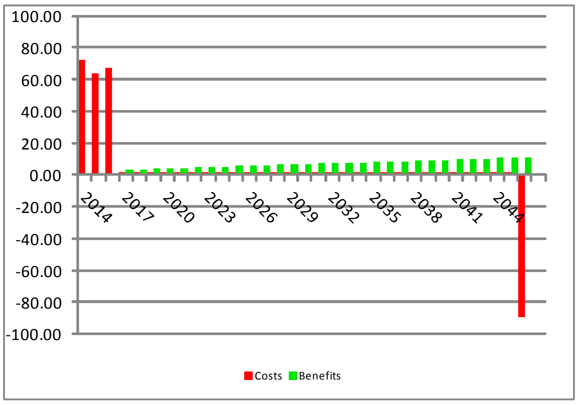
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	47.27	37.61	84.88	29.8%	64.8%	39.2%
VOT	100.75	13.87	114.62	63.6%	23.9%	53.0%
Accidents	17.65	1.13	18.78	11.1%	1.9%	8.7%
External costs	-7.31	5.48	-1.83	-4.6%	9.4%	-0.8%
TOTAL	158.36	58.09	216.45	73.2%	26.8%	100.0%
Total / km	6.16	2.26	8.42			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	198.40	194.43
Management costs	5.96	5.84
Land acquisition	2.44	2.39
Contingencies	0.00	0.00
Total	206.80	202.66
Cost / km	8.05	7.89
Residual value	92.47	90.62
Net O&M over 30 years	37.24	36.49

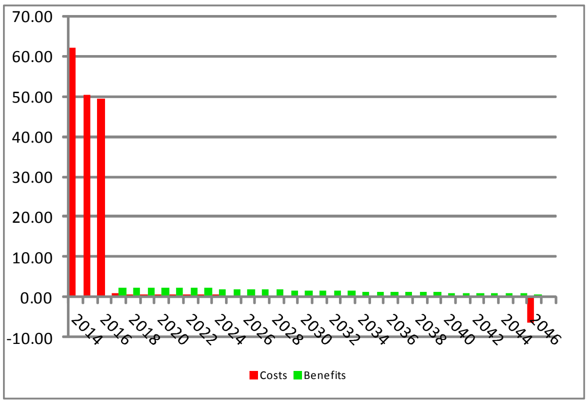


Economic indicators	
EIRR	1.3%
NPV 2012 EURm @ 8%	-116.68
B/C	1:0.29

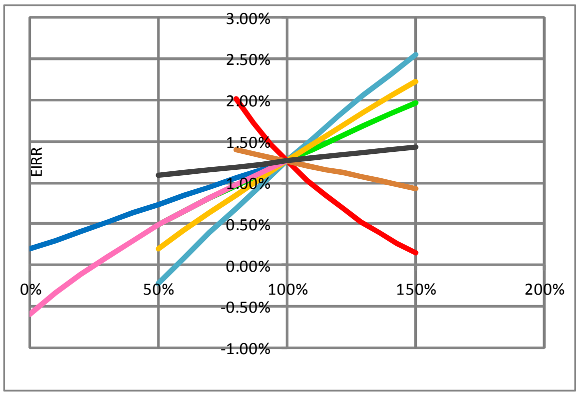
Cashflow: undiscounted



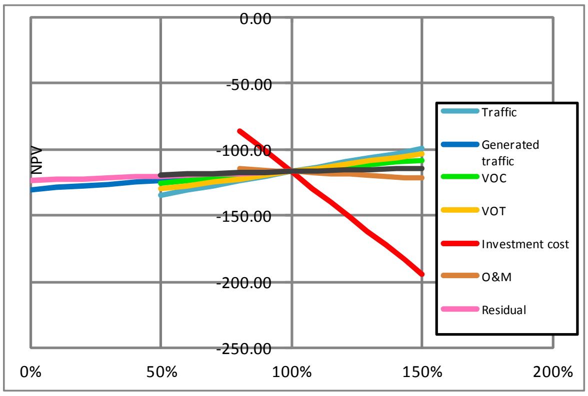
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	1.26%	-116.68
50%	-0.23%	-134.14
60%	0.09%	-130.65
70%	0.40%	-127.16
80%	0.69%	-123.66
90%	0.98%	-120.17
100%	1.26%	-116.68
110%	1.53%	-113.19
120%	1.80%	-109.69
130%	2.06%	-106.20
140%	2.31%	-102.71
150%	2.56%	-99.21
Critical?		N

Generated traffic

	EIRR	NPV
100%	1.26%	-116.68
0%	0.19%	-130.04
10%	0.30%	-128.71
20%	0.41%	-127.37
30%	0.52%	-126.03
40%	0.63%	-124.70
50%	0.74%	-123.36
60%	0.84%	-122.02
70%	0.95%	-120.69
80%	1.05%	-119.35
90%	1.16%	-118.01
100%	1.26%	-116.68
Critical?		N

VOC

	EIRR	NPV
100%	1.26%	-116.68
50%	0.49%	-125.41
60%	0.65%	-123.67
70%	0.81%	-121.92
80%	0.96%	-120.17
90%	1.11%	-118.43
100%	1.26%	-116.68
110%	1.41%	-114.93
120%	1.55%	-113.18
130%	1.69%	-111.44
140%	1.83%	-109.69
150%	1.96%	-107.94
Critical?		N

VOT

	EIRR	NPV
100%	1.26%	-116.68
50%	0.21%	-129.94
60%	0.43%	-127.29
70%	0.64%	-124.64
80%	0.85%	-121.98
90%	1.06%	-119.33
100%	1.26%	-116.68
110%	1.46%	-114.03
120%	1.66%	-111.37
130%	1.85%	-108.72
140%	2.04%	-106.07
150%	2.23%	-103.41
Critical?		N

Investment cost

	EIRR	NPV
100%	1.26%	-116.68
80%	2.01%	-85.70
87%	1.72%	-96.54
94%	1.46%	-107.38
101%	1.23%	-118.23
108%	1.03%	-129.07
115%	0.84%	-139.91
122%	0.68%	-150.76
129%	0.53%	-161.60
136%	0.39%	-172.45
143%	0.27%	-183.29
150%	0.16%	-194.13
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	1.26%	-116.68
80%	1.39%	-114.67
87%	1.35%	-115.37
94%	1.30%	-116.07
101%	1.25%	-116.78
108%	1.21%	-117.48
115%	1.16%	-118.19
122%	1.11%	-118.89
129%	1.07%	-119.60
136%	1.02%	-120.30
143%	0.97%	-121.01
150%	0.93%	-121.71
Critical?		N

Residual

	EIRR	NPV
100%	1.26%	-116.68
0%	-0.59%	-123.30
10%	-0.34%	-122.64
20%	-0.11%	-121.97
30%	0.10%	-121.31
40%	0.30%	-120.65
50%	0.49%	-119.99
60%	0.66%	-119.33
70%	0.82%	-118.66
80%	0.97%	-118.00
90%	1.12%	-117.34
100%	1.26%	-116.68
Critical?		N

Accidents

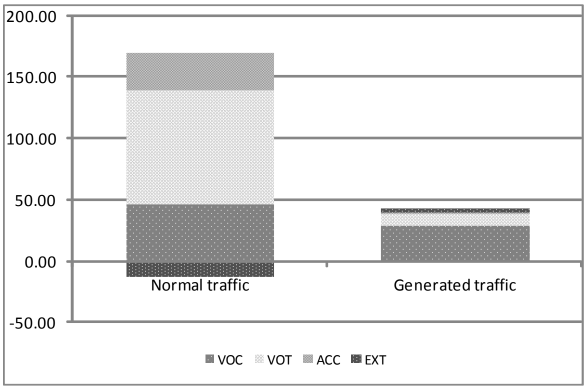
	EIRR	NPV
100%	1.26%	-116.68
50%	1.09%	-119.01
60%	1.13%	-118.54
70%	1.16%	-118.08
80%	1.19%	-117.61
90%	1.23%	-117.14
100%	1.26%	-116.68
110%	1.29%	-116.21
120%	1.33%	-115.75
130%	1.36%	-115.28
140%	1.39%	-114.81
150%	1.43%	-114.35
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S7

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	25.3 km

Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	45.42	28.22	73.64	29.2%	66.3%	37.2%
VOT	93.11	9.87	102.98	59.9%	23.2%	52.0%
Accidents	30.37	0.78	31.15	19.5%	1.8%	15.7%
External costs	-13.48	3.71	-9.77	-8.7%	8.7%	-4.9%
TOTAL	155.42	42.58	198.00	78.5%	21.5%	100.0%
Total / km	6.14	1.68	7.83			

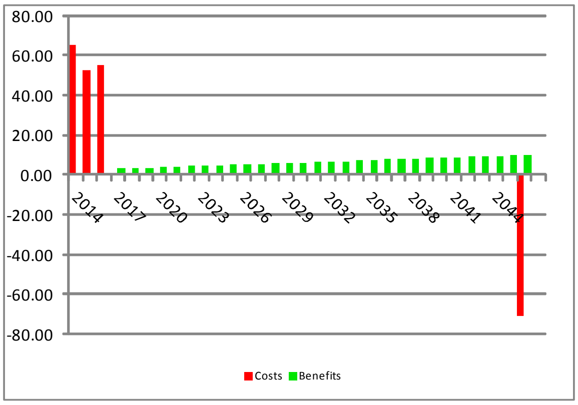
Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	163.37	160.11
Management costs	4.91	4.81
Land acquisition	8.14	7.98
Contingencies	0.00	0.00
Total	176.42	172.89
Cost / km	6.97	6.83
Residual value	72.73	71.28
Net O&M over 30 years	19.09	18.71



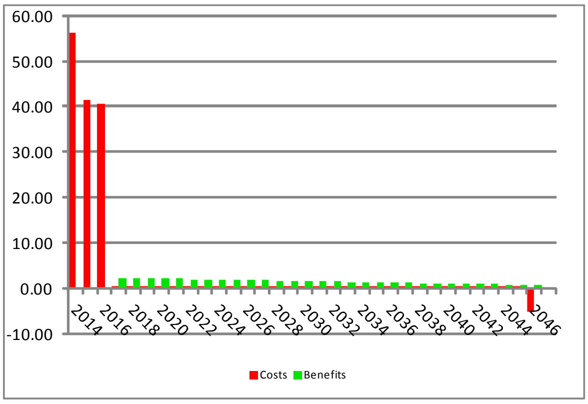
Economic indicators

EIRR	1.7%
NPV 2012 EURm @ 8%	-94.04
B/C	1:0.32

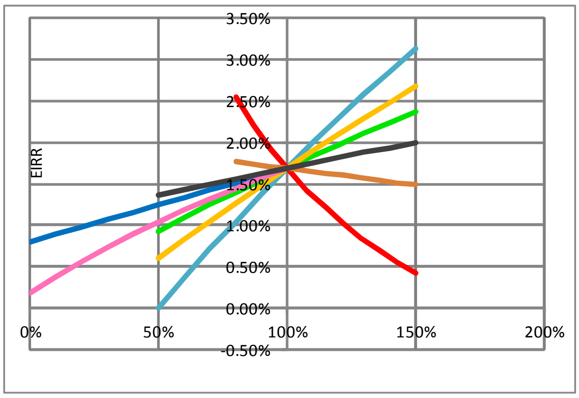
Cashflow: undiscounted



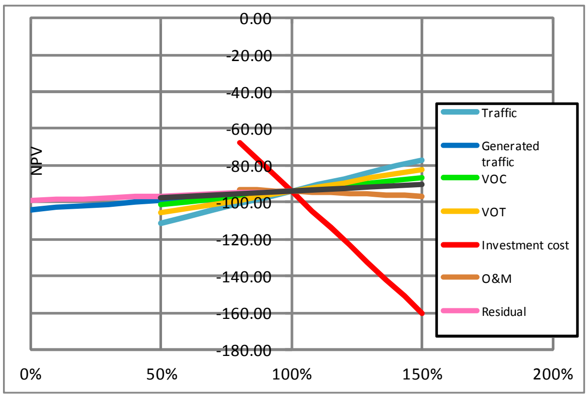
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	1.69%	-94.04
50%	0.00%	-111.13
60%	0.36%	-107.72
70%	0.71%	-104.30
80%	1.05%	-100.88
90%	1.37%	-97.46
100%	1.69%	-94.04
110%	1.99%	-90.62
120%	2.29%	-87.20
130%	2.57%	-83.78
140%	2.85%	-80.36
150%	3.13%	-76.94
Critical?		N

Generated traffic

	EIRR	NPV
100%	1.69%	-94.04
0%	0.79%	-103.92
10%	0.89%	-102.94
20%	0.98%	-101.95
30%	1.07%	-100.96
40%	1.16%	-99.97
50%	1.25%	-98.98
60%	1.34%	-97.99
70%	1.43%	-97.00
80%	1.51%	-96.01
90%	1.60%	-95.03
100%	1.69%	-94.04
Critical?		N

VOC

	EIRR	NPV
100%	1.69%	-94.04
50%	0.93%	-101.28
60%	1.09%	-99.83
70%	1.24%	-98.39
80%	1.39%	-96.94
90%	1.54%	-95.49
100%	1.69%	-94.04
110%	1.83%	-92.59
120%	1.97%	-91.14
130%	2.10%	-89.69
140%	2.24%	-88.24
150%	2.37%	-86.79
Critical?		N

VOT

	EIRR	NPV
100%	1.69%	-94.04
50%	0.60%	-105.93
60%	0.82%	-103.56
70%	1.05%	-101.18
80%	1.26%	-98.80
90%	1.48%	-96.42
100%	1.69%	-94.04
110%	1.89%	-91.66
120%	2.09%	-89.28
130%	2.29%	-86.90
140%	2.49%	-84.52
150%	2.68%	-82.14
Critical?		N

Investment cost

	EIRR	NPV
100%	1.69%	-94.04
80%	2.54%	-67.45
87%	2.20%	-76.75
94%	1.91%	-86.06
101%	1.65%	-95.37
108%	1.42%	-104.67
115%	1.21%	-113.98
122%	1.02%	-123.29
129%	0.85%	-132.59
136%	0.69%	-141.90
143%	0.55%	-151.21
150%	0.42%	-160.52
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	1.69%	-94.04
80%	1.76%	-93.00
87%	1.74%	-93.37
94%	1.71%	-93.73
101%	1.68%	-94.09
108%	1.65%	-94.45
115%	1.63%	-94.81
122%	1.60%	-95.17
129%	1.57%	-95.53
136%	1.54%	-95.90
143%	1.52%	-96.26
150%	1.49%	-96.62
Critical?		N

Residual

	EIRR	NPV
100%	1.69%	-94.04
0%	0.19%	-99.24
10%	0.38%	-98.72
20%	0.56%	-98.20
30%	0.73%	-97.68
40%	0.89%	-97.16
50%	1.04%	-96.64
60%	1.18%	-96.12
70%	1.31%	-95.60
80%	1.44%	-95.08
90%	1.57%	-94.56
100%	1.69%	-94.04
Critical?		N

Accidents

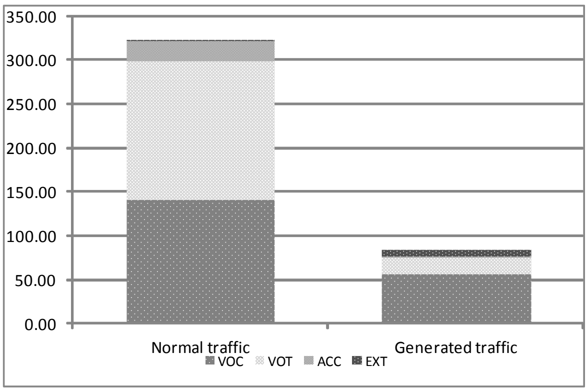
	EIRR	NPV
100%	1.69%	-94.04
50%	1.36%	-97.86
60%	1.43%	-97.10
70%	1.49%	-96.33
80%	1.56%	-95.57
90%	1.62%	-94.80
100%	1.69%	-94.04
110%	1.75%	-93.27
120%	1.81%	-92.51
130%	1.87%	-91.74
140%	1.94%	-90.98
150%	2.00%	-90.21
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S8

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	No
Length of new road	26.1 km

Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	139.69	56.21	195.91	43.4%	67.5%	48.3%
VOT	157.83	17.55	175.38	49.0%	21.1%	43.3%
Accidents	23.73	1.72	25.45	7.4%	2.1%	6.3%
External costs	0.95	7.81	8.76	0.3%	9.4%	2.2%
TOTAL	322.21	83.29	405.50	79.5%	20.5%	100.0%
Total / km	12.35	3.19	15.54			

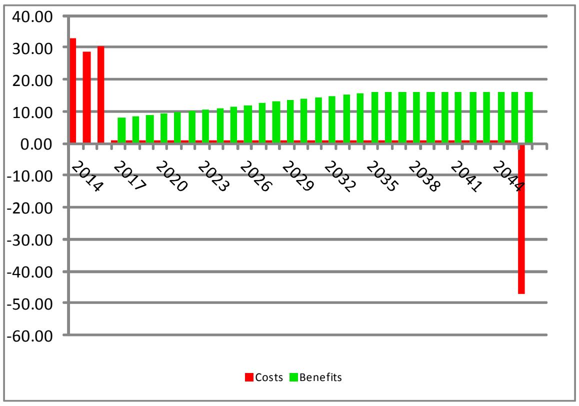
Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	89.85	88.05
Management costs	2.70	2.64
Land acquisition	1.15	1.13
Contingencies	0.00	0.00
Total	93.70	91.82
Cost / km	3.59	3.52
Residual value	49.13	48.15
Net O&M over 30 years	29.36	28.78



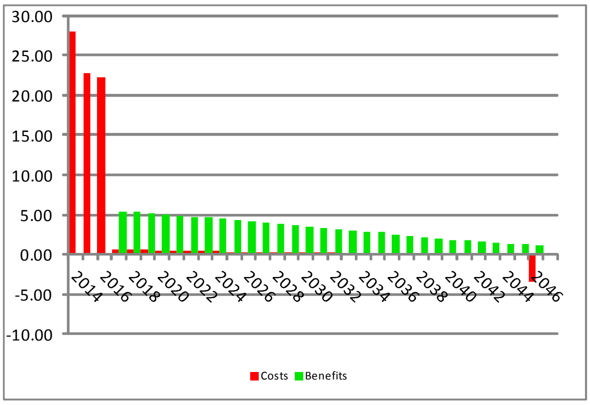
Economic indicators

EIRR	10.0%
NPV 2012 EURm @ 8%	19.86
B/C	1:1.26

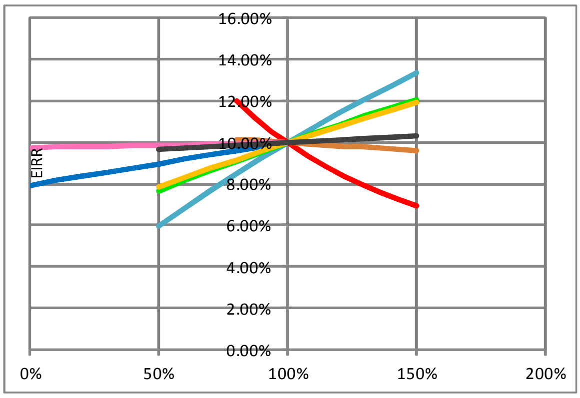
Cashflow: undiscounted



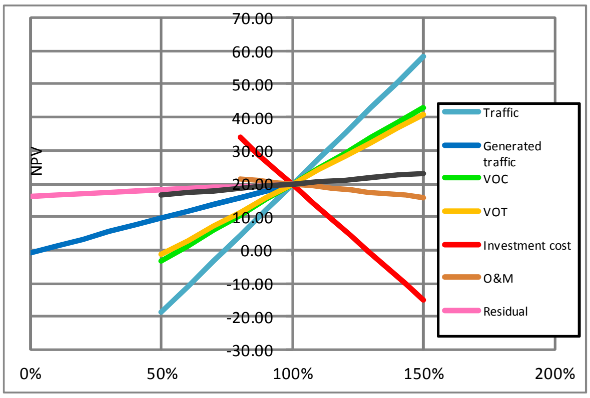
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	9.98%	19.86
50%	5.93%	-18.56
60%	6.82%	-10.88
70%	7.66%	-3.19
80%	8.47%	4.49
90%	9.24%	12.18
100%	9.98%	19.86
110%	10.69%	27.55
120%	11.39%	35.23
130%	12.06%	42.92
140%	12.72%	50.60
150%	13.35%	58.29
Critical?		Y

Generated traffic

	EIRR	NPV
100%	9.98%	19.86
0%	7.92%	-0.76
10%	8.14%	1.31
20%	8.35%	3.37
30%	8.56%	5.43
40%	8.77%	7.49
50%	8.97%	9.55
60%	9.18%	11.62
70%	9.38%	13.68
80%	9.58%	15.74
90%	9.78%	17.80
100%	9.98%	19.86
Critical?		N

VOC

	EIRR	NPV
100%	9.98%	19.86
50%	7.64%	-3.37
60%	8.13%	1.27
70%	8.61%	5.92
80%	9.08%	10.57
90%	9.53%	15.22
100%	9.98%	19.86
110%	10.41%	24.51
120%	10.84%	29.16
130%	11.26%	33.81
140%	11.67%	38.45
150%	12.07%	43.10
Critical?		Y

VOT

	EIRR	NPV
100%	9.98%	19.86
50%	7.87%	-1.29
60%	8.31%	2.94
70%	8.74%	7.17
80%	9.16%	11.40
90%	9.57%	15.63
100%	9.98%	19.86
110%	10.38%	24.09
120%	10.77%	28.32
130%	11.15%	32.55
140%	11.53%	36.78
150%	11.90%	41.01
Critical?		Y

Investment cost

	EIRR	NPV
100%	9.98%	19.86
80%	12.00%	33.80
87%	11.21%	28.92
94%	10.51%	24.04
101%	9.89%	19.17
108%	9.34%	14.29
115%	8.84%	9.41
122%	8.39%	4.54
129%	7.97%	-0.34
136%	7.59%	-5.22
143%	7.24%	-10.10
150%	6.92%	-14.97
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	9.98%	19.86
80%	10.13%	21.45
87%	10.08%	20.89
94%	10.02%	20.34
101%	9.97%	19.78
108%	9.92%	19.23
115%	9.86%	18.67
122%	9.81%	18.12
129%	9.75%	17.56
136%	9.70%	17.01
143%	9.64%	16.45
150%	9.59%	15.89
Critical?		N

Residual

	EIRR	NPV
100%	9.98%	19.86
0%	9.73%	16.35
10%	9.75%	16.70
20%	9.78%	17.05
30%	9.81%	17.40
40%	9.83%	17.75
50%	9.86%	18.10
60%	9.88%	18.46
70%	9.91%	18.81
80%	9.93%	19.16
90%	9.95%	19.51
100%	9.98%	19.86
Critical?		N

Accidents

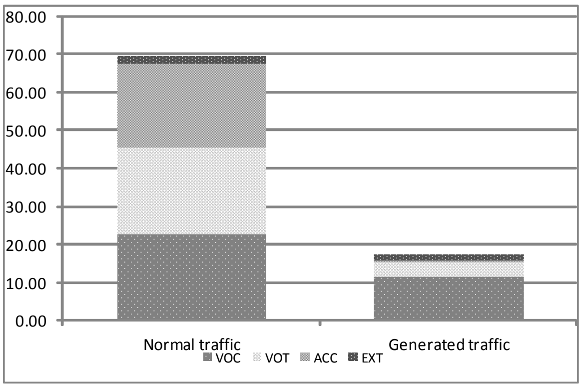
	EIRR	NPV
100%	9.98%	19.86
50%	9.66%	16.61
60%	9.73%	17.26
70%	9.79%	17.91
80%	9.85%	18.56
90%	9.92%	19.21
100%	9.98%	19.86
110%	10.04%	20.51
120%	10.10%	21.16
130%	10.17%	21.81
140%	10.23%	22.46
150%	10.29%	23.11
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S9

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2015
Construction period:	2 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	9 km

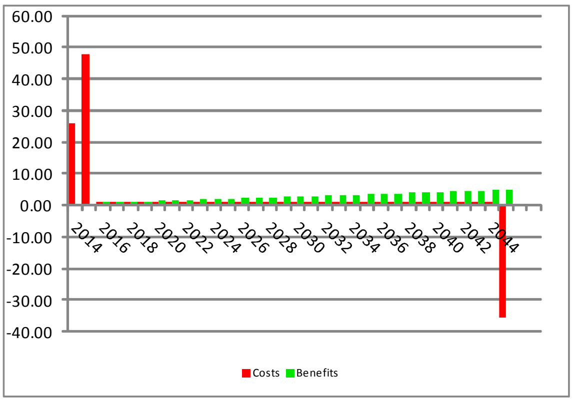
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	22.51	11.42	33.94	32.4%	66.1%	39.1%
VOT	22.73	3.77	26.50	32.7%	21.8%	30.5%
Accidents	22.18	0.34	22.52	31.9%	2.0%	25.9%
External costs	2.09	1.76	3.85	3.0%	10.2%	4.4%
TOTAL	69.51	17.29	86.80	80.1%	19.9%	100.0%
Total / km	7.72	1.92	9.64			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	73.04	71.58
Management costs	2.20	2.16
Land acquisition	0.36	0.35
Contingencies	0.00	0.00
Total	75.60	74.09
Cost / km	8.40	8.23
Residual value	37.52	36.77
Net O&M over 30 years	32.67	32.02

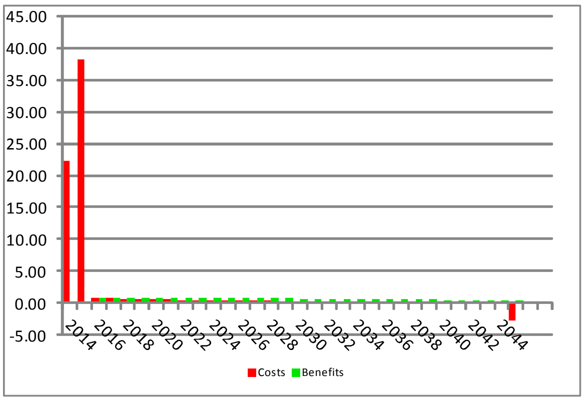


Economic indicators	
EIRR	0.9%
NPV 2012 EURm @ 8%	-47.86
B/C	1:0.29

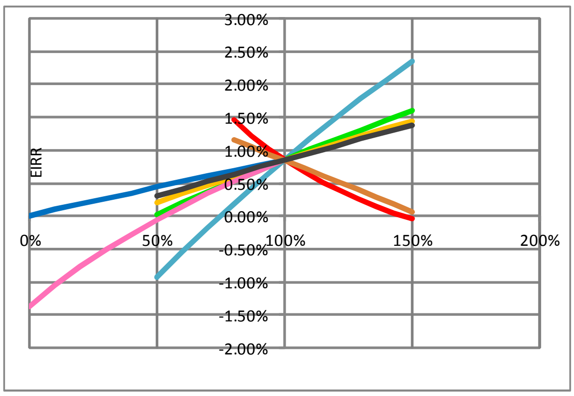
Cashflow: undiscounted



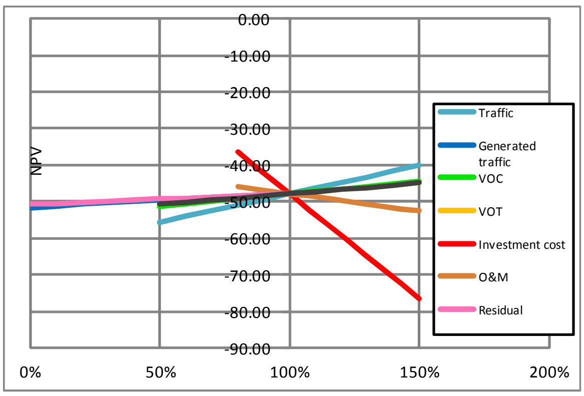
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	0.85%	-47.86
50%	-0.92%	-55.63
60%	-0.54%	-54.08
70%	-0.17%	-52.52
80%	0.18%	-50.97
90%	0.52%	-49.41
100%	0.85%	-47.86
110%	1.17%	-46.30
120%	1.48%	-44.75
130%	1.78%	-43.20
140%	2.08%	-41.64
150%	2.36%	-40.09
Critical?		N

Generated traffic

	EIRR	NPV
100%	0.85%	-47.86
0%	0.01%	-51.56
10%	0.10%	-51.19
20%	0.18%	-50.82
30%	0.27%	-50.45
40%	0.36%	-50.08
50%	0.44%	-49.71
60%	0.52%	-49.34
70%	0.61%	-48.97
80%	0.69%	-48.60
90%	0.77%	-48.23
100%	0.85%	-47.86
Critical?		N

VOC

	EIRR	NPV
100%	0.85%	-47.86
50%	0.03%	-51.29
60%	0.20%	-50.60
70%	0.37%	-49.92
80%	0.53%	-49.23
90%	0.69%	-48.54
100%	0.85%	-47.86
110%	1.01%	-47.17
120%	1.16%	-46.49
130%	1.31%	-45.80
140%	1.46%	-45.12
150%	1.60%	-44.43
Critical?		N

VOT

	EIRR	NPV
100%	0.85%	-47.86
50%	0.21%	-50.75
60%	0.34%	-50.17
70%	0.47%	-49.59
80%	0.60%	-49.01
90%	0.73%	-48.44
100%	0.85%	-47.86
110%	0.97%	-47.28
120%	1.10%	-46.70
130%	1.22%	-46.13
140%	1.33%	-45.55
150%	1.45%	-44.97
Critical?		N

Investment cost

	EIRR	NPV
100%	0.85%	-47.86
80%	1.45%	-36.34
87%	1.22%	-40.37
94%	1.01%	-44.40
101%	0.83%	-48.43
108%	0.66%	-52.46
115%	0.52%	-56.49
122%	0.38%	-60.52
129%	0.26%	-64.55
136%	0.15%	-68.58
143%	0.05%	-72.61
150%	-0.04%	-76.64
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	0.85%	-47.86
80%	1.16%	-45.95
87%	1.05%	-46.62
94%	0.94%	-47.29
101%	0.84%	-47.95
108%	0.73%	-48.62
115%	0.62%	-49.29
122%	0.51%	-49.96
129%	0.40%	-50.62
136%	0.29%	-51.29
143%	0.18%	-51.96
150%	0.07%	-52.63
Critical?		N

Residual

	EIRR	NPV
100%	0.85%	-47.86
0%	-1.37%	-50.76
10%	-1.05%	-50.47
20%	-0.77%	-50.18
30%	-0.51%	-49.89
40%	-0.27%	-49.60
50%	-0.05%	-49.31
60%	0.15%	-49.02
70%	0.34%	-48.73
80%	0.52%	-48.44
90%	0.69%	-48.15
100%	0.85%	-47.86
Critical?		N

Accidents

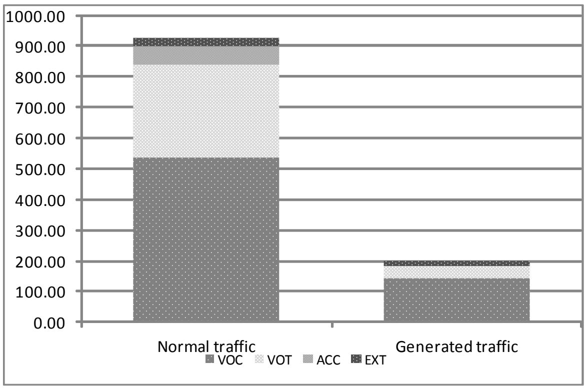
	EIRR	NPV
100%	0.85%	-47.86
50%	0.31%	-50.81
60%	0.42%	-50.22
70%	0.53%	-49.63
80%	0.64%	-49.04
90%	0.74%	-48.45
100%	0.85%	-47.86
110%	0.96%	-47.27
120%	1.06%	-46.68
130%	1.17%	-46.08
140%	1.27%	-45.49
150%	1.38%	-44.90
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S10

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2017
Construction period:	4 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	44.1 km

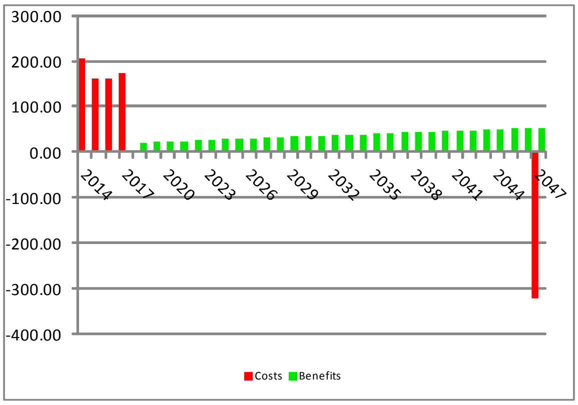
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	538.11	144.57	682.68	58.2%	71.7%	60.6%
VOT	301.10	35.44	336.54	32.5%	17.6%	29.9%
Accidents	60.10	3.00	63.10	6.5%	1.5%	5.6%
External costs	25.79	18.72	44.51	2.8%	9.3%	4.0%
TOTAL	925.11	201.72	1126.83	82.1%	17.9%	100.0%
Total / km	20.98	4.57	25.55			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	671.17	657.74
Management costs	20.13	19.73
Land acquisition	25.27	24.76
Contingencies	0.00	0.00
Total	716.57	702.24
Cost / km	16.25	15.92
Residual value	333.13	326.47
Net O&M over 30 years	125.69	123.17

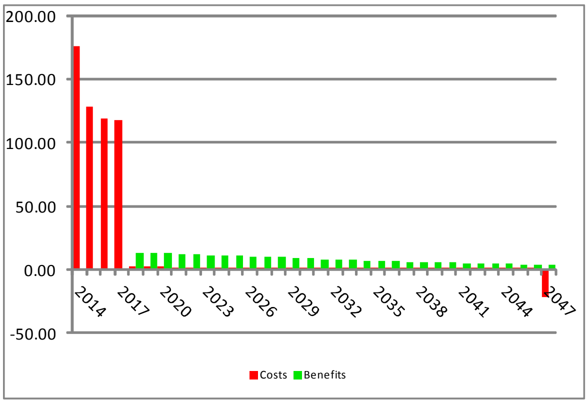


Economic indicators	
EIRR	3.0%
NPV 2012 EURm @ 8%	-307.90
B/C	1:0.44

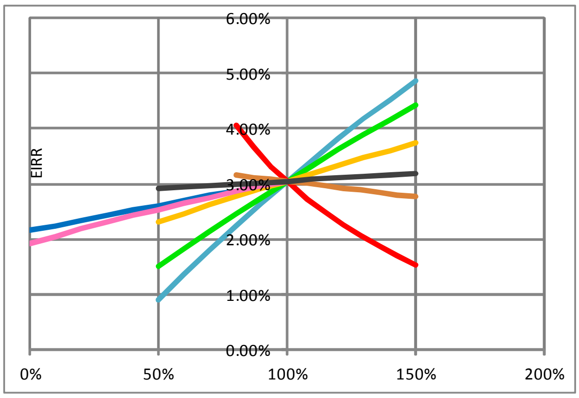
Cashflow: undiscounted



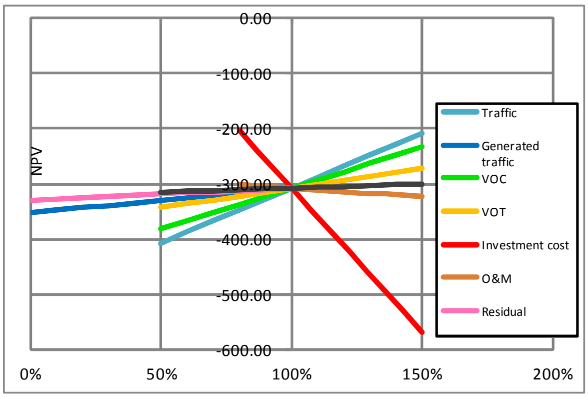
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	3.05%	-307.90
50%	0.89%	-407.09
60%	1.36%	-387.25
70%	1.81%	-367.41
80%	2.24%	-347.58
90%	2.65%	-327.74
100%	3.05%	-307.90
110%	3.43%	-288.07
120%	3.81%	-268.23
130%	4.17%	-248.39
140%	4.52%	-228.56
150%	4.86%	-208.72
Critical?		N

Generated traffic

	EIRR	NPV
100%	3.05%	-307.90
0%	2.15%	-352.28
10%	2.25%	-347.85
20%	2.34%	-343.41
30%	2.43%	-338.97
40%	2.52%	-334.53
50%	2.61%	-330.09
60%	2.70%	-325.66
70%	2.79%	-321.22
80%	2.87%	-316.78
90%	2.96%	-312.34
100%	3.05%	-307.90
Critical?		N

VOC

	EIRR	NPV
100%	3.05%	-307.90
50%	1.50%	-381.97
60%	1.82%	-367.15
70%	2.14%	-352.34
80%	2.45%	-337.53
90%	2.75%	-322.72
100%	3.05%	-307.90
110%	3.33%	-293.09
120%	3.62%	-278.28
130%	3.89%	-263.47
140%	4.16%	-248.66
150%	4.42%	-233.84
Critical?		N

VOT

	EIRR	NPV
100%	3.05%	-307.90
50%	2.31%	-343.42
60%	2.47%	-336.32
70%	2.61%	-329.21
80%	2.76%	-322.11
90%	2.91%	-315.01
100%	3.05%	-307.90
110%	3.19%	-300.80
120%	3.33%	-293.70
130%	3.46%	-286.59
140%	3.60%	-279.49
150%	3.73%	-272.39
Critical?		N

Investment cost

	EIRR	NPV
100%	3.05%	-307.90
80%	4.06%	-204.07
87%	3.66%	-240.41
94%	3.31%	-276.75
101%	3.01%	-313.10
108%	2.73%	-349.44
115%	2.48%	-385.78
122%	2.26%	-422.13
129%	2.05%	-458.47
136%	1.87%	-494.81
143%	1.70%	-531.16
150%	1.54%	-567.50
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	3.05%	-307.90
80%	3.16%	-301.61
87%	3.12%	-303.81
94%	3.08%	-306.02
101%	3.04%	-308.22
108%	3.00%	-310.42
115%	2.96%	-312.62
122%	2.92%	-314.82
129%	2.88%	-317.03
136%	2.85%	-319.23
143%	2.81%	-321.43
150%	2.77%	-323.63
Critical?		N

Residual

	EIRR	NPV
100%	3.05%	-307.90
0%	1.91%	-329.98
10%	2.05%	-327.78
20%	2.18%	-325.57
30%	2.30%	-323.36
40%	2.42%	-321.15
50%	2.54%	-318.94
60%	2.65%	-316.74
70%	2.75%	-314.53
80%	2.86%	-312.32
90%	2.95%	-310.11
100%	3.05%	-307.90
Critical?		N

Accidents

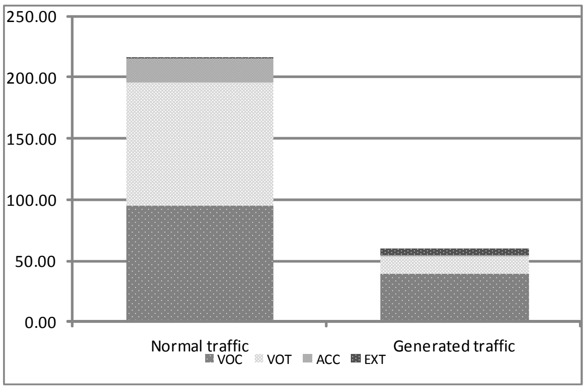
	EIRR	NPV
100%	3.05%	-307.90
50%	2.91%	-315.12
60%	2.94%	-313.68
70%	2.97%	-312.24
80%	2.99%	-310.79
90%	3.02%	-309.35
100%	3.05%	-307.90
110%	3.08%	-306.46
120%	3.10%	-305.02
130%	3.13%	-303.57
140%	3.16%	-302.13
150%	3.18%	-300.69
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S11

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	24 km

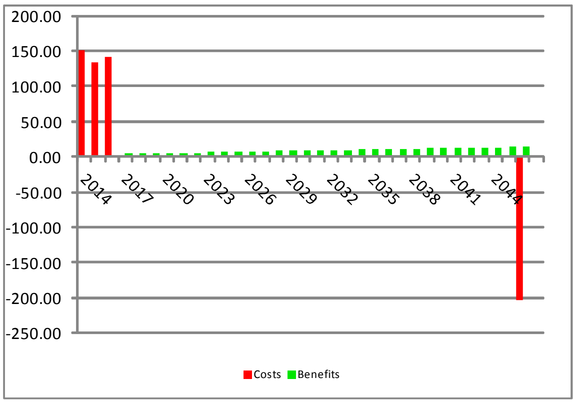
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	95.16	39.10	134.26	44.1%	65.7%	48.8%
VOT	99.67	13.85	113.52	46.2%	23.3%	41.2%
Accidents	19.83	1.12	20.95	9.2%	1.9%	7.6%
External costs	1.14	5.41	6.55	0.5%	9.1%	2.4%
TOTAL	215.81	59.48	275.28	78.4%	21.6%	100.0%
Total / km	8.99	2.48	11.47			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	417.65	409.30
Management costs	12.52	12.27
Land acquisition	4.55	4.46
Contingencies	0.00	0.00
Total	434.72	426.03
Cost / km	18.11	17.75
Residual value	209.92	205.72
Net O&M over 30 years	63.72	62.45

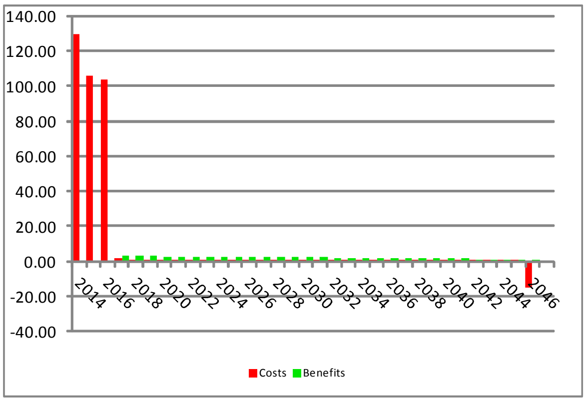


Economic indicators	
EIRR	-0.1%
NPV 2012 EURm @ 8%	-280.81
B/C	1:0.18

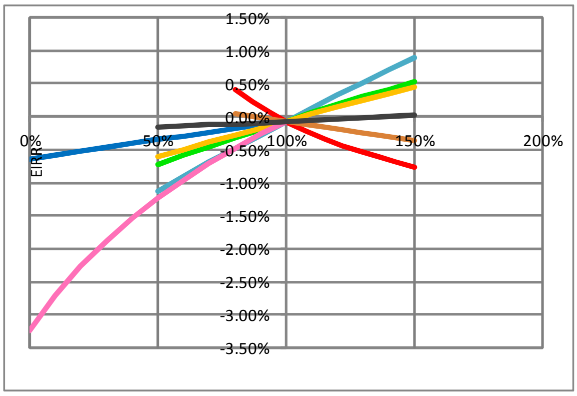
Cashflow: undiscounted



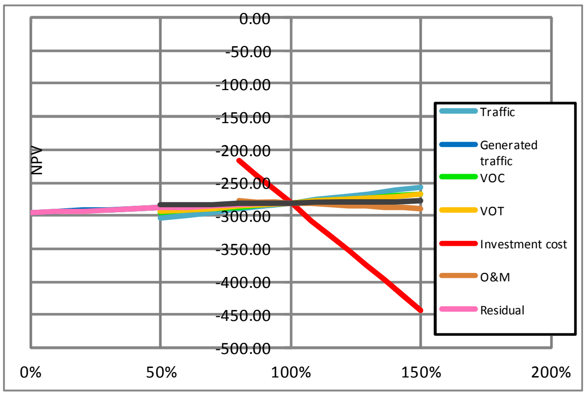
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	-0.07%	-280.81
50%	-1.13%	-304.36
60%	-0.91%	-299.65
70%	-0.69%	-294.94
80%	-0.48%	-290.23
90%	-0.27%	-285.52
100%	-0.07%	-280.81
110%	0.13%	-276.09
120%	0.32%	-271.38
130%	0.52%	-266.67
140%	0.70%	-261.96
150%	0.89%	-257.25
Critical?		N

Generated traffic

	EIRR	NPV
100%	-0.07%	-280.81
0%	-0.64%	-294.61
10%	-0.58%	-293.23
20%	-0.52%	-291.85
30%	-0.46%	-290.47
40%	-0.41%	-289.09
50%	-0.35%	-287.71
60%	-0.29%	-286.33
70%	-0.24%	-284.95
80%	-0.18%	-283.57
90%	-0.12%	-282.19
100%	-0.07%	-280.81
Critical?		N

VOC

	EIRR	NPV
100%	-0.07%	-280.81
50%	-0.72%	-294.90
60%	-0.58%	-292.08
70%	-0.45%	-289.26
80%	-0.32%	-286.44
90%	-0.20%	-283.62
100%	-0.07%	-280.81
110%	0.05%	-277.99
120%	0.18%	-275.17
130%	0.30%	-272.35
140%	0.42%	-269.53
150%	0.54%	-266.71
Critical?		N

VOT

	EIRR	NPV
100%	-0.07%	-280.81
50%	-0.61%	-293.83
60%	-0.50%	-291.22
70%	-0.39%	-288.62
80%	-0.28%	-286.01
90%	-0.18%	-283.41
100%	-0.07%	-280.81
110%	0.04%	-278.20
120%	0.14%	-275.60
130%	0.24%	-272.99
140%	0.35%	-270.39
150%	0.45%	-267.79
Critical?		N

Investment cost

	EIRR	NPV
100%	-0.07%	-280.81
80%	0.41%	-215.91
87%	0.22%	-238.62
94%	0.06%	-261.34
101%	-0.09%	-284.05
108%	-0.22%	-306.77
115%	-0.33%	-329.48
122%	-0.43%	-352.19
129%	-0.53%	-374.91
136%	-0.61%	-397.62
143%	-0.69%	-420.34
150%	-0.76%	-443.05
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	-0.07%	-280.81
80%	0.05%	-277.36
87%	0.01%	-278.57
94%	-0.03%	-279.77
101%	-0.08%	-280.98
108%	-0.12%	-282.18
115%	-0.16%	-283.39
122%	-0.20%	-284.60
129%	-0.24%	-285.80
136%	-0.28%	-287.01
143%	-0.32%	-288.21
150%	-0.36%	-289.42
Critical?		N

Residual

	EIRR	NPV
100%	-0.07%	-280.81
0%	-3.24%	-295.83
10%	-2.70%	-294.33
20%	-2.26%	-292.83
30%	-1.88%	-291.32
40%	-1.54%	-289.82
50%	-1.24%	-288.32
60%	-0.96%	-286.82
70%	-0.71%	-285.31
80%	-0.48%	-283.81
90%	-0.27%	-282.31
100%	-0.07%	-280.81
Critical?		N

Accidents

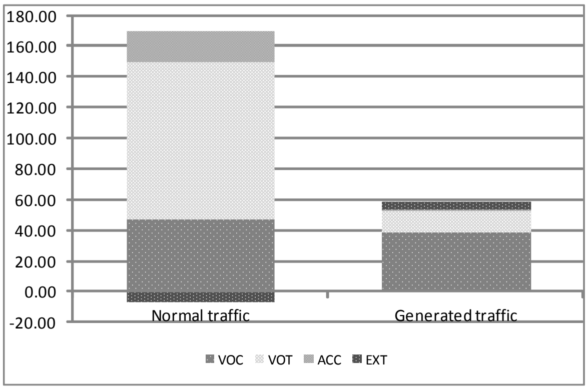
	EIRR	NPV
100%	-0.07%	-280.81
50%	-0.17%	-283.40
60%	-0.15%	-282.88
70%	-0.13%	-282.36
80%	-0.11%	-281.84
90%	-0.09%	-281.32
100%	-0.07%	-280.81
110%	-0.05%	-280.29
120%	-0.03%	-279.77
130%	-0.01%	-279.25
140%	0.01%	-278.73
150%	0.03%	-278.21
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S12

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	25.7 km

Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	47.27	37.93	85.20	29.1%	64.8%	38.5%
VOT	102.31	13.97	116.28	63.0%	23.9%	52.6%
Accidents	20.19	1.13	21.32	12.4%	1.9%	9.6%
External costs	-7.31	5.54	-1.77	-4.5%	9.5%	-0.8%
TOTAL	162.46	58.57	221.03	73.5%	26.5%	100.0%
Total / km	6.32	2.28	8.60			

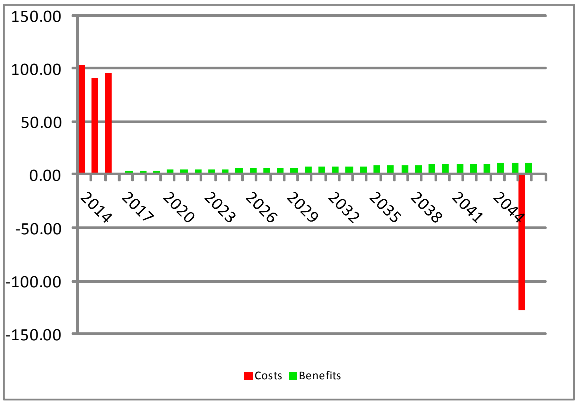
Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	283.42	277.76
Management costs	8.51	8.34
Land acquisition	3.49	3.42
Contingencies	0.00	0.00
Total	295.42	289.52
Cost / km	11.50	11.27
Residual value	132.10	129.46
Net O&M over 30 years	53.20	52.14



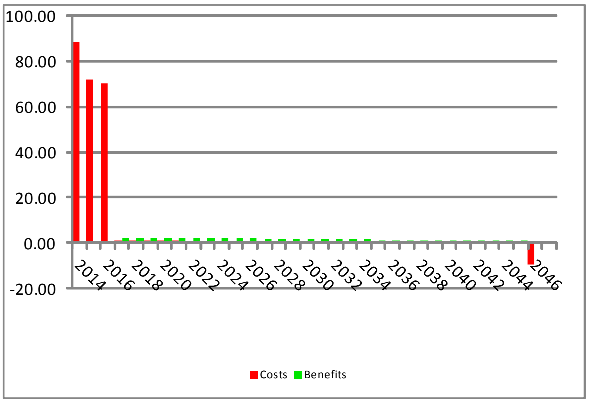
Economic indicators

EIRR	0.1%
NPV 2012 EURm @ 8%	-186.28
B/C	1:0.21

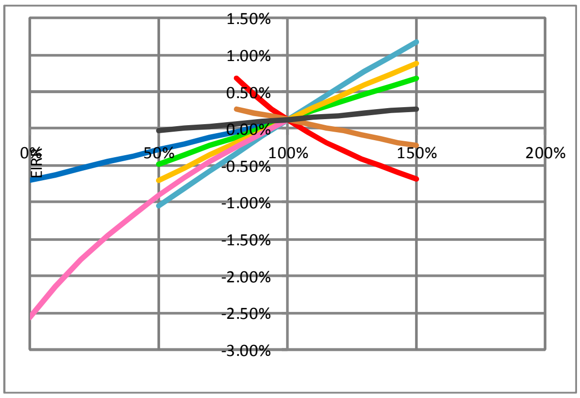
Cashflow: undiscounted



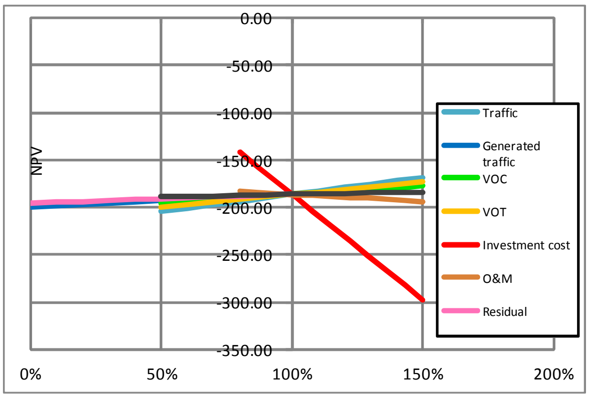
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	0.12%	-186.28
50%	-1.06%	-204.24
60%	-0.81%	-200.65
70%	-0.57%	-197.06
80%	-0.33%	-193.47
90%	-0.10%	-189.87
100%	0.12%	-186.28
110%	0.34%	-182.69
120%	0.56%	-179.10
130%	0.77%	-175.50
140%	0.97%	-171.91
150%	1.17%	-168.32
Critical?		N

Generated traffic

	EIRR	NPV
100%	0.12%	-186.28
0%	-0.71%	-199.75
10%	-0.62%	-198.41
20%	-0.54%	-197.06
30%	-0.45%	-195.71
40%	-0.37%	-194.36
50%	-0.29%	-193.02
60%	-0.20%	-191.67
70%	-0.12%	-190.32
80%	-0.04%	-188.98
90%	0.04%	-187.63
100%	0.12%	-186.28
Critical?		N

VOC

	EIRR	NPV
100%	0.12%	-186.28
50%	-0.48%	-195.05
60%	-0.36%	-193.30
70%	-0.23%	-191.54
80%	-0.11%	-189.79
90%	0.00%	-188.04
100%	0.12%	-186.28
110%	0.24%	-184.53
120%	0.35%	-182.77
130%	0.46%	-181.02
140%	0.57%	-179.27
150%	0.68%	-177.51
Critical?		N

VOT

	EIRR	NPV
100%	0.12%	-186.28
50%	-0.70%	-199.73
60%	-0.53%	-197.04
70%	-0.37%	-194.35
80%	-0.20%	-191.66
90%	-0.04%	-188.97
100%	0.12%	-186.28
110%	0.28%	-183.59
120%	0.44%	-180.90
130%	0.59%	-178.21
140%	0.74%	-175.52
150%	0.89%	-172.84
Critical?		N

Investment cost

	EIRR	NPV
100%	0.12%	-186.28
80%	0.68%	-142.02
87%	0.46%	-157.51
94%	0.27%	-173.00
101%	0.10%	-188.49
108%	-0.05%	-203.98
115%	-0.18%	-219.48
122%	-0.30%	-234.97
129%	-0.41%	-250.46
136%	-0.51%	-265.95
143%	-0.60%	-281.44
150%	-0.68%	-296.93
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	0.12%	-186.28
80%	0.26%	-183.41
87%	0.21%	-184.41
94%	0.16%	-185.42
101%	0.11%	-186.42
108%	0.06%	-187.43
115%	0.01%	-188.44
122%	-0.04%	-189.44
129%	-0.09%	-190.45
136%	-0.14%	-191.46
143%	-0.19%	-192.46
150%	-0.24%	-193.47
Critical?		N

Residual

	EIRR	NPV
100%	0.12%	-186.28
0%	-2.56%	-195.74
10%	-2.14%	-194.79
20%	-1.78%	-193.85
30%	-1.46%	-192.90
40%	-1.17%	-191.95
50%	-0.91%	-191.01
60%	-0.67%	-190.06
70%	-0.45%	-189.12
80%	-0.25%	-188.17
90%	-0.06%	-187.23
100%	0.12%	-186.28
Critical?		N

Accidents

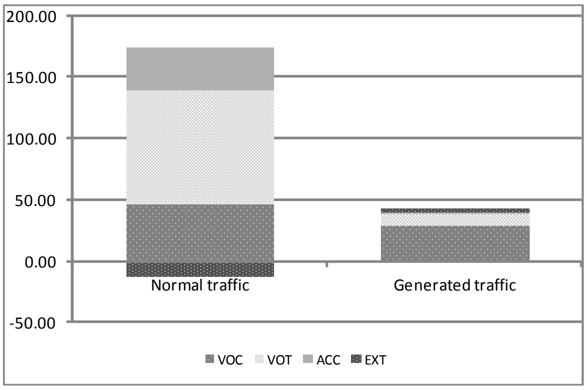
	EIRR	NPV
100%	0.12%	-186.28
50%	-0.03%	-188.94
60%	0.00%	-188.41
70%	0.03%	-187.88
80%	0.06%	-187.34
90%	0.09%	-186.81
100%	0.12%	-186.28
110%	0.15%	-185.75
120%	0.18%	-185.22
130%	0.21%	-184.69
140%	0.24%	-184.16
150%	0.27%	-183.62
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S13

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2016
Construction period:	3 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	25.3 km

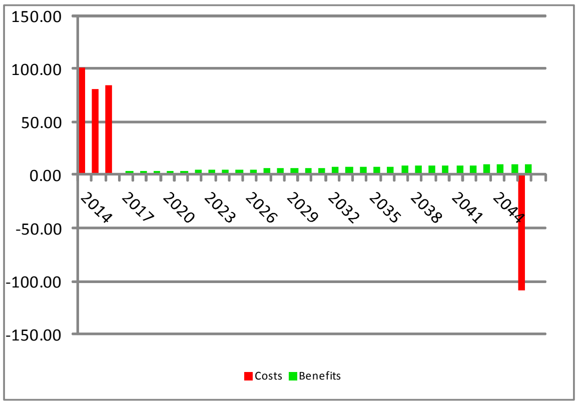
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	45.42	28.31	73.73	28.4%	66.3%	36.4%
VOT	93.50	9.91	103.41	58.5%	23.2%	51.1%
Accidents	34.30	0.78	35.09	21.5%	1.8%	17.3%
External costs	-13.48	3.72	-9.75	-8.4%	8.7%	-4.8%
TOTAL	159.74	42.73	202.47	78.9%	21.1%	100.0%
Total / km	6.31	1.69	8.00			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	251.34	246.32
Management costs	7.55	7.40
Land acquisition	12.52	12.27
Contingencies	0.00	0.00
Total	271.41	265.98
Cost / km	10.73	10.51
Residual value	111.90	109.66
Net O&M over 30 years	29.38	28.79

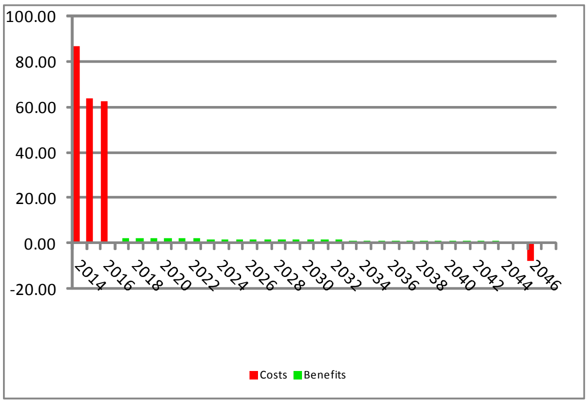


Economic indicators	
EIRR	0.3%
NPV 2012 EURm @ 8%	-167.36
B/C	1:0.21

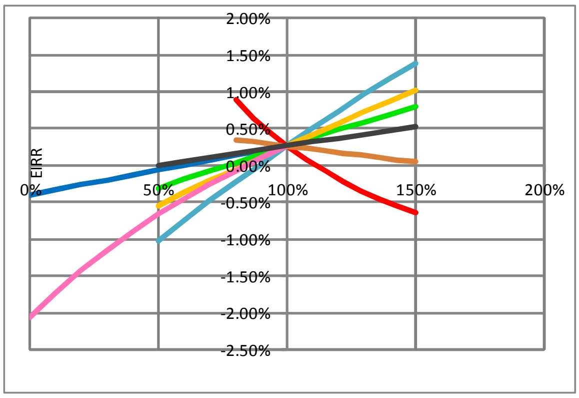
Cashflow: undiscounted



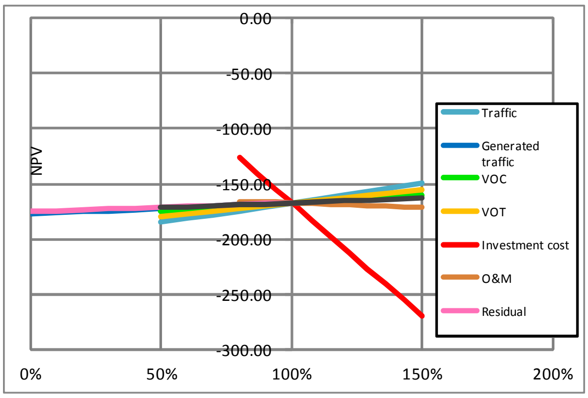
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	0.26%	-167.36
50%	-1.02%	-184.97
60%	-0.75%	-181.45
70%	-0.48%	-177.92
80%	-0.23%	-174.40
90%	0.02%	-170.88
100%	0.26%	-167.36
110%	0.50%	-163.84
120%	0.73%	-160.32
130%	0.96%	-156.80
140%	1.18%	-153.28
150%	1.39%	-149.76
Critical?		N

Generated traffic

	EIRR	NPV
100%	0.26%	-167.36
0%	-0.40%	-177.28
10%	-0.33%	-176.29
20%	-0.26%	-175.29
30%	-0.19%	-174.30
40%	-0.13%	-173.31
50%	-0.06%	-172.32
60%	0.00%	-171.33
70%	0.07%	-170.34
80%	0.13%	-169.35
90%	0.20%	-168.35
100%	0.26%	-167.36
Critical?		N

VOC

	EIRR	NPV
100%	0.26%	-167.36
50%	-0.31%	-174.62
60%	-0.19%	-173.17
70%	-0.07%	-171.72
80%	0.04%	-170.26
90%	0.15%	-168.81
100%	0.26%	-167.36
110%	0.37%	-165.91
120%	0.48%	-164.46
130%	0.59%	-163.01
140%	0.69%	-161.56
150%	0.80%	-160.11
Critical?		N

VOT

	EIRR	NPV
100%	0.26%	-167.36
50%	-0.54%	-179.30
60%	-0.38%	-176.91
70%	-0.21%	-174.52
80%	-0.05%	-172.14
90%	0.11%	-169.75
100%	0.26%	-167.36
110%	0.42%	-164.97
120%	0.57%	-162.59
130%	0.72%	-160.20
140%	0.87%	-157.81
150%	1.01%	-155.42
Critical?		N

Investment cost

	EIRR	NPV
100%	0.26%	-167.36
80%	0.89%	-126.45
87%	0.64%	-140.77
94%	0.43%	-155.09
101%	0.24%	-169.41
108%	0.07%	-183.73
115%	-0.08%	-198.04
122%	-0.22%	-212.36
129%	-0.34%	-226.68
136%	-0.45%	-241.00
143%	-0.55%	-255.32
150%	-0.65%	-269.63
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	0.26%	-167.36
80%	0.35%	-165.77
87%	0.32%	-166.33
94%	0.29%	-166.89
101%	0.26%	-167.44
108%	0.23%	-168.00
115%	0.20%	-168.55
122%	0.17%	-169.11
129%	0.14%	-169.66
136%	0.11%	-170.22
143%	0.08%	-170.78
150%	0.05%	-171.33
Critical?		N

Residual

	EIRR	NPV
100%	0.26%	-167.36
0%	-2.07%	-175.37
10%	-1.73%	-174.57
20%	-1.42%	-173.77
30%	-1.15%	-172.97
40%	-0.90%	-172.17
50%	-0.67%	-171.37
60%	-0.46%	-170.57
70%	-0.26%	-169.76
80%	-0.07%	-168.96
90%	0.10%	-168.16
100%	0.26%	-167.36
Critical?		N

Accidents

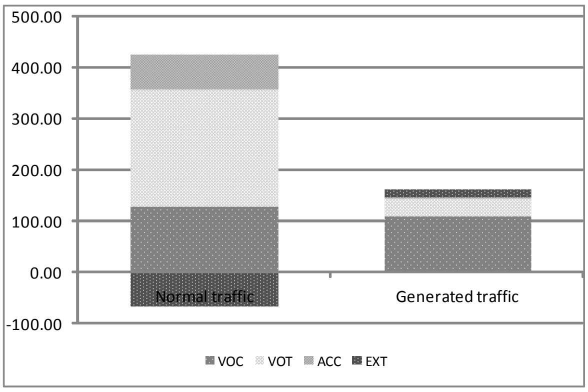
	EIRR	NPV
100%	0.26%	-167.36
50%	0.00%	-171.66
60%	0.05%	-170.80
70%	0.10%	-169.94
80%	0.16%	-169.08
90%	0.21%	-168.22
100%	0.26%	-167.36
110%	0.32%	-166.50
120%	0.37%	-165.64
130%	0.42%	-164.78
140%	0.47%	-163.92
150%	0.52%	-163.06
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S15

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2017
Construction period:	4 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	40.7 km

Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	128.05	108.26	236.31	35.7%	67.0%	45.4%
VOT	227.31	35.67	262.97	63.4%	22.1%	50.6%
Accidents	69.12	2.07	71.19	19.3%	1.3%	13.7%
External costs	-66.21	15.68	-50.53	-18.5%	9.7%	-9.7%
TOTAL	358.27	161.68	519.95	68.9%	31.1%	100.0%
Total / km	8.80	3.97	12.78			

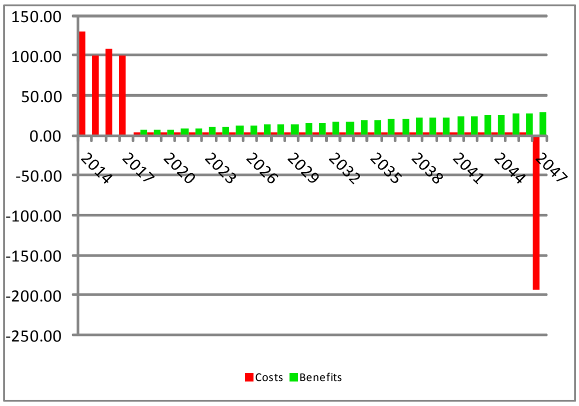
Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	415.48	407.17
Management costs	12.46	12.22
Land acquisition	19.77	19.37
Contingencies	0.00	0.00
Total	447.71	438.76
Cost / km	11.00	10.78
Residual value	201.16	197.14
Net O&M over 30 years	94.31	92.42



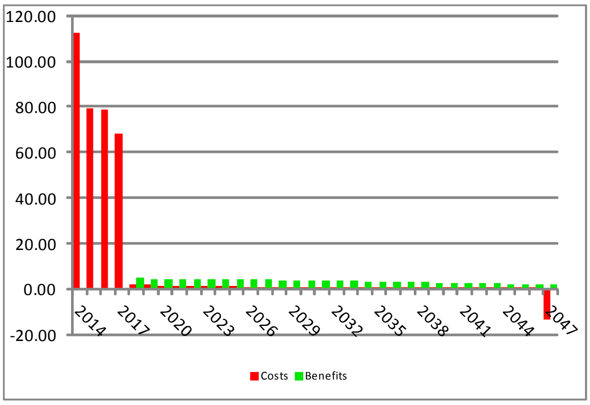
Economic indicators

EIRR	1.5%
NPV 2012 EURm @ 8%	-247.00
B/C	1:0.29

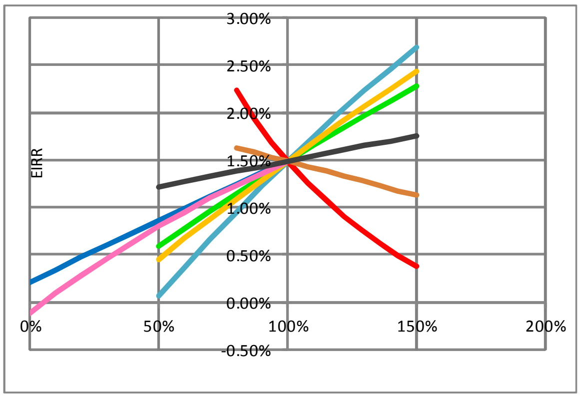
Cashflow: undiscounted



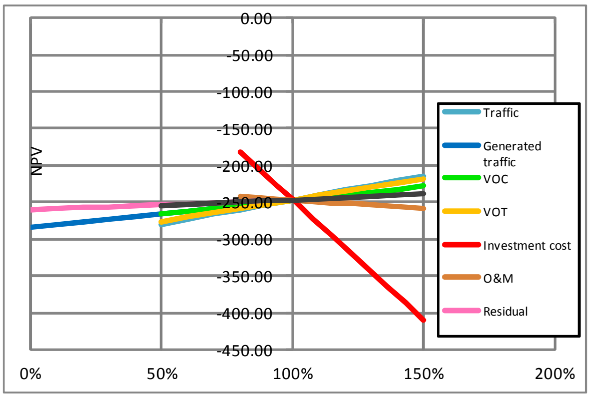
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	1.49%	-247.00
50%	0.06%	-279.66
60%	0.37%	-273.13
70%	0.66%	-266.60
80%	0.95%	-260.07
90%	1.22%	-253.53
100%	1.49%	-247.00
110%	1.74%	-240.47
120%	1.99%	-233.94
130%	2.23%	-227.41
140%	2.47%	-220.88
150%	2.69%	-214.35
Critical?		N

Generated traffic

	EIRR	NPV
100%	1.49%	-247.00
0%	0.20%	-283.90
10%	0.34%	-280.21
20%	0.47%	-276.52
30%	0.60%	-272.83
40%	0.73%	-269.14
50%	0.86%	-265.45
60%	0.99%	-261.76
70%	1.12%	-258.07
80%	1.24%	-254.38
90%	1.37%	-250.69
100%	1.49%	-247.00
Critical?		N

VOC

	EIRR	NPV
100%	1.49%	-247.00
50%	0.59%	-265.45
60%	0.78%	-261.76
70%	0.96%	-258.07
80%	1.14%	-254.38
90%	1.32%	-250.69
100%	1.49%	-247.00
110%	1.65%	-243.31
120%	1.82%	-239.62
130%	1.97%	-235.94
140%	2.13%	-232.25
150%	2.28%	-228.56
Critical?		N

VOT

	EIRR	NPV
100%	1.49%	-247.00
50%	0.46%	-276.20
60%	0.67%	-270.36
70%	0.88%	-264.52
80%	1.09%	-258.68
90%	1.29%	-252.84
100%	1.49%	-247.00
110%	1.68%	-241.16
120%	1.88%	-235.32
130%	2.07%	-229.48
140%	2.26%	-223.64
150%	2.44%	-217.80
Critical?		N

Investment cost

	EIRR	NPV
100%	1.49%	-247.00
80%	2.23%	-181.88
87%	1.94%	-204.68
94%	1.68%	-227.47
101%	1.46%	-250.26
108%	1.25%	-273.05
115%	1.07%	-295.84
122%	0.91%	-318.64
129%	0.75%	-341.43
136%	0.62%	-364.22
143%	0.49%	-387.01
150%	0.37%	-409.80
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	1.49%	-247.00
80%	1.63%	-242.28
87%	1.58%	-243.93
94%	1.53%	-245.59
101%	1.48%	-247.24
108%	1.43%	-248.89
115%	1.38%	-250.54
122%	1.33%	-252.20
129%	1.28%	-253.85
136%	1.23%	-255.50
143%	1.18%	-257.15
150%	1.13%	-258.81
Critical?		N

Residual

	EIRR	NPV
100%	1.49%	-247.00
0%	-0.12%	-260.34
10%	0.09%	-259.00
20%	0.29%	-257.67
30%	0.47%	-256.34
40%	0.64%	-255.00
50%	0.80%	-253.67
60%	0.95%	-252.34
70%	1.10%	-251.00
80%	1.23%	-249.67
90%	1.36%	-248.34
100%	1.49%	-247.00
Critical?		N

Accidents

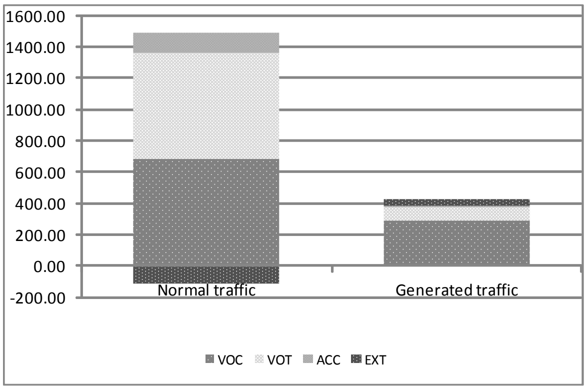
	EIRR	NPV
100%	1.49%	-247.00
50%	1.22%	-255.17
60%	1.27%	-253.53
70%	1.33%	-251.90
80%	1.38%	-250.27
90%	1.43%	-248.64
100%	1.49%	-247.00
110%	1.54%	-245.37
120%	1.60%	-243.74
130%	1.65%	-242.11
140%	1.70%	-240.47
150%	1.76%	-238.84
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S16

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2023
Construction period:	10 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	159.9 km

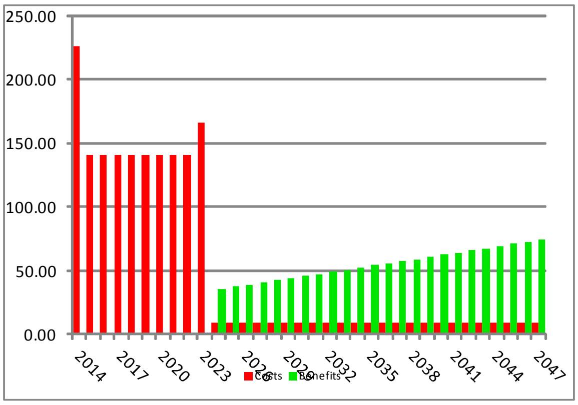
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	685.73	291.17	976.90	50.0%	68.6%	54.4%
VOT	673.92	84.47	758.39	49.2%	19.9%	42.2%
Accidents	127.32	5.49	132.81	9.3%	1.3%	7.4%
External costs	-116.30	43.45	-72.85	-8.5%	10.2%	-4.1%
TOTAL	1370.68	424.57	1795.26	76.4%	23.6%	100.0%
Total / km	8.57	2.66	11.23			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	1455.90	1426.78
Management costs	43.68	42.80
Land acquisition	50.32	49.31
Contingencies	0.00	0.00
Total	1549.89	1518.90
Cost / km	9.69	9.50
Residual value	704.52	690.42
Net O&M over 30 years	270.48	265.07

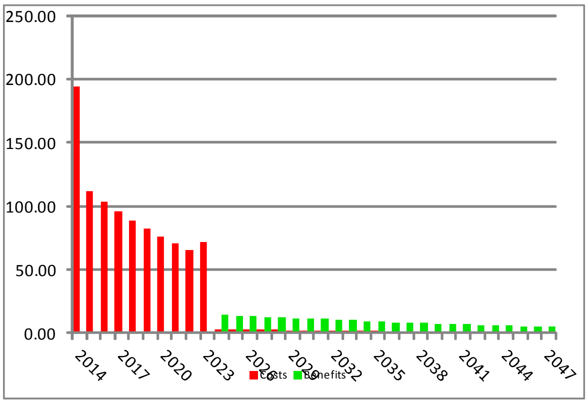


Economic indicators	
EIRR	1.5%
NPV 2012 EURm @ 8%	-726.12
B/C	1:0.25

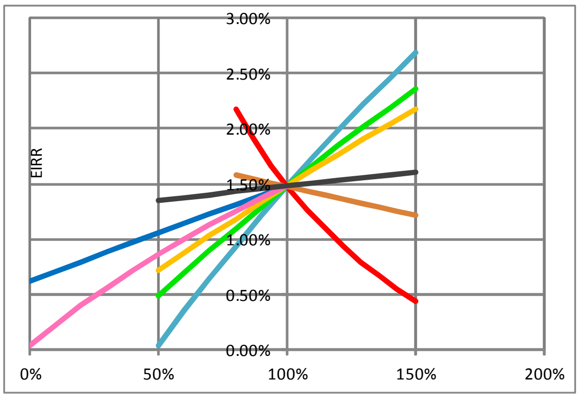
Cashflow: undiscounted



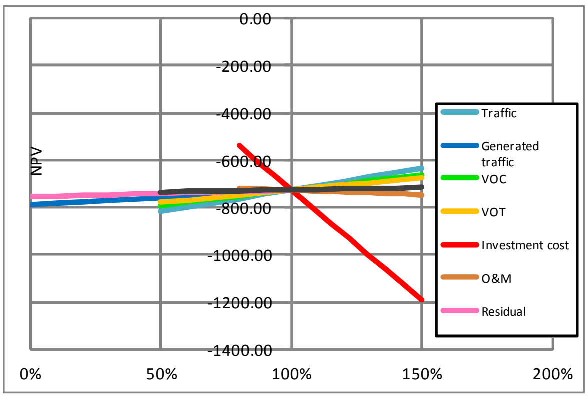
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	1.48%	-726.12
50%	0.04%	-817.97
60%	0.35%	-799.60
70%	0.65%	-781.23
80%	0.94%	-762.86
90%	1.21%	-744.49
100%	1.48%	-726.12
110%	1.74%	-707.75
120%	1.99%	-689.39
130%	2.23%	-671.02
140%	2.46%	-652.65
150%	2.68%	-634.28
Critical?		N

Generated traffic

	EIRR	NPV
100%	1.48%	-726.12
0%	0.61%	-788.42
10%	0.71%	-782.19
20%	0.79%	-775.96
30%	0.88%	-769.73
40%	0.97%	-763.50
50%	1.06%	-757.27
60%	1.14%	-751.04
70%	1.23%	-744.81
80%	1.31%	-738.58
90%	1.40%	-732.35
100%	1.48%	-726.12
Critical?		N

VOC

	EIRR	NPV
100%	1.48%	-726.12
50%	0.48%	-791.17
60%	0.69%	-778.16
70%	0.90%	-765.15
80%	1.10%	-752.14
90%	1.29%	-739.13
100%	1.48%	-726.12
110%	1.66%	-713.11
120%	1.84%	-700.11
130%	2.02%	-687.10
140%	2.19%	-674.09
150%	2.36%	-661.08
Critical?		N

VOT

	EIRR	NPV
100%	1.48%	-726.12
50%	0.71%	-779.15
60%	0.87%	-768.55
70%	1.03%	-757.94
80%	1.18%	-747.33
90%	1.33%	-736.73
100%	1.48%	-726.12
110%	1.62%	-715.52
120%	1.77%	-704.91
130%	1.91%	-694.31
140%	2.04%	-683.70
150%	2.18%	-673.10
Critical?		N

Investment cost

	EIRR	NPV
100%	1.48%	-726.12
80%	2.17%	-540.23
87%	1.90%	-605.30
94%	1.66%	-670.36
101%	1.45%	-735.42
108%	1.26%	-800.48
115%	1.09%	-865.54
122%	0.93%	-930.60
129%	0.79%	-995.66
136%	0.66%	-1060.73
143%	0.54%	-1125.79
150%	0.44%	-1190.85
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	1.48%	-726.12
80%	1.58%	-717.59
87%	1.55%	-720.58
94%	1.51%	-723.56
101%	1.47%	-726.55
108%	1.44%	-729.54
115%	1.40%	-732.52
122%	1.36%	-735.51
129%	1.33%	-738.50
136%	1.29%	-741.48
143%	1.25%	-744.47
150%	1.21%	-747.45
Critical?		N

Residual

	EIRR	NPV
100%	1.48%	-726.12
0%	0.03%	-755.55
10%	0.22%	-752.61
20%	0.40%	-749.67
30%	0.56%	-746.72
40%	0.72%	-743.78
50%	0.86%	-740.84
60%	1.00%	-737.89
70%	1.13%	-734.95
80%	1.25%	-732.01
90%	1.37%	-729.07
100%	1.48%	-726.12
Critical?		N

Accidents

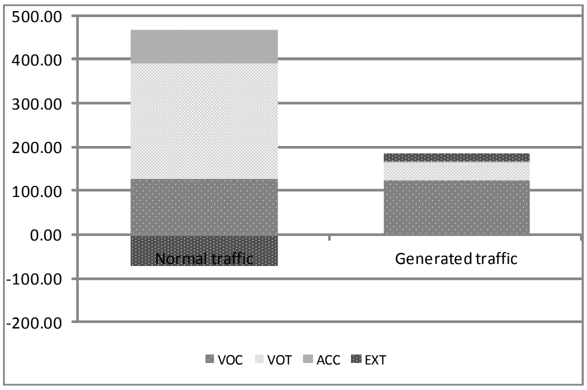
	EIRR	NPV
100%	1.48%	-726.12
50%	1.35%	-735.80
60%	1.38%	-733.86
70%	1.40%	-731.93
80%	1.43%	-729.99
90%	1.45%	-728.06
100%	1.48%	-726.12
110%	1.51%	-724.19
120%	1.53%	-722.25
130%	1.56%	-720.32
140%	1.58%	-718.38
150%	1.61%	-716.45
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S17

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2018
Construction period:	5 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	49.7 km

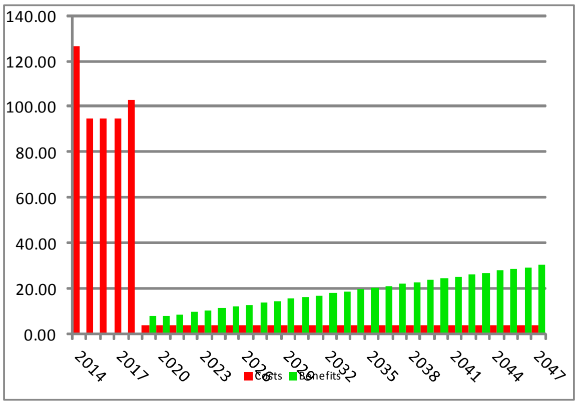
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	126.73	124.67	251.40	32.3%	67.7%	43.6%
VOT	262.99	38.18	301.17	67.0%	20.7%	52.2%
Accidents	76.85	2.17	79.02	19.6%	1.2%	13.7%
External costs	-73.93	19.01	-54.93	-18.8%	10.3%	-9.5%
TOTAL	392.64	184.03	576.67	68.1%	31.9%	100.0%
Total / km	7.90	3.70	11.60			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	488.52	478.75
Management costs	14.66	14.36
Land acquisition	20.13	19.73
Contingencies	0.00	0.00
Total	523.31	512.84
Cost / km	10.53	10.32
Residual value	238.68	233.90
Net O&M over 30 years	126.98	124.44

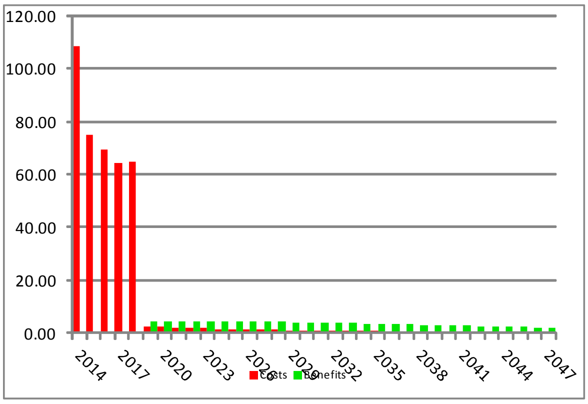


Economic indicators	
EIRR	1.2%
NPV 2012 EURm @ 8%	-291.35
B/C	1:0.27

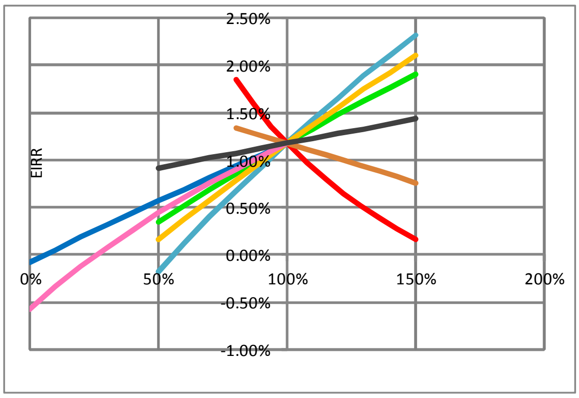
Cashflow: undiscounted



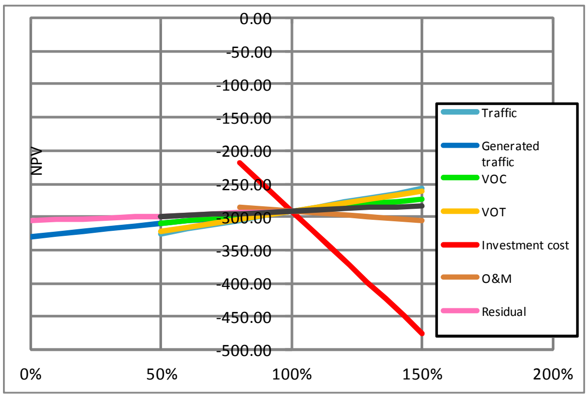
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	1.18%	-291.35
50%	-0.17%	-325.04
60%	0.12%	-318.30
70%	0.40%	-311.56
80%	0.67%	-304.82
90%	0.93%	-298.09
100%	1.18%	-291.35
110%	1.42%	-284.61
120%	1.66%	-277.87
130%	1.88%	-271.13
140%	2.11%	-264.39
150%	2.32%	-257.66
Critical?		N

Generated traffic

	EIRR	NPV
100%	1.18%	-291.35
0%	-0.08%	-329.40
10%	0.05%	-325.59
20%	0.19%	-321.79
30%	0.31%	-317.98
40%	0.44%	-314.18
50%	0.57%	-310.37
60%	0.69%	-306.57
70%	0.82%	-302.76
80%	0.94%	-298.96
90%	1.06%	-295.15
100%	1.18%	-291.35
Critical?		N

VOC

	EIRR	NPV
100%	1.18%	-291.35
50%	0.35%	-310.09
60%	0.52%	-306.34
70%	0.69%	-302.59
80%	0.86%	-298.84
90%	1.02%	-295.09
100%	1.18%	-291.35
110%	1.33%	-287.60
120%	1.48%	-283.85
130%	1.63%	-280.10
140%	1.77%	-276.36
150%	1.91%	-272.61
Critical?		N

VOT

	EIRR	NPV
100%	1.18%	-291.35
50%	0.16%	-321.71
60%	0.37%	-315.64
70%	0.58%	-309.56
80%	0.78%	-303.49
90%	0.98%	-297.42
100%	1.18%	-291.35
110%	1.37%	-285.27
120%	1.56%	-279.20
130%	1.74%	-273.13
140%	1.93%	-267.06
150%	2.10%	-260.98
Critical?		N

Investment cost

	EIRR	NPV
100%	1.18%	-291.35
80%	1.85%	-217.88
87%	1.59%	-243.59
94%	1.36%	-269.31
101%	1.15%	-295.02
108%	0.96%	-320.73
115%	0.80%	-346.45
122%	0.65%	-372.16
129%	0.51%	-397.88
136%	0.38%	-423.59
143%	0.27%	-449.31
150%	0.16%	-475.02
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	1.18%	-291.35
80%	1.34%	-285.46
87%	1.28%	-287.52
94%	1.23%	-289.58
101%	1.17%	-291.64
108%	1.11%	-293.70
115%	1.05%	-295.76
122%	1.00%	-297.82
129%	0.94%	-299.88
136%	0.88%	-301.94
143%	0.82%	-304.00
150%	0.76%	-306.06
Critical?		N

Residual

	EIRR	NPV
100%	1.18%	-291.35
0%	-0.57%	-306.00
10%	-0.34%	-304.53
20%	-0.12%	-303.07
30%	0.08%	-301.60
40%	0.27%	-300.14
50%	0.44%	-298.67
60%	0.61%	-297.21
70%	0.76%	-295.74
80%	0.91%	-294.28
90%	1.05%	-292.81
100%	1.18%	-291.35
Critical?		N

Accidents

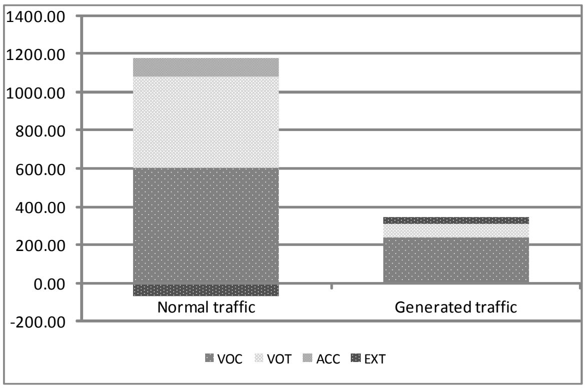
	EIRR	NPV
100%	1.18%	-291.35
50%	0.92%	-299.72
60%	0.97%	-298.04
70%	1.02%	-296.37
80%	1.07%	-294.70
90%	1.13%	-293.02
100%	1.18%	-291.35
110%	1.23%	-289.67
120%	1.28%	-288.00
130%	1.33%	-286.32
140%	1.38%	-284.65
150%	1.43%	-282.98
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S18

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2021
Construction period:	8 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	93.8 km

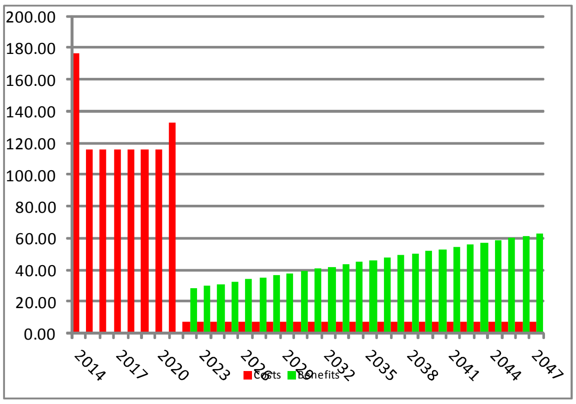
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	598.95	241.67	840.62	54.2%	70.0%	58.0%
VOT	481.34	65.47	546.81	43.6%	19.0%	37.7%
Accidents	93.01	4.38	97.40	8.4%	1.3%	6.7%
External costs	-68.62	33.49	-35.13	-6.2%	9.7%	-2.4%
TOTAL	1104.69	345.01	1449.70	76.2%	23.8%	100.0%
Total / km	11.78	3.68	15.46			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	958.34	939.17
Management costs	28.75	28.18
Land acquisition	37.82	37.06
Contingencies	0.00	0.00
Total	1024.91	1004.41
Cost / km	10.93	10.71
Residual value	471.87	462.43
Net O&M over 30 years	214.96	210.66

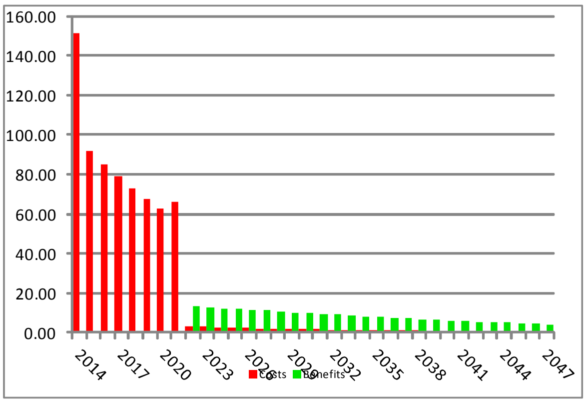


Economic indicators	
EIRR	2.2%
NPV 2012 EURm @ 8%	-462.49
B/C	1:0.33

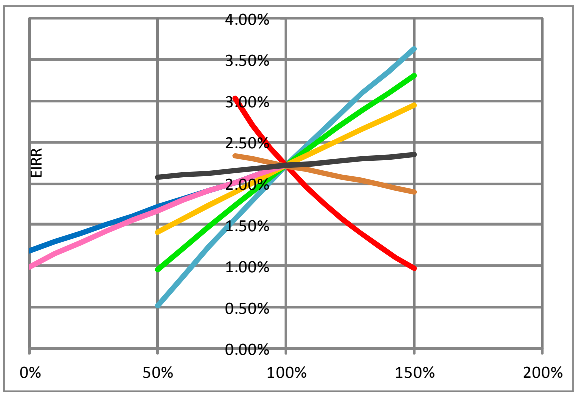
Cashflow: undiscounted



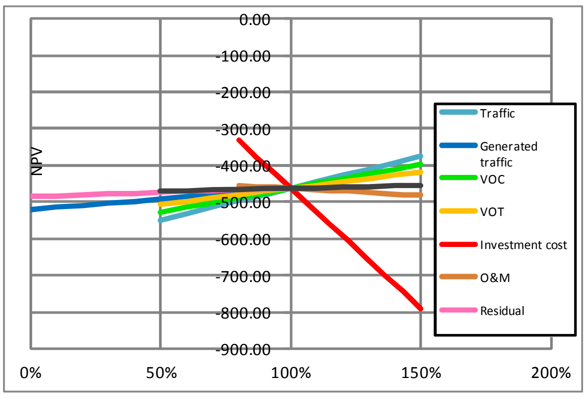
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	2.21%	-462.49
50%	0.51%	-548.95
60%	0.88%	-531.66
70%	1.24%	-514.37
80%	1.57%	-497.07
90%	1.90%	-479.78
100%	2.21%	-462.49
110%	2.51%	-445.20
120%	2.81%	-427.91
130%	3.09%	-410.62
140%	3.36%	-393.33
150%	3.62%	-376.03
Critical?		N

Generated traffic

	EIRR	NPV
100%	2.21%	-462.49
0%	1.18%	-520.58
10%	1.29%	-514.77
20%	1.40%	-508.96
30%	1.50%	-503.15
40%	1.61%	-497.34
50%	1.71%	-491.54
60%	1.81%	-485.73
70%	1.91%	-479.92
80%	2.02%	-474.11
90%	2.11%	-468.30
100%	2.21%	-462.49
Critical?		N

VOC

	EIRR	NPV
100%	2.21%	-462.49
50%	0.95%	-527.74
60%	1.22%	-514.69
70%	1.48%	-501.64
80%	1.73%	-488.59
90%	1.98%	-475.54
100%	2.21%	-462.49
110%	2.44%	-449.44
120%	2.67%	-436.39
130%	2.88%	-423.34
140%	3.10%	-410.29
150%	3.30%	-397.24
Critical?		N

VOT

	EIRR	NPV
100%	2.21%	-462.49
50%	1.41%	-506.84
60%	1.58%	-497.97
70%	1.74%	-489.10
80%	1.90%	-480.23
90%	2.06%	-471.36
100%	2.21%	-462.49
110%	2.37%	-453.62
120%	2.52%	-444.75
130%	2.66%	-435.88
140%	2.81%	-427.01
150%	2.95%	-418.14
Critical?		N

Investment cost

	EIRR	NPV
100%	2.21%	-462.49
80%	3.03%	-331.70
87%	2.71%	-377.48
94%	2.43%	-423.25
101%	2.18%	-469.03
108%	1.95%	-514.81
115%	1.75%	-560.58
122%	1.57%	-606.36
129%	1.40%	-652.14
136%	1.25%	-697.91
143%	1.11%	-743.69
150%	0.98%	-789.47
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	2.21%	-462.49
80%	2.34%	-454.58
87%	2.29%	-457.35
94%	2.25%	-460.12
101%	2.21%	-462.89
108%	2.16%	-465.65
115%	2.12%	-468.42
122%	2.08%	-471.19
129%	2.03%	-473.96
136%	1.99%	-476.73
143%	1.95%	-479.50
150%	1.90%	-482.26
Critical?		N

Residual

	EIRR	NPV
100%	2.21%	-462.49
0%	0.99%	-485.48
10%	1.14%	-483.18
20%	1.29%	-480.88
30%	1.42%	-478.58
40%	1.55%	-476.28
50%	1.68%	-473.99
60%	1.79%	-471.69
70%	1.90%	-469.39
80%	2.01%	-467.09
90%	2.11%	-464.79
100%	2.21%	-462.49
Critical?		N

Accidents

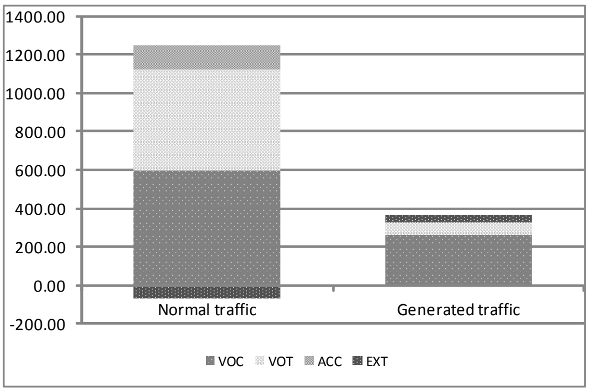
	EIRR	NPV
100%	2.21%	-462.49
50%	2.07%	-470.76
60%	2.10%	-469.10
70%	2.13%	-467.45
80%	2.16%	-465.80
90%	2.19%	-464.14
100%	2.21%	-462.49
110%	2.24%	-460.84
120%	2.27%	-459.19
130%	2.30%	-457.53
140%	2.32%	-455.88
150%	2.35%	-454.23
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S19

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2021
Construction period:	8 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	93.8 km

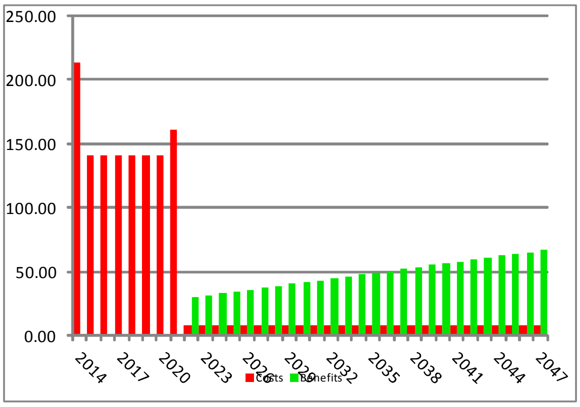
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	598.23	255.93	854.15	50.8%	70.4%	55.4%
VOT	519.89	67.49	587.38	44.1%	18.6%	38.1%
Accidents	128.39	4.00	132.39	10.9%	1.1%	8.6%
External costs	-68.80	36.26	-32.54	-5.8%	10.0%	-2.1%
TOTAL	1177.71	363.67	1541.38	76.4%	23.6%	100.0%
Total / km	12.56	3.88	16.43			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	1159.69	1136.49
Management costs	34.79	34.09
Land acquisition	45.40	44.49
Contingencies	0.00	0.00
Total	1239.88	1215.08
Cost / km	13.22	12.95
Residual value	571.81	560.37
Net O&M over 30 years	252.67	247.61

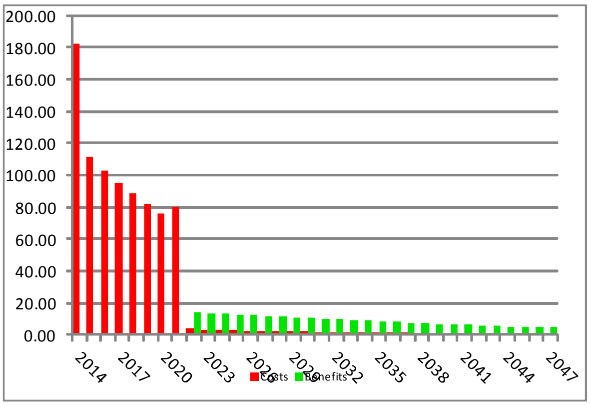


Economic indicators	
EIRR	1.7%
NPV 2012 EURm @ 8%	-592.22
B/C	1:0.29

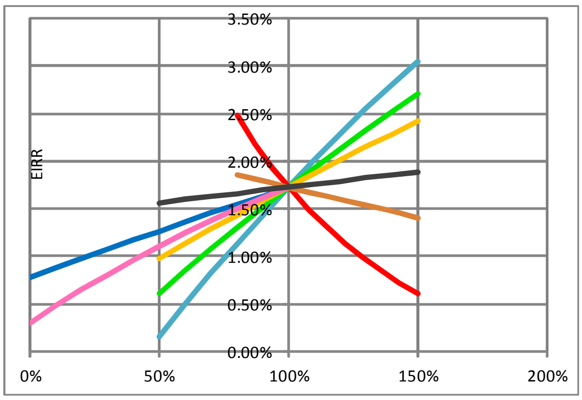
Cashflow: undiscounted



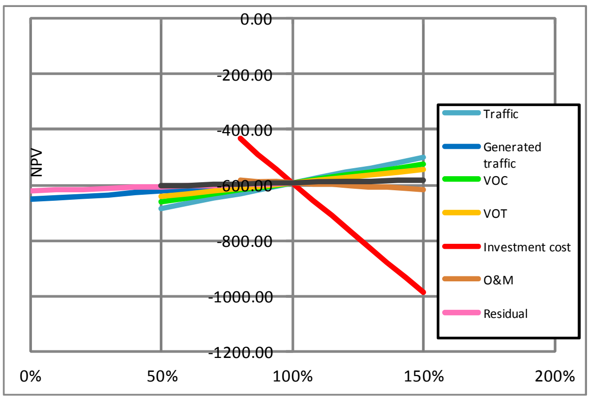
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	1.73%	-592.22
50%	0.15%	-684.43
60%	0.49%	-665.99
70%	0.82%	-647.55
80%	1.13%	-629.11
90%	1.44%	-610.66
100%	1.73%	-592.22
110%	2.01%	-573.78
120%	2.28%	-555.34
130%	2.55%	-536.90
140%	2.80%	-518.46
150%	3.05%	-500.02
Critical?		N

Generated traffic

	EIRR	NPV
100%	1.73%	-592.22
0%	0.78%	-653.07
10%	0.88%	-646.98
20%	0.98%	-640.90
30%	1.08%	-634.81
40%	1.17%	-628.73
50%	1.27%	-622.65
60%	1.36%	-616.56
70%	1.45%	-610.48
80%	1.55%	-604.39
90%	1.64%	-598.31
100%	1.73%	-592.22
Critical?		N

VOC

	EIRR	NPV
100%	1.73%	-592.22
50%	0.62%	-658.49
60%	0.85%	-645.24
70%	1.08%	-631.98
80%	1.30%	-618.73
90%	1.52%	-605.48
100%	1.73%	-592.22
110%	1.93%	-578.97
120%	2.13%	-565.72
130%	2.33%	-552.46
140%	2.52%	-539.21
150%	2.70%	-525.95
Critical?		N

VOT

	EIRR	NPV
100%	1.73%	-592.22
50%	0.98%	-639.51
60%	1.13%	-630.05
70%	1.28%	-620.60
80%	1.43%	-611.14
90%	1.58%	-601.68
100%	1.73%	-592.22
110%	1.87%	-582.77
120%	2.01%	-573.31
130%	2.15%	-563.85
140%	2.28%	-554.39
150%	2.42%	-544.94
Critical?		N

Investment cost

	EIRR	NPV
100%	1.73%	-592.22
80%	2.48%	-434.02
87%	2.18%	-489.39
94%	1.92%	-544.76
101%	1.70%	-600.13
108%	1.49%	-655.50
115%	1.31%	-710.87
122%	1.14%	-766.24
129%	0.99%	-821.61
136%	0.85%	-876.98
143%	0.72%	-932.35
150%	0.60%	-987.72
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	1.73%	-592.22
80%	1.85%	-582.93
87%	1.81%	-586.18
94%	1.76%	-589.43
101%	1.72%	-592.69
108%	1.68%	-595.94
115%	1.63%	-599.20
122%	1.59%	-602.45
129%	1.54%	-605.70
136%	1.50%	-608.96
143%	1.45%	-612.21
150%	1.41%	-615.46
Critical?		N

Residual

	EIRR	NPV
100%	1.73%	-592.22
0%	0.29%	-620.08
10%	0.48%	-617.30
20%	0.65%	-614.51
30%	0.81%	-611.72
40%	0.97%	-608.94
50%	1.11%	-606.15
60%	1.25%	-603.37
70%	1.38%	-600.58
80%	1.50%	-597.79
90%	1.61%	-595.01
100%	1.73%	-592.22
Critical?		N

Accidents

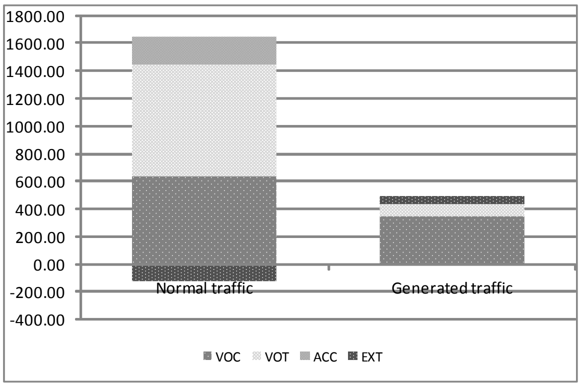
	EIRR	NPV
100%	1.73%	-592.22
50%	1.56%	-603.47
60%	1.59%	-601.22
70%	1.63%	-598.97
80%	1.66%	-596.72
90%	1.69%	-594.47
100%	1.73%	-592.22
110%	1.76%	-589.97
120%	1.79%	-587.72
130%	1.83%	-585.48
140%	1.86%	-583.23
150%	1.89%	-580.98
Critical?		N

SUMMARY RESULTS OF ECONOMIC EVALUATION FOR SEETO IV: S20

Base year for cost data:	2012
Year construction begins:	2014
Year construction ends:	2023
Construction period:	10 years
Appraisal period:	30 years
Discount rate	8.0%
Traffic extrapolated?	Yes
Length of new road	168.9 km

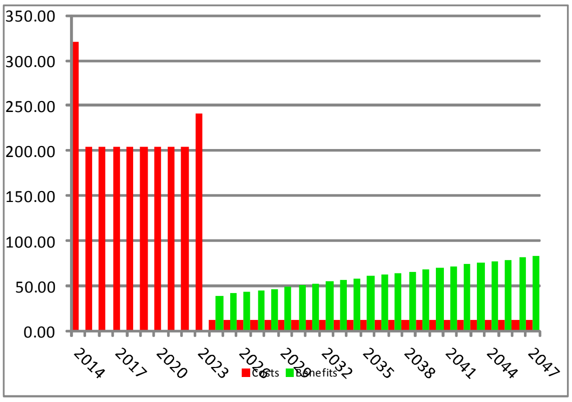
Benefits	EURm			%		
(undiscounted)	Normal	Generat	TOTAL	Normal	Generat	TOTAL
VOC	637.19	348.37	985.56	41.7%	70.6%	48.8%
VOT	808.77	85.45	894.22	53.0%	17.3%	44.3%
Accidents	203.58	4.16	207.75	13.3%	0.8%	10.3%
External costs	-123.15	55.40	-67.75	-8.1%	11.2%	-3.4%
TOTAL	1526.40	493.38	2019.78	75.6%	24.4%	100.0%
Total / km	9.04	2.92	11.96			

Investment costs	EURm	
(undiscounted)	Financial	Economic
Works	2112.12	2069.88
Management costs	63.36	62.10
Land acquisition	65.96	64.64
Contingencies	0.00	0.00
Total	2241.44	2196.61
Cost / km	13.27	13.01
Residual value	1025.73	1005.21
Net O&M over 30 years	398.96	390.98

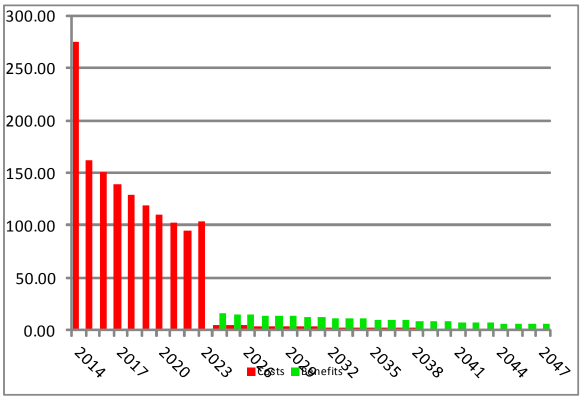


Economic indicators	
EIRR	0.7%
NPV 2012 EURm @ 8%	-1128.96
B/C	1:0.2

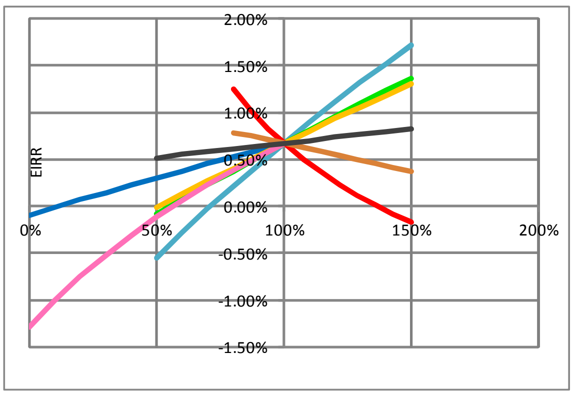
Cashflow: undiscounted



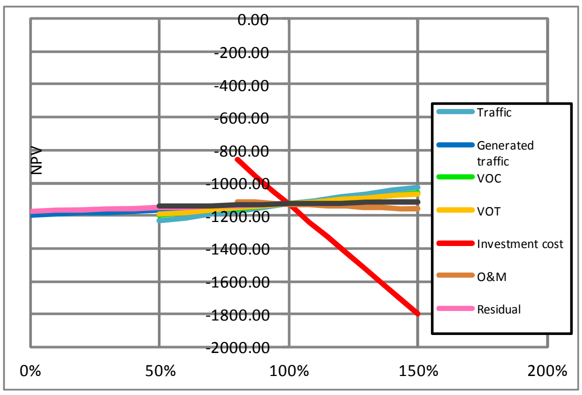
Cashflow: discounted



Sensitivity of EIRR



Sensitivity of NPV



Traffic

	EIRR	NPV
100%	0.67%	-1128.96
50%	-0.54%	-1231.64
60%	-0.28%	-1211.10
70%	-0.03%	-1190.57
80%	0.21%	-1170.03
90%	0.44%	-1149.50
100%	0.67%	-1128.96
110%	0.89%	-1108.42
120%	1.11%	-1087.89
130%	1.32%	-1067.35
140%	1.52%	-1046.82
150%	1.72%	-1026.28
Critical?		N

Generated traffic

	EIRR	NPV
100%	0.67%	-1128.96
0%	-0.09%	-1199.88
10%	-0.01%	-1192.79
20%	0.07%	-1185.70
30%	0.15%	-1178.61
40%	0.22%	-1171.51
50%	0.30%	-1164.42
60%	0.38%	-1157.33
70%	0.45%	-1150.24
80%	0.53%	-1143.14
90%	0.60%	-1136.05
100%	0.67%	-1128.96
Critical?		N

VOC

	EIRR	NPV
100%	0.67%	-1128.96
50%	-0.09%	-1194.85
60%	0.07%	-1181.67
70%	0.22%	-1168.49
80%	0.38%	-1155.32
90%	0.53%	-1142.14
100%	0.67%	-1128.96
110%	0.82%	-1115.78
120%	0.96%	-1102.60
130%	1.09%	-1089.43
140%	1.23%	-1076.25
150%	1.36%	-1063.07
Critical?		N

VOT

	EIRR	NPV
100%	0.67%	-1128.96
50%	-0.02%	-1190.49
60%	0.13%	-1178.19
70%	0.27%	-1165.88
80%	0.40%	-1153.57
90%	0.54%	-1141.27
100%	0.67%	-1128.96
110%	0.80%	-1116.65
120%	0.93%	-1104.35
130%	1.06%	-1092.04
140%	1.18%	-1079.73
150%	1.30%	-1067.43
Critical?		N

Investment cost

	EIRR	NPV
100%	0.67%	-1128.96
80%	1.25%	-860.50
87%	1.02%	-954.46
94%	0.82%	-1048.42
101%	0.65%	-1142.38
108%	0.49%	-1236.35
115%	0.35%	-1330.31
122%	0.23%	-1424.27
129%	0.11%	-1518.23
136%	0.01%	-1612.19
143%	-0.08%	-1706.16
150%	-0.17%	-1800.12
Critical?		Y

O&M + renewals

	EIRR	NPV
100%	0.67%	-1128.96
80%	0.79%	-1116.37
87%	0.75%	-1120.78
94%	0.71%	-1125.18
101%	0.67%	-1129.59
108%	0.63%	-1133.99
115%	0.58%	-1138.40
122%	0.54%	-1142.80
129%	0.50%	-1147.21
136%	0.46%	-1151.61
143%	0.42%	-1156.02
150%	0.38%	-1160.42
Critical?		N

Residual

	EIRR	NPV
100%	0.67%	-1128.96
0%	-1.28%	-1171.80
10%	-1.00%	-1167.52
20%	-0.75%	-1163.23
30%	-0.52%	-1158.95
40%	-0.31%	-1154.67
50%	-0.12%	-1150.38
60%	0.06%	-1146.10
70%	0.23%	-1141.81
80%	0.39%	-1137.53
90%	0.53%	-1133.24
100%	0.67%	-1128.96
Critical?		N

Accidents

	EIRR	NPV
100%	0.67%	-1128.96
50%	0.52%	-1144.09
60%	0.55%	-1141.07
70%	0.58%	-1138.04
80%	0.61%	-1135.01
90%	0.64%	-1131.99
100%	0.67%	-1128.96
110%	0.70%	-1125.93
120%	0.73%	-1122.91
130%	0.76%	-1119.88
140%	0.79%	-1116.85
150%	0.82%	-1113.83
Critical?		N

ANNEX 2: ROUTE SECTION SINGLE/DUAL STATUS

URS

SEETO Road Route 4

Investment Plan

Final - Traffic Modelling Report

August 2012

Prepared for: Ministry of Transport & Maritime Affairs, Montenegro

MONTENEGRO

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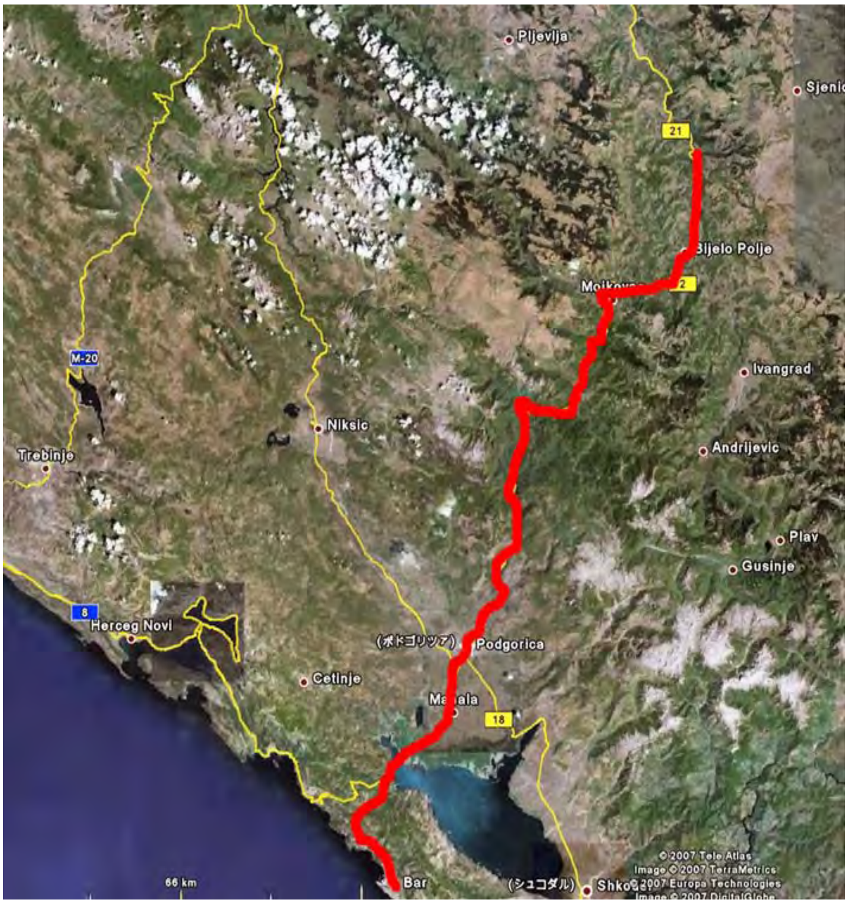

REVISION SCHEDULE					
Rev	**Date**	**Details**	**Prepared by**	**Reviewed by**	**Approved by**
1	July 2012	Draft	Ewa Skupinska Transport Planne	Philippe Perret Principal Consultant	Martin Edge Project Director
2	August 2012	Final		P Perret	Martin Edge

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TABLE OF CONTENTS

1 INTRODUCTION

The construction of the SEETO Road Route 4 connecting the Port of Bar with Corridor 10 in Serbia and extending to Romania and Hungary is seen as a necessary pre-requisite to stimulate the economic growth of Montenegro and to improve reliability and safety of road travel. Within Montenegro, the project will also provide an important connection between the north of the country, the capital Podgorica, and the Adriatic coast to the south. For the Government of Montenegro the project is therefore a priority infrastructure investment.

The present report is submitted as part of the documents comprising the Technical Options Report aiming to access the competing Technical Options for the exact alignment, road profile and grade of the proposed new road. The proposed Road Route 4 motorway is divided into the seven distinct sections:

- Section I: Djurmani – Virpazar;
- Section II: Virpazar – Farmaci;
- Section III: Farmaci - Smokovac (including Podgorica bypass);
- Section IV: Smokovac – Mateshevo;
- Section V: Mateshevo – Andrijevica;
- Section VI: Andrijevica – Berane – Poda; and
- Section VII: Poda – Boljare/Serbian border.

A strategic VISUM model of the Montenegrin road network has been used to identify the optimum layout of the new road link for each of the seven sections in turn as well as Route 4 as a whole. Base year and future year assessments of traffic levels and demand were additionally carried out as part of the study to identify the likely trends in traffic volumes on the Montenegrin road network in general and along Route 4 in particular. Future year demand forecasting was carried out for years 2020 and 2035 with a base model of 2012, to give an indication of demand changes over the next 23 years.

The present report outlines the process undertaken as part of the base model creation, including the data collection methodology and model calibration. It then outlines the process undertaken and the results obtained as part of the future year forecasting and scenario testing of the new road alignment, where detailed assessment of various layout options for each of the seven road sections and Route 4 as a whole were carried out.

1.1 Structure of the Report

The report discusses the traffic surveys that were carried out and the development of the traffic model, including model calibration. This report also focuses on the analysis of the future year assignments including scenario testing and gives conclusions and recommendations.

The remainder of this report will be structured as follows:

- Section 2 reviews the various types of traffic surveys that were undertaken as part of this study;
- Section 3 describes the development of the model base year highway networks;
- Section 4 describes the development of the model base year trip matrices;
- Section 5 discusses the procedures by which the base year model was calibrated and presents the results of a comparison of observed against modelled data for a variety of link flows;

- Section 6 details the development of the forecast year highway networks;
- Section 7 describes the development of the forecast year matrices;
- Section 8 describes the future year assignment process and results;
- Section 9 discusses the traffic outputs used in the economic evaluation model including annualisation factors; and
- Section 10 provides a summary and conclusions.

2 TRAFFIC SURVEYS

This chapter presents the methodology used for the traffic surveys carried out as part of the SEETO Road Route 4 study. This includes both the initial set of surveys carried out in 2007 by Louis Berger and the additional data collection exercise carried out by URS in 2012. It then presents some of the main findings from the analysis of the survey outputs.

2.1 Initial Data Collection

Road Side Interviews (RSI) were carried out at 16 locations by Louis Berger in October 2007, covering all strategic corridors and main roads in Montenegro. The purpose of these surveys was to provide specific information on the type of trips using the highway network within Montenegro, especially with regard to the origins and destinations of those trips.

This data was used as a key component in the development of trip matrices for the Route 4 study, in particular in the context of vehicle route choice. During the RSI surveys, a sample of vehicles was stopped on the roadside, and the vehicle driver asked certain questions pertinent to his trip.

The sample was then expanded into the total flow using traffic counts that were conducted simultaneously. The locations of the RSI's are illustrated in Figure 2.1.

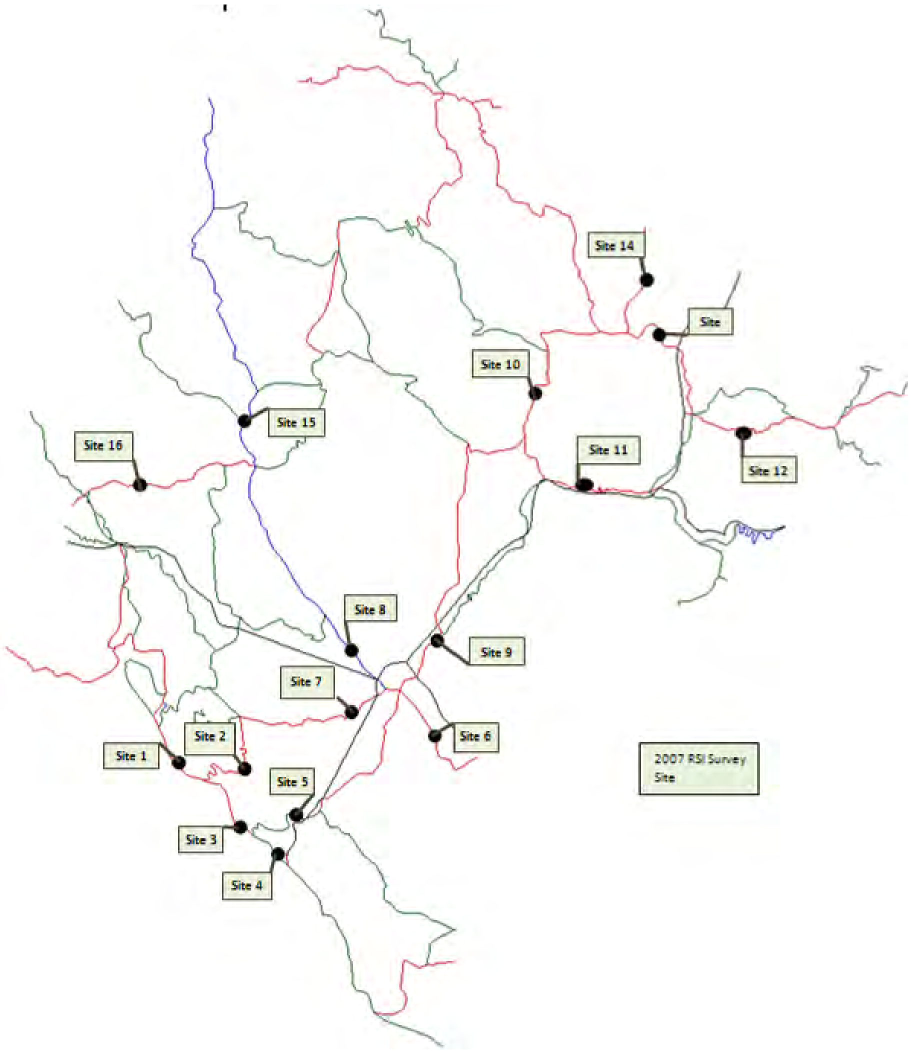
The RSI's were carried out by Louis Berger for a single day over a twelve hour period between 07:00 and 19:00, for both directions of traffic. During the interviews, the following data was collected:

- The vehicle classification: passenger car, light goods vehicle (LGV), medium or heavy goods vehicle (MGV, HGV), bus, or articulated lorry (artic);
- The number of occupants in the vehicle; Location where vehicle was registered;
- The origin and destination (OD) of the trip. municipality in Montenegro or country outside Montenegro;
- The trip origin purpose: home, work education, tourism (short and long), shopping or visiting friends or personal trips, others;
- The trip destination purpose: home, work education, tourism (short and long), shopping or visiting friends or personal trips, others; and
- Frequency of trip.

In addition to the RSI surveys, Manual Classified Counts (MCC's) were undertaken at each of the RSI stations, for the duration of the survey for 24 hours. The purpose of the MCC's was to allow the sample of traffic surveyed during the RSI's to be expanded to the total flow. This expansion is carried out by vehicle type, at that specific location.

Traffic Counts were undertaken at all locations for a period of one week, inclusive of the survey day for twelve hours each day. This was to determine average weekly flows for the RSI locations, and allow for any variations in traffic flows that may have occurred during the day of the RSI. Such variation can potentially take place if the RSI itself causes traffic disruption and diversion from the site.

Figure 2-1: Location of LB traffic surveys



Source: Louis Berger

2.2 2012 Traffic Surveys

Automated Traffic Count surveys were commissioned by URS in April 2012 to update the traffic volumes and demand levels identified during the 2007 RSI and MCC surveys. The surveys were carried out for a seven day period in April 2012 with vehicle volumes for cars, light good vehicles and heavy good vehicles recorded in both directions of travel. This period was chosen to undertake traffic data collection as considered relatively neutral, avoiding winter months and summer holiday periods.

The surveys were carried out at 13 locations across the national Montenegro road network. Where possible, the survey locations were chosen to coincide with the location of the RSI surveys carried out five years previously. The location of the sites is shown in Figure 2.2.

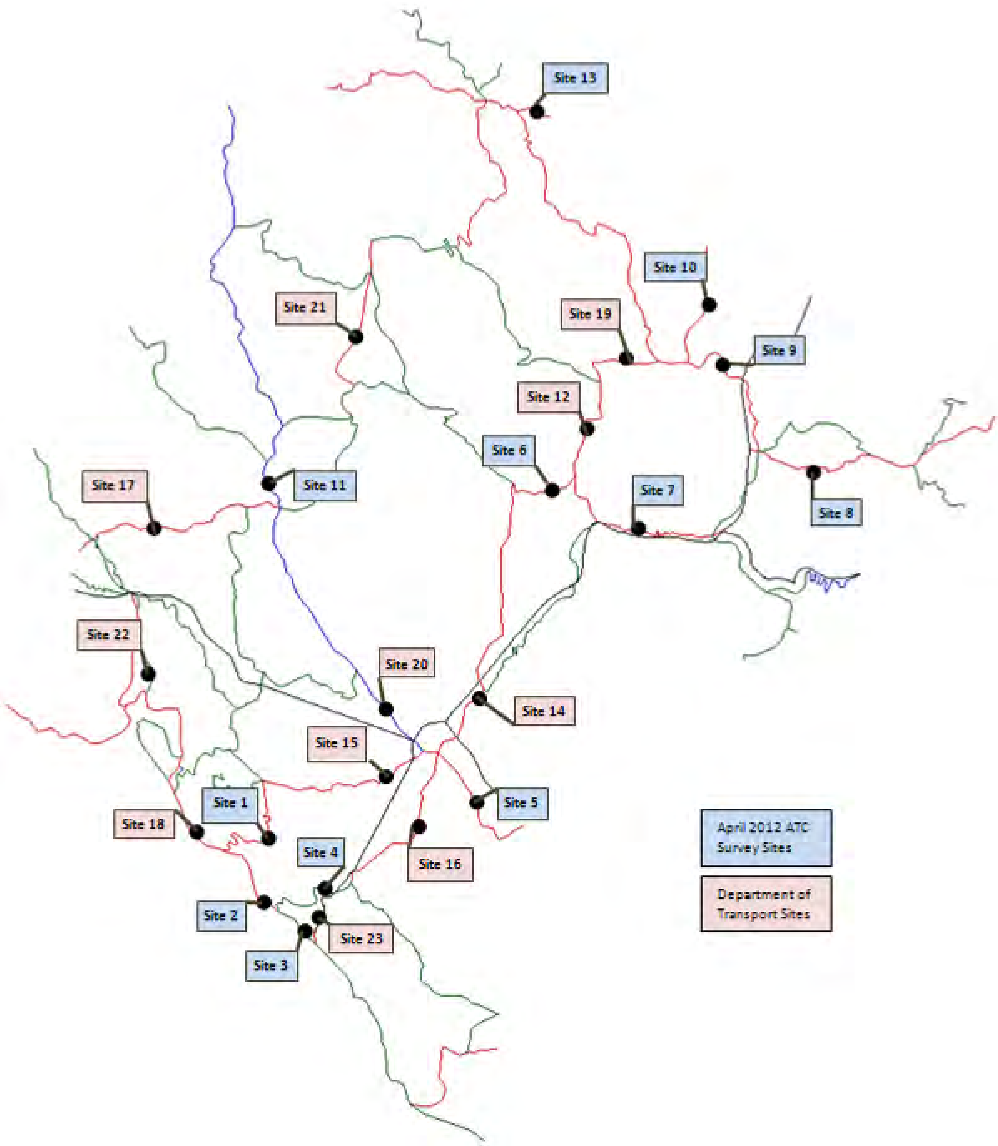
2.3 Additional Data Collection

Considerable volume of information has been collected through the RSI, MCC and ATC surveys. Secondary data was subsequently used to supplement the primary data collected.

Traffic data collected by the Montenegrin Road Directorate (Crnagoraput) at 10 different locations and data collected at the Sozina tunnel toll plaza (Monteput DDO) was made available to URS and was incorporated into the overall dataset for the subsequent inclusion into the calculation of the Annual Average Daily Traffic levels for each one of the total 23 sites.

The location of the 23 sites, identifying the URS-commissioned ATCs surveys as well as the data originating from Department of Transport counts is shown in Figure 2.2. The 23 sites include all of the 16 sites originally chosen as part of the RSI surveys carried out in 2007.

Figure 2-2: Location of LB traffic surveys



2.4 Traffic Volumes

In depth analysis of the data collected from RSI and ATC surveys as well as governmental historic data allowed for the calculation of the Annual Average Daily Traffic (AADT) flow levels across the key road links in Montenegro. This led to a number of conclusions being drawn in relation to traffic patterns across the country:

- The busiest site is on the coast between Budva and Tivat, with an AADT in excess of 11,000;
- Sites 5 and 20 to the east and west of Podgorica are also experiencing relatively high AADTs;
- Site 7 east of Matesevo and site 21 north of Savnik show a very low level of AADT, 192 and 719 respectively; and
- Car traffic makes a high proportion of the overall traffic flow, on average 85%. Site 7 experienced the highest levels of car traffic as proportion of overall flow at 97%. The lowest proportion of car traffic (76%) at site 6, west of Kolasin;

Figure 2-3: Observed AADT at count the 23 count locations

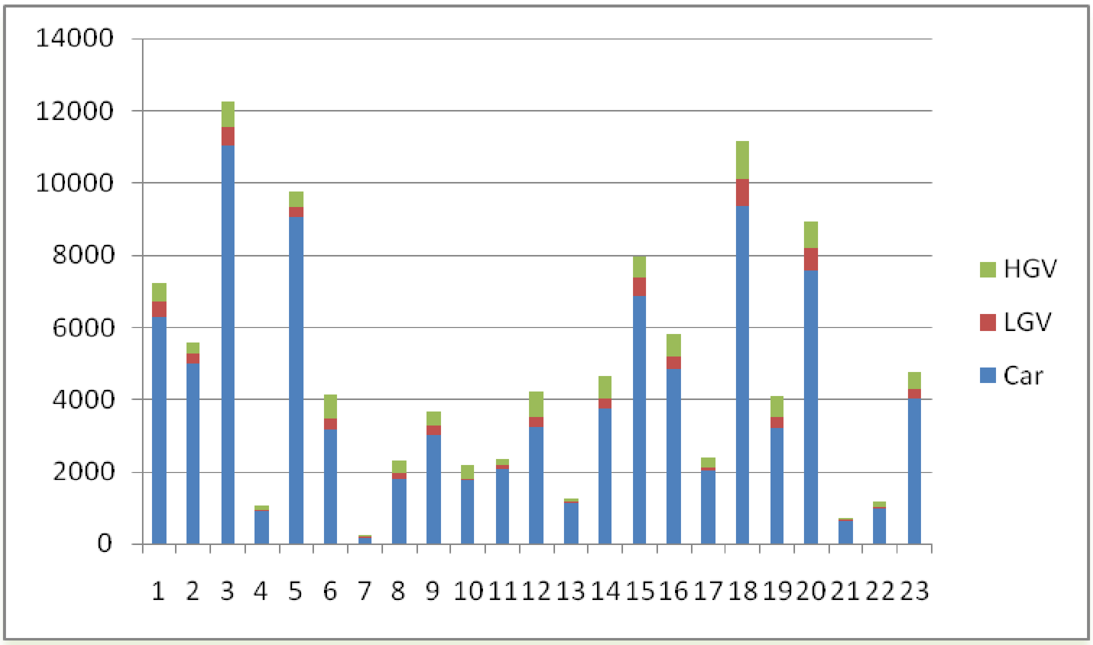


Figure 2.3 shows the percentage mode split for all sites. Three categories have been considered combining the various modes as follows:

- Passenger Car
- LGV (van, minibus and light truck)
- HGV (bus, medium truck and heavy truck with trailer)

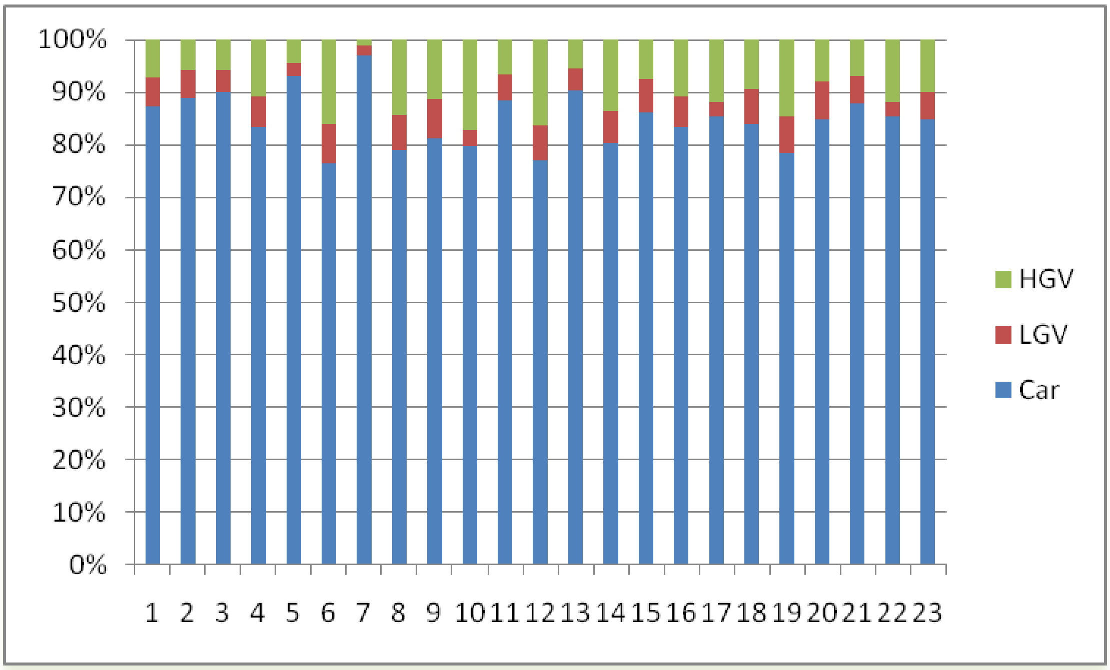
The chart shows that cars represent the largest proportion of the overall traffic. The chart also suggests that sites 3, 18, 5 and 20 experience highest AADT values in excess of 8,000. In contrast, sites 7, 21, 22 and 4 experience AADT values of less than 1,000.

The vehicle type split of traffic is shown in Figure 2.4. This suggests that on average cars represent about 85% of the overall traffic, with sites 5, 7 and 13 experiencing in excess of 90% car traffic. Lower proportion of car traffic was recorded at sites 6, 12 and 19.

There also tends to be more heavy goods vehicles (HGV) than light goods vehicles (LGV), with HGVs representing on average 10% of the overall traffic and LGVs representing 5% of the overall volumes.

Further analysis of the MCC and traffic count results can be found in **Appendix 1**. This includes the daily and weekly variations per site.

Figure 2-4: Observed mode split at LB traffic survey locations



Weekly profiles are relatively flat for most sites with an equal proportion of traffic using the road every day of the week. Exceptions are site 7 east of Matesevo, site 11 north of Niksic, site 13 east of Pljevlja and site 21 north of Savnik. At those four sites the Saturday and Sunday flows account for the highest levels of weekly traffic (in excess of 20%) with Tuesday and Wednesday significantly below average (below 10%). Daily profiles are usually similar across all sites showing low levels of traffic until 7:00 and showing peaks between 12:00 and 18:00.

Further analysis of the Road Directorate and Monteput DDO data provided for years 2009 to 2011 was undertaken to identify past traffic trends. This highlights that traffic has generally decreased at the surveyed locations over the last 3 to 4 years.

One of the main reasons cited for the possible reduction in traffic, in particular on the SEETO Route 4 corridor, includes the opening of two new sections of road, these are:

- New road link between Šavnik and Žabljak; and
- New road link between Lipci, Grahovo and Vilusi.

These sections have now created a second corridor from the Serbian border to the Montenegrin coast, acting as a competitor to the SEETO Route 4 corridor.

However, the widespread reduction suggests further causes. General traffic trends in Europe have shown a slow down in road travel. This seems to have also affected Montenegro and triggered reductions in traffic volumes. It is important however to realise the high seasonality of traffic in Montenegro, in particular on the coast, with traffic sometimes tripling in summer in comparison to winter.

Changes in freight traffic at Sozina Tunnel have also been analysed. It shown that heavy good vehicles using Sozina have started to reduce since 2009. This could possibly due to the opening of the 2 new routes listed above. This drop in heavy goods vehicles is likely to be reflected throughout the length of the SEETO Route 4 corridor.

2.5 Stated Preference Survey Analysis

A Stated Preference (SP) survey was carried out in 2008 to provide values of time of drivers of cars and freight vehicles within the framework of the then Bar – Boljare Motorway Project. Results of this survey can be found in the SP report, but the main conclusions are presented below.

Time and cost of travel are highly correlated in reality. Furthermore, the new motorway alternative which could be chosen does not yet exist. Therefore, computer assisted interviews were conducted with drivers travelling along the Bar – Boljare corridor. Assuming a hypothetical choice situation, drivers were asked to choose between the actual mountainous route and the proposed new motorway. Travel times were related to the actual trip of the interviewees. Using several different choice situations, travel times and toll levels were varied systematically between 6 and 12 eurocents per km for car drivers and up to 20 eurocents per km for drivers of freight vehicles.

In December 2008, 376 valid interviews were conducted on the Bar – Boljare corridor, north and south of Podgorica. Since the share of cars exceeds the share of freight vehicles interviewers explicitly tried to stop drivers of light goods vehicles (LGV ≤ 3.5 tons maximum gross weight) and heavy goods vehicles (HGV ≥ 7.5 tons) in order to allow for estimation of cost functions for both vehicle groups.

Almost all car trips (86%) and LGV trips (88%) had their origin and destination within Montenegro. Around 50% of the trips were lasting for less than 90 minutes and 120 minutes, respectively. Only HGV showed 50% of trips lasting longer than six hours. International traffic was travelling mainly between Montenegro and Serbia. Based on the collected information, the average speed was calculated to be around 60 km/h for cars, but only 46 km/h for LGV and HGV.

Most of the drivers of freight vehicles were in charge to decide whether to use a tolled motorway or not. Three quarters and two third of the drivers of LGV and HGV, respectively, stated that they were in charge to make that decision. Those who worked on their own account usually also owned the vehicle they drove whereas those who decided on behalf of their company usually did not own the vehicle they drove.

The willingness to pay for savings in travel time is almost 4 euro/h for drivers of cars, around 9.5 euro/h for drivers of LGV, and 16 euro for drivers of HGV . Though, for all three groups there is a willingness to pay for the motorway for other reasons, presumably for gains in safety. Almost all drivers agreed with the statement that ‘driving on the motorway would be much safer compared with the mountainous road’. Further, almost all of these drivers agreed with the statement that ‘the gain in safety would be almost completely due to avoiding some dangerous sections of the existing roads’.

The willingness to pay for the motorway is around 7 euro for drivers of cars and around 6 euro for drivers of LGV. For drivers of HGV the willingness to pay for the motorway is around 13 Euros. Sensitivity analysis showed that drivers of larger vehicles were often prepared to pay more than 20 cent per km regardless of savings in travel time. Therefore, the high willingness to pay for the motorway itself partly accounts for savings in travel time of the large vehicles.

The calculation of market shares of the motorway were demonstrated for cars, LGV, and HGV for different distances of trips. Results showed quite an elastic demand of cars and LGV whereas demand of HGV seemed to be rather price inelastic.

Most of the drivers disagreed with the statement 'the gains in safety would only occur in winter'. Therefore, the results can be assumed to have no seasonal bias.

The utility functions, implied values of time (VOT) and vehicle operating costs (VOC) are discussed later on in this report. Further details of the SP survey can be found in the SP survey report.

2.6 Analysis of freight traffic

As part of the Stated Preference (SP) survey, data on carried commodities was collected for a period of two days. Table 2.2 provides a breakdown of the sample by group of commodity carried and types of freight vehicles. The commodity groups are defined according to the Nomenclatures NST R described in detail in **Appendix 2**.

Analysis of Table 2.2 shows that LGV are rather used for the transport of agricultural goods and live animals while they are not used at all for crude minerals and building materials but rather for Manufactured Articles and Miscellaneous Goods.

HGV appear to be used for foodstuff and animal fodder, but otherwise there is no clear pattern suggesting that the transport industry is relying heavily on particular commodities.

TABLE 2.1: DISTRIBUTION OF TRIPS BY COMMODITY GROUP AND VEHICLE TYPE

Commodity Groups	Vehicle Type		Total
	LGV (<3.5T)	HGV (>7.5T)	
Agricultural Products and Live Animals	3	5	8
	12%	6%	8%
Foodstuffs and Animal Fodder	5	28	33
	20%	35%	32%
Solid Mineral Fuels	0	1	1
	0%	1%	1%
Petroleum Products	0	4	4
	0%	5%	4%
Ores and Metal Waste	1	4	5
	4%	5%	5%
Metal Products	4	7	11
	16%	9%	11%
Crude and Manufactured Minerals, Building Material	0	14	14
	0%	18%	14%
Fertilizers	0	3	3
	0%	4%	3%
Chemicals	1	2	3
	4%	3%	3%
Machinery, Transport Equipment, manufactured Articles and Miscellaneous	11	11	22
	44%	14%	21%
Total	**25**	**79**	**104**
	100%	**100%**	**100%**

3 NETWORK BUILDING

This chapter details the development of the base year VISUM network.

The main characteristics of the VISUM model developed are presented below. The model covers the whole of Montenegro with neighbouring countries treated as external zones. The main features of the model are:

- AADT model;
- 21 internal zones, based on Montenegrin municipalities and 9 external zones, representing neighbouring countries;
- 119 nodes;
- 288 links, covering a network of 2,160 kilometres of main and regional roads; and
- Three user classes, cars, light good vehicles and heavy good vehicles.

3.1 Zoning System

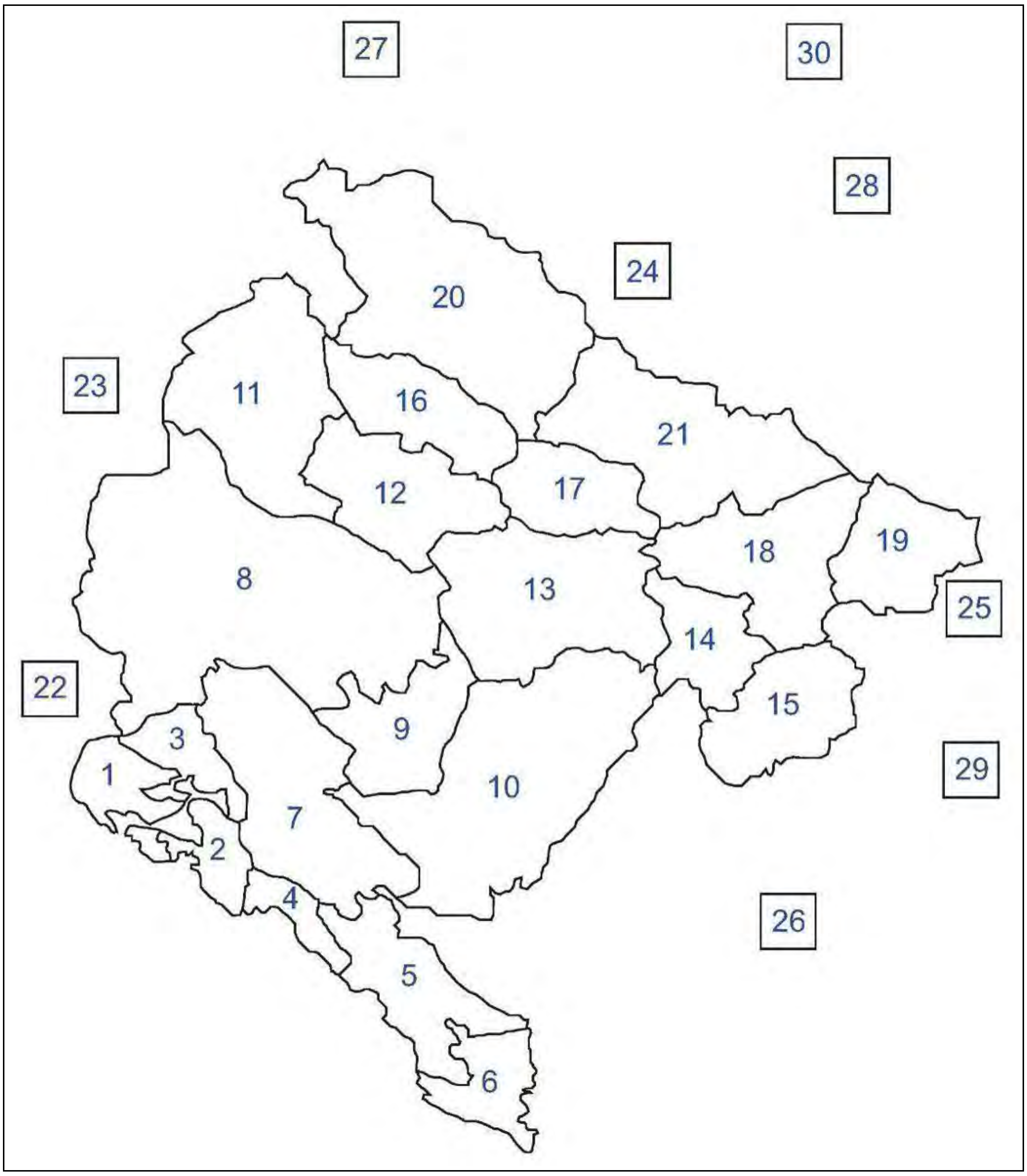
The zoning system used in the model is presented in Figure 3.1 with the full list of zones in Table 3.1. The model includes 21 internal zones (within Montenegro) and 9 external zones. The zoning system used suits the needs of the model as the municipality level is the most disaggregated level at which socio-economic data can be obtained in Montenegro.

TABLE 3.1: TRAFFIC MODEL ZONES

Internal Zones		External Zones	
Number	**Name**	**Number**	**Name**
1	Herceg Novi	22	Croatia
2	Tivat	23	Bosnia and Herzegovina
3	Kotor	24	Serbia
4	Budva	25	Kosovo
5	Bar	26	Albania
6	Ulcinj	27	Slovenia
7	Cetinje	28	Bulgaria and Romania
8	Nikšić	29	Macedonia
9	Danilovgrad	30	Europe and all other countries
10	Podgorica		
11	Plužine		
12	Šavnik		
13	Kolašin		
14	Andrijevica		

15	Plav		
16	Žabljak		
17	Mojkovac		
18	Berane		
19	Rožaje		
20	Pljevlja		
21	Bijelo Polje		

Figure 3 1: Traffic Model Zoning System



3.2 Network

The existing road network of Montenegro has (based on the official report of the Crnagoraput Company which is in charge of road maintenance) 845 km of main and 963 km of regional roads, shown in Figure 3.2, while there are approximately 5,000 km of minor roads. The network coverage as currently used is sufficient for the purpose of the study which focuses on strategic movements around Montenegro only.

The 2007 network has been checked for consistency and minor adjustments have been carried out to generate a 2012 network. It should be noted that existing tolls at the Sozina tunnel location are included in the base year model. The network was updated to include two new roads which have been constructed in the past five years. These include:

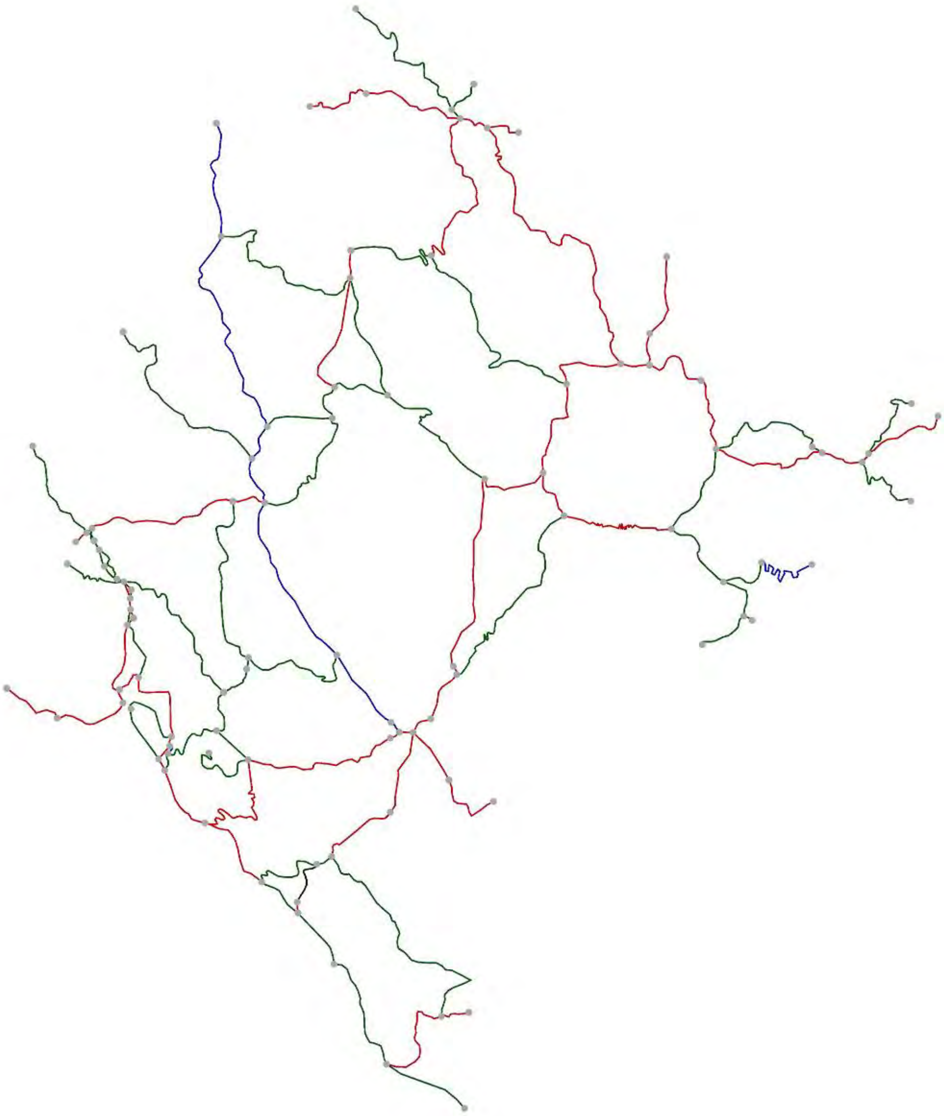
- New road link between Šavnik and Žabljak; and
- New road link between Lipci, Grahovo and Vilusi.

The modelled VISUM network represents the main and regional road roads, as shown in Figure 3.2.

Figure 3 2: Montenegrin strategic road network

Source: Crnagoraput

Figure 3-3: VISUM traffic model representation of the Montenegrin road network



The network characteristics coded for each link, per direction, include:

- Distance;
- Free flow speed;
- Capacity (in vehicles per day);
- Number of lanes; and
- Authorised vehicles classes.

The links are also associated with volume-delay curves to represent the reduction in speed as traffic volumes increase. Based on the above characteristics, the model uses the following curve to derive the loaded travel times:

$$T_{cur} = T_0 \times (1 + a \times SAT^b) \text{ with } SAT = \frac{q}{q_{max} \times c}$$

Where T_{cur} is the expected travel time on the loaded section, T_0 is the travel time at free flow, q is the traffic volume on the section, q_{max} the capacity of the section and a, b, c calibration parameters.

The assignment is carried out using an incremental equilibrium, an approach suited to relatively low traffic levels. In the base year, the minimum path is based purely on time, and is:

$$imp = VOT \times T_{cur}$$

Where T_{cur} is the expected travel time on the loaded section, VOT the value of time and imp the impedance of the path.

Connectors are used to connect the zones to the network. In the model each zones tends to have several loading points depending on the direction of travel. A few connectors have been adjusted to improve the loading but overall the coding of the speed flow curves was considered adequate. The assignment method, using incremental equilibrium is the best approach considering the low levels of flow expected on some sections of the network.

To facilitate the economic analysis, each link has also been allocated a road type (motorway, new single 2, main road, regional road) and terrain (flat, rolling, mountainous) , based on which accident rates and vehicle operating costs get appended during the economics calculations.

3.3 User Classes

Both the results from the SP survey and the network characteristics (including gradients: flat, rolling, mountainous) prompted the need three user classes as the vehicle operating costs would be different per vehicle type. The three categories have been considered combining the various modes as follows

- Passenger car;
- LGV: Van + Minibus + Light truck; and
- HGV: Bus + Medium truck + Heavy truck and heavy truck with trailer.

In order to accurately represent driving behaviours of the three categories included in the model, maximum travelling speeds have been capped for each user class:

- Passenger car – maximum 120 km/h;
- LGV – maximum 100 km/h; and
- HGV – maximum 80 km/h.

3.4 Impedance and Generalised Costs

Impedances are used in VISUM in order for the model to calculate the best route. The generalised costs for the impedance should be monetised. These were derived from the SP survey which produced perceived Value of Time (VOT) and Vehicle Operating Costs (VOC). These have been calculated for each user class. A slight adjustment to the SP values was carried out to convert the constant in a per km parameter. This was done assuming that the average travel time and distance were one hour and 60 kilometres respectively. A summary of assignment parameters (EUR per vehicle) are given below:

- imp_{Cars} = (3.94 x hour) + (0.057 x km) – (0.119 x motorway km) + (toll rate x km)
- imp_{LGV} = (9.17 x hour) + (0.128 x km) – (0.103 x motorway km) + (toll rate x km)
- imp_{HGV} = (9.17 x hour) + (0.240 x km) – (0.103 x motorway km) + (toll rate x km)

4 MATRIX DEVELOPMENT

This section provides details of the RSI data manipulation undertaken to build the trip matrices for the study and describes the methodology adopted in combining these data sources to obtain the prior matrix used for the calibration of the traffic model.

The creation of the base matrices for the 2012 base model was carried out using the data outputs of the data collection and surveys carried out in both 2007 and 2012. The RSI surveys carried out in 2007 were used as the main indicator of routing as well as origin and destination of drivers on the road network. Thus the proportion of traffic travelling between each O/D pair was derived from the RSI data gathered at the 16 sites across the Montenegrin road network.

2012 ATC surveys for 13 sites supplemented by the further 10 sites from the government-derived data for the same period were considered more relevant in the generation of more up-to-date traffic flows. The data from the 23 sites was therefore used as the key source of the actual demand levels and overall traffic volumes.

The two data sources were used concurrently to generate base matrices for 2012.

The AADT trip matrices have been built for the following three user classes:

- UC1: Cars;
- UC2: LGVs; and
- UC3: HGVs.

4.1 Roadside Interview Data Processing

The RSI data that was collected covers 16 sites around Montenegro as noted in chapter 2. Table 4.1 shows that the percentage of drivers interviewed averages at 10% of all drivers which is deemed representative of the overall traffic.

Sites 11 and 14 show low returns, below 5% and more interviews would have improved these sites. Furthermore, the sample sizes in absolute terms appear to be very low at some sites such as for example sites 5, 11, 15 and 16 but this is not considered as a major issue as these sites make a very small percentage of the traffic movements observed in the country.

The data collected during the RSIs relating to approximately 10% of all traffic was subsequently expanded using the AADT traffic volumes to arrive at a complete O/D matrix for all traffic.

TABLE 4.1 PERCENTAGE DRIVERS INTERVIEWED AT THE RSI SITES

Site	Car		LGV		HGV		Total		
	AADT	Inter-viewed	AADT	Inter-viewed	AADT	Inter-viewed	AADT	Inter-viewed	% Inter-viewed
1	11,233	1,312	1,995	233	1,096	128	14,324	1,673	11.7%
2	5,387	672	970	121	457	57	6,814	850	12.5%
3	4,852	575	684	81	624	74	6,160	730	11.9%
4	6,693	503	1,503	113	1,011	76	9,207	692	7.5%
5	588	79	97	13	193	26	878	118	13.4%

6	7,302	849	1,066	124	602	70	8,970	1,043	11.6%
7	9,968	973	1,127	110	492	48	11,586	1,131	9.8%
8	9,610	701	1,577	115	1,248	91	12,435	907	7.3%
9	4,231	346	721	59	1,198	98	6,151	503	8.2%
10	5,381	465	1,169	101	868	75	7,417	641	8.6%
11	534	18	59	2	30	1	623	21	3.4%
12	3,228	373	589	68	87	10	3,903	451	11.6%
13	4,357	331	724	55	158	12	5,239	398	7.6%
14	8,983	363	1,361	55	1,138	46	11,482	464	4.0%
15	1,154	97	226	19	83	7	1,463	123	8.4%
16	840	108	233	30	280	36	1,354	174	12.9%

In total 16 matrices per vehicle class have been created. These 16 matrices were then combined for each vehicle class thus creating three RSI combined matrices.

As the RSIs form barriers across the network, it is possible to cross several RSI points to go from one origin to a destination thus introducing double counting when carrying out the surveys. Double counting was addressed by dividing the combined RSI matrix by the number of times an RSI point needs to be crossed to from one origin to one destination.

For example, to travel from the Serbian border to Podgorica, there is a need to pass through 3 RSI sites: 14, 10 and 9. Hence the observed movements through the RSI needed to be divided by three. This double counting matrix is given in **Appendix 3**.

Table 4.2 shows that the impact of double counting removal on the matrix totals.

TABLE 4.2 IMPACT OF DOUBLE COUNTING REMOVAL

	RSI Combined Matrix	Combined Matrix, double-counting removed
Car	74,219	56,133
LGV	4,780	3,509
HGV	7,884	5,018

4.2 AADT Volume Calculations

Annual Average Daily Traffic (AADT) volume calculations were carried out to derive an AADT value for each of the 13 sites where ATC data was collected. Furthermore, AADT values were calculated for the 10 sites were governmental traffic volume data was made available to URS. The resulting set of 23 sites was used to generate AADT values based on April 2012 traffic volumes at various locations across the network.

The AADT values were generated separately for car, LGV and HGV vehicle types, using governmental data to derive the yearly variation in traffic levels as compared to April, the data for which was collected during the surveys.

Four factors were calculated to convert the traffic counts to AADT flows:

- Daily traffic distribution factor (12h to 24h conversion);
- Weekly traffic distribution factor (day to average day of the week factor for the counting week);
- Monthly traffic distribution factor (from an average weekday of counting week to average weekday of the month); and
- Annual traffic distribution factor (from the April month to average month).

The daily distribution factor was derived directly from the 24h counts carried out at all 23 site locations. 24-hour traffic totals were available for one week in April 2012. These were taken to be representative of all weeks in April of that year.

Data derived from governmental statistics for eight of the surveyed sites included monthly traffic flow variations for 2011. This data was ultimately used to derive traffic volume fluctuations per month and thus allowed for the generation of average monthly volumes at the 23 locations. A further calculation allowed for the identification of the AADT for each of the sites and for each vehicle type. The generated AADT values are summarised in Table 4.3.

TABLE 4.3 PERCENTAGE DRIVERS INTERVIEWED AT THE RSI SITES

Site		Average Daily Traffic			Factors		
Number	Location/Road Section	Weekly	Monthly	Annually	Weekly	Monthly	Annually
1	Budva-Cetinje	6707	6676	7224	1.000	0.995	1.082
2	Budva-Petrovac	5202	5177	5603	1.000	0.995	1.082
3	Petrovac-Bar	11387	11322	12252	1.000	0.994	1.082
4	Virpazar-Petrovac	996	991	1072	1.000	0.994	1.082
5	Podgorica-Tuzi	9070	9013	9754	1.000	0.994	1.082
6	Crkvine-Kolasin	3855	3844	4160	1.000	0.997	1.082
7	Matesevo-Kraljske Bare	175	177	192	1.000	1.013	1.082
8	Berane-Rozaje	2130	2122	2296	1.000	0.996	1.082
9	Ribarevine Interchange	3424	3407	3687	1.000	0.995	1.082
10	Bijelo Polje-Border	2042	2030	2196	1.000	0.994	1.082
11	Niksic-Jasenovo Polje	2166	2185	2365	1.000	1.009	1.082
12	Kolasin-Majkovac	3900	3887	4206	1.000	0.997	1.082
13	Pljevlja-Border	1176	1174	1270	1.000	0.998	1.082
14	Podgorica-Kolasin	4907	4301	4654	1.000	0.877	1.082
15	Podgorica-Cetinje	8460	7361	7966	1.000	0.870	1.082
16	Virpazar-Podgorica	6129	5371	5812	1.000	0.876	1.082
17	Vilusi-Niksic	2469	2203	2384	1.000	0.892	1.082

18	Tivat-Budva	11654	10314	11162	1.000	0.885	1.082
19	Mojkovac-Ribarevina	4195	3799	4111	1.000	0.905	1.082
20	Danilovgrad-Podgorica	8919	8251	8928	1.000	0.925	1.082
21	Savnik-Zabljak	834	664	719	1.000	0.796	1.082
22	Lipci-Vilusi	1229	1077	1165	1.000	0.876	1.082
23	Sozina Tunnel	4411	4411	4773	2.000	1.000	1.082

The AADT factors were applied to the RSI data extracted from the Roadside Interview surveys. The data was then entered into the model at the relevant locations within the network. This resulted in a Prior matrix being generated.

Copies of the final prior matrix for each vehicle class are given in **Appendix 4** with and without intrazonals. These correspond to the corrected observed movements.

An analysis of these matrices suggests the following:

- The matrices have a high percentage of intrazonal trips;
- The key trip generators for cars and LGVs are Podgorica (excluding intrazonals) followed by Budva and Niksic. LGV trips appear to be more spread across the matrix than cars;
- HGV trips originating in Serbia and likely to use the SEETO Route 4 corridor are relatively high, backing up the fact that the Route 4 is a strategic corridor.

5 CALIBRATION

This chapter presents the calibration exercise carried out to ensure good fit of the modelled flows to observed flows.

5.1 Matrix Estimation

The process of combining the trip matrices from the various sources, as discussed in Section 4, produces what is called a 'prior' matrix. This is effectively a first estimate of what the matrix is likely to contain. The next step is to assign this prior matrix onto the coded network, and use Matrix Estimation (ME2) techniques to calibrate the matrix.

ME2 is required to ensure that the trip matrices are reproducing, within defined limits, a set of observed conditions, when they are assigned to the model networks. During matrix estimation, adjustments are made to the trip matrices to improve the degree of match between the observed and modelled data.

ME2 is undertaken with the TFLOWFUZZY module within VISUM. This module takes as inputs target traffic counts at various locations within the network. The module then seeks to undertake minimum revisions to the matrix so that it matches these user defined link flows as much as possible.

5.2 Calibration Results

The two directional observed counts at the 23 ATC locations derived from URS surveys and governmental data were used as input controls for the ME2 procedure.

The calibration results have been assessed by comparing the observed and modelled (assigned) flows at all of the locations used as input to the matrix estimation process. The generally accepted main indicator for the goodness of fit is the GEH statistic, which is defined as:

$$\text{GEH} = \sqrt{\frac{(\text{modelled flow - observed flow})^2}{0.5 \times (\text{observed flow} + \text{modelled flow})}}$$

The GEH calculation takes into account the percentage change between modelled and observed flow values as proportion of the overall flow on a given link. A GEH value between zero and five is considered a good fit between observed and modelled values, with a GEH value between five and ten considered acceptable only if the majority of links in the network have a GEH value of less than five. GEH values in excess of ten are considered too great, indicating that the difference between modelled and observed values is too high.

5.3 Model Calibration

A total of 23 points, corresponding to the counts shown in Figure 2.2, were chosen for ME2. All three user classes were subject to matrix estimation to improve the fit to observed counts. It is generally considered acceptable that 85% of all links analysed should have a GEH value of five or less.

Table 5.1 shows the results when the prior matrix is assigned to the network. It shows that apart from sites 14, 15, 16 and 21, the modelled flows are far from the observed AADT. For the other sites, modelled flows are lower than observed, this can be explained by the number of intrazonal (local) trips recorded at all sites, that the model does not assign specifically.

TABLE 5.1: GEH RESULTS PRIOR TO MATRIX ESTIMATION

SITE	LINK	FROM	TO	MODELLED				OBSERVED				GEH			
				CAR	LCV	HCV	SUM	CAR	LCV	HCV	SUM	CAR	LCV	HCV	SUM
6	1	101	102	1286	91	233	1610	1590	155	334	2080	8.0	5.8	6.0	10.9
6	1	102	101	1138	126	248	1512	1590	155	334	2080	12.7	1.7	3.1	12.9
19	3	105	106	1013	79	208	1300	1609	146	300	2055	16.5	6.3	5.8	18.4
19	3	106	105	724	70	227	1021	1609	146	300	2055	25.9	7.3	4.5	26.4
18	7	112	113	3310	233	187	3730	4685	367	528	5581	21.8	7.7	18.0	27.1
18	7	113	112	3366	281	324	3971	4685	367	528	5581	20.8	4.8	9.9	23.3
13	25	137	138	110	9	12	131	574	27	34	635	25.1	4.3	4.7	25.8
13	25	138	137	99	13	125	237	574	27	34	635	92.2	13.4	7.1	91.8
5	33	149	151	285	13	97	395	4535	124	218	4877	86.6	13.4	9.6	87.3
5	33	151	149	145	2	4	151	4535	124	218	4877	90.7	15.4	20.3	94.3
7	47	162	167	475	28	125	628	93	2	1	96	22.7	6.8	15.6	28.0
7	47	167	162	668	50	112	830	93	2	1	96	12.9	1.1	3.3	11.1
11	65	180	182	275	33	153	461	1045	58	79	1182	30.0	3.7	6.8	25.2
11	65	182	180	237	25	70	332	1045	58	79	1182	45.4	12.5	19.1	50.8
12	79	102	105	1200	89	217	1506	1619	138	345	2103	11.2	4.6	7.7	14.1
12	79	105	102	861	88	237	1186	1619	138	345	2103	0.5	7.0	3.3	2.6
10	87	191	192	662	36	186	884	875	33	190	1098	7.7	0.5	0.3	6.8
10	87	192	191	523	36	226	785	875	33	190	1098	50.7	11.7	4.6	47.6
2	100	194	195	1351	65	163	1579	2492	148	162	2801	26.0	8.0	0.1	26.1
2	100	195	194	2078	120	83	2281	2492	148	162	2801	8.7	2.4	7.1	10.3
8	110	143	161	555	50	46	651	906	78	164	1148	13.0	3.5	11.5	16.6
8	110	161	143	672	53	127	852	906	78	164	1148	33.6	9.1	12.5	37.0
14	121	109	132	1689	179	366	2234	1872	142	313	2327	4.3	2.9	2.9	1.9
14	121	132	109	2075	171	413	2659	1872	142	313	2327	21.1	2.0	8.2	17.0
1	125	185	195	2137	114	71	2322	3151	198	263	3612	19.7	6.7	14.8	23.7
1	125	195	185	2809	163	90	3062	3151	198	263	3612	6.3	2.6	13.0	9.5
9	130	142	200	861	83	172	1116	1499	137	208	1844	18.6	5.1	2.6	18.9
9	130	200	142	772	68	20	860	1499	137	208	1844	84.6	15.0	24.2	89.1
3	137	133	204	3211	173	378	3762	5519	259	348	6126	34.9	5.9	1.6	33.6
3	137	204	133	4577	283	340	5200	5519	259	348	6126	13.3	1.4	0.4	12.3
23	147	203	208	1860	108	179	2147	2021	126	239	2387	3.7	1.7	4.2	5.0
23	147	208	203	2499	163	221	2883	2021	126	239	2387	10.0	3.1	1.2	9.7
4	149	194	208	0	0	36	36	447	31	58	536	29.9	7.8	3.2	29.6
4	149	208	194	0	0	36	36	447	31	58	536	29.9	7.8	3.2	29.6
15	152	121	185	3514	231	287	4032	3429	259	295	3983	1.5	1.8	0.5	0.8
15	152	185	121	3063	257	354	3674	3429	259	295	3983	49.3	18.6	10.0	52.7
20	154	104	123	3737	189	167	4093	3779	323	362	4464	0.7	8.4	12.0	5.7
20	154	123	104	4456	443	582	5481	3779	323	362	4464	10.6	6.1	10.1	14.4
16	158	151	209	2499	163	311	2973	2428	164	314	2906	1.4	0.1	0.2	1.2
16	158	209	151	1860	108	280	2248	2428	164	314	2906	12.3	4.8	2.0	13.0
17	159	116	210	1218	99	190	1507	1019	31	143	1192	6.0	8.5	3.6	8.6
17	159	210	116	1279	140	165	1584	1019	31	143	1192	7.7	11.8	1.8	10.5
22	172	212	213	718	79	91	888	498	15	70	583	8.9	9.3	2.4	11.3
22	172	213	212	644	56	158	858	498	15	70	583	6.1	6.9	8.3	10.3
21	191	172	175	353	51	122	526	316	18	25	359	2.0	5.6	11.3	7.9
21	191	175	172	297	19	51	367	316	18	25	359	1.1	0.2	4.2	0.4
MEAN												22.7	6.4	7.1	24.1
Percentage of links with a GEH value of more than 5%												83%	59%	50%	89%

Table 5.2 shows the results following matrix estimation. The results show that a high level of calibration has been achieved on the existing links, for both directions of movements for most sites.

TABLE 5.2: GEH RESULTS FOLLOWING MATRIX ESTIMATION

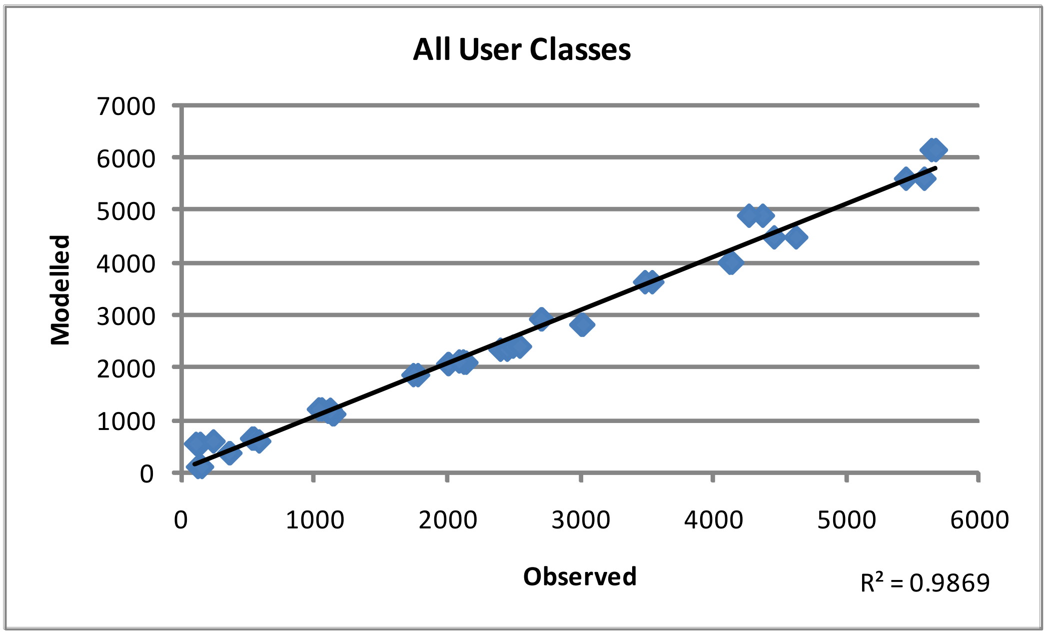
SITE	LINK	FROM	TO	MODELLED				OBSERVED				GEH			
				CAR	LCV	HCV	SUM	CAR	LCV	HCV	SUM	CAR	LCV	HCV	SUM
6	1	101	102	1671	135	315	2122	1590	155	334	2080	2.0	1.7	1.1	0.9
6	1	102	101	1675	141	324	2140	1590	155	334	2080	2.1	1.2	0.6	1.3
19	3	105	106	1576	135	299	2009	1609	146	300	2055	0.8	1.0	0.1	1.0
19	3	106	105	1577	129	297	2003	1609	146	300	2055	0.8	1.5	0.2	1.2
18	7	112	113	4657	343	446	5446	4685	367	528	5581	0.4	1.3	3.7	1.8
18	7	113	112	4760	357	467	5584	4685	367	528	5581	1.1	0.5	2.7	0.0
13	25	137	138	486	20	24	529	574	27	34	635	3.8	1.5	1.9	4.4
13	25	138	137	489	19	37	545	574	27	34	635	3.7	1.7	0.4	3.7
5	33	149	151	4079	92	197	4369	4535	124	218	4877	6.9	3.1	1.5	7.5
5	33	151	149	4041	82	143	4266	4535	124	218	4877	7.5	4.2	5.6	9.0
7	47	162	167	117	3	3	123	93	2	1	96	2.3	0.8	1.3	2.6
7	47	167	162	147	3	3	153	93	2	1	96	4.9	0.8	1.3	5.1
11	65	180	182	981	54	86	1120	1045	58	79	1182	2.0	0.5	0.7	1.8
11	65	182	180	980	43	94	1117	1045	58	79	1182	2.0	2.1	1.6	1.9
12	79	102	105	1675	139	304	2118	1619	138	345	2103	1.4	0.0	2.3	0.3
12	79	105	102	1638	132	317	2087	1619	138	345	2103	0.5	0.6	1.6	0.4
10	87	191	192	905	37	192	1134	875	33	190	1098	1.0	0.7	0.2	1.1
10	87	192	191	894	37	217	1147	875	33	190	1098	0.6	0.7	1.9	1.5
2	100	194	195	2714	131	159	3005	2492	148	162	2801	4.4	1.4	0.2	3.8
2	100	195	194	2735	140	144	3019	2492	148	162	2801	4.8	0.6	1.4	4.0
8	110	143	161	895	75	130	1100	906	78	164	1148	0.4	0.4	2.8	1.4
8	110	161	143	896	74	147	1117	906	78	164	1148	0.3	0.5	1.3	0.9
14	121	109	132	1911	162	324	2397	1872	142	313	2327	0.9	1.6	0.6	1.4
14	121	132	109	1937	159	351	2448	1872	142	313	2327	1.5	1.3	2.1	2.5
1	125	185	195	3148	176	214	3538	3151	198	263	3612	0.1	1.6	3.1	1.2
1	125	195	185	3101	187	196	3484	3151	198	263	3612	0.9	0.8	4.4	2.2
9	130	142	200	1438	131	207	1777	1499	137	208	1844	1.6	0.5	0.1	1.6
9	130	200	142	1462	128	152	1743	1499	137	208	1844	1.0	0.8	4.2	2.4
3	137	133	204	4970	267	400	5638	5519	259	348	6126	7.6	0.5	2.7	6.4
3	137	204	133	4991	280	399	5670	5519	259	348	6126	7.3	1.3	2.7	5.9
23	147	203	208	2115	136	241	2492	2021	126	239	2387	2.1	0.9	0.1	2.1
23	147	208	203	2163	139	240	2543	2021	126	239	2387	3.1	1.1	0.0	3.1
4	149	194	208	141	0	0	141	447	31	58	536	17.8	7.8	10.8	21.5
4	149	208	194	92	1	15	108	447	31	58	536	21.6	7.5	7.2	23.9
15	152	121	185	3530	269	322	4121	3429	259	295	3983	1.7	0.6	1.5	2.2
15	152	185	121	3525	270	344	4139	3429	259	295	3983	1.6	0.7	2.7	2.4
20	154	104	123	3863	294	299	4455	3779	323	362	4464	1.4	1.7	3.5	0.1
20	154	123	104	3901	347	372	4620	3779	323	362	4464	2.0	1.3	0.5	2.3
16	158	151	209	2255	141	314	2710	2428	164	314	2906	3.6	1.9	0.0	3.7
16	158	209	151	2256	136	310	2702	2428	164	314	2906	3.6	2.3	0.2	3.9
17	159	116	210	966	17	72	1055	1019	31	143	1192	1.7	2.8	6.9	4.1
17	159	210	116	976	17	38	1032	1019	31	143	1192	1.3	2.8	11.0	4.8
22	172	212	213	209	11	19	239	498	15	70	583	15.4	1.1	7.6	17.0
22	172	213	212	513	17	52	583	498	15	70	583	0.7	0.5	2.3	0.0
21	191	172	175	315	22	29	366	316	18	25	359	0.1	0.9	0.7	0.3
21	191	175	172	305	21	30	357	316	18	25	359	0.6	0.6	0.9	0.1
MEAN												3.3	1.5	2.4	3.7
Percentage of links with a GEH value of more than 5%												22%	6%	19%	25%

The mean GEH values for the three user classes are 3.7 or less, and 75% of the links result in a GEH value of less than five. Although this is slightly below the 85% target, this is expected due to the very large number of sites used as part of the calibration process and the very low traffic volumes observed affecting the performance of the GEH criterion. In addition, a single site – Site 4 along the old road between Virpazar and Petrovac – is responsible for the increased overall GEH average for the whole network. The low attractiveness of this route when compared with the parallel Sozina Tunnel results in low vehicle volumes which it was not possible to reproduce within the model using the TFlow Fuzzy technique.

Sites 3, 5, 17 and 22 also display some GEH values in excess of 5 with the Car user class in particular experiencing higher than desired GEH values. This is not considered a significant problem as none of these sites lie along the studied SEETO Route 4 corridor. Elsewhere in the network the GEH values are very low, suggesting a good fit between observed and modelled flows.

A graphical representation of the correlation between observed and modelled flow is given in Figure 5.1. It shows a high level of correlation with a R-square of 0.99, confirming that the model properly represents observations.

Figure 5-1: Observed v's Modelled Flows Correlation



5.4 Regression Analysis

In order to ensure that the integrity of the matrices has not been materially jeopardised due to the ME2 process, a regression analysis has been carried out for the three different user classes. The analysis compares the pre and post ME2 trips within the zones.

Figures 5.2 to 5.4 illustrate the regression analysis for the three different user classes. These show that the prior demand tended to underestimate the demand and the matrix estimation adjusted this to the higher observed demand. This can be explained by the need for the demand to increase to match observed flows at the validation points as the intrazonal demand is not assigned.

Figure 5-2: Regression Analysis for Car Demand

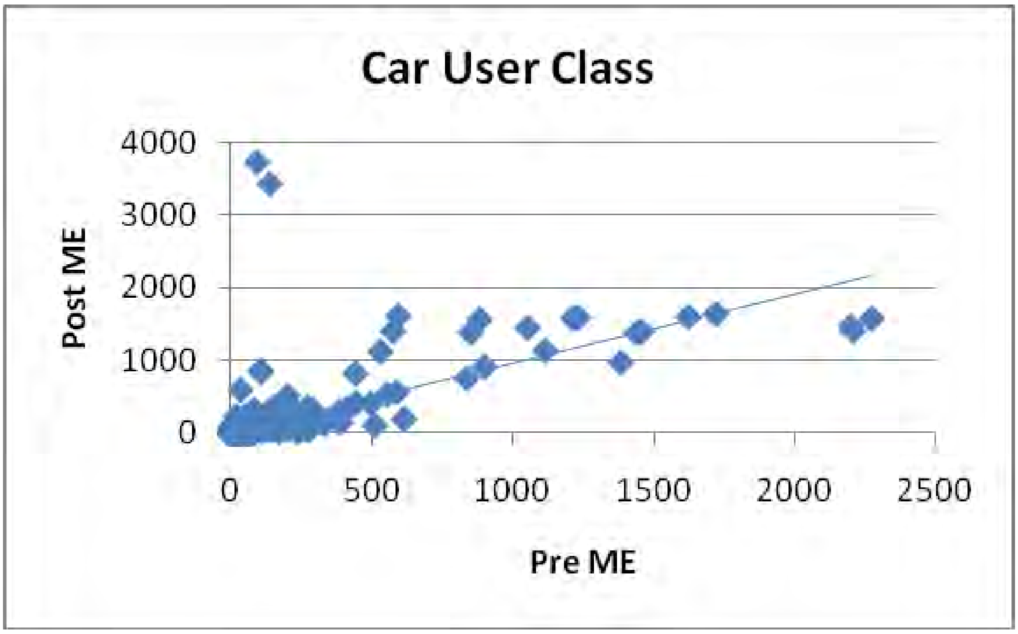


Figure 5-3: Regression Analysis for LGV Demand

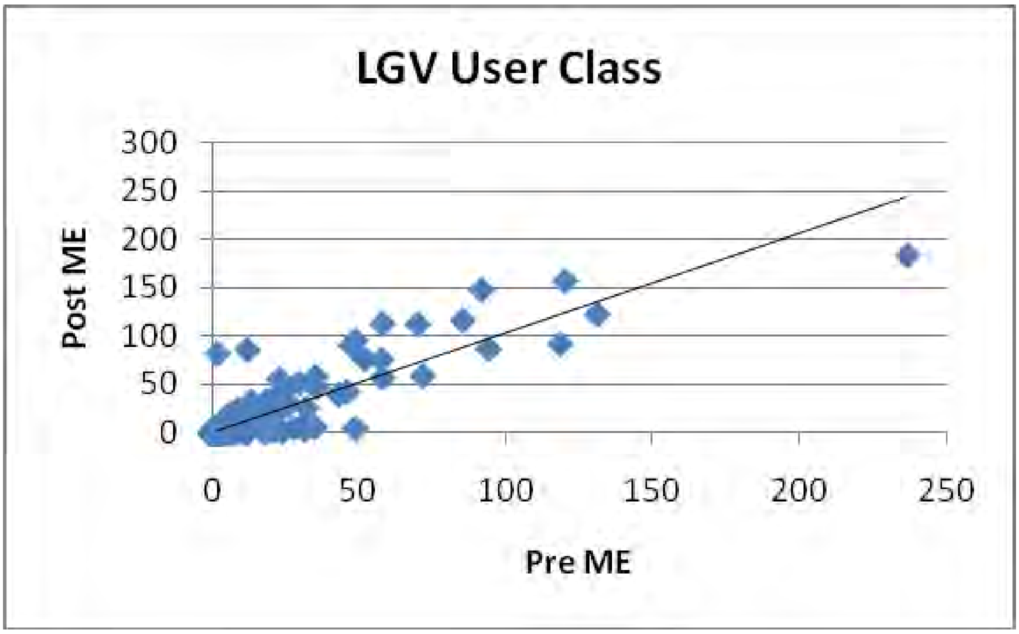
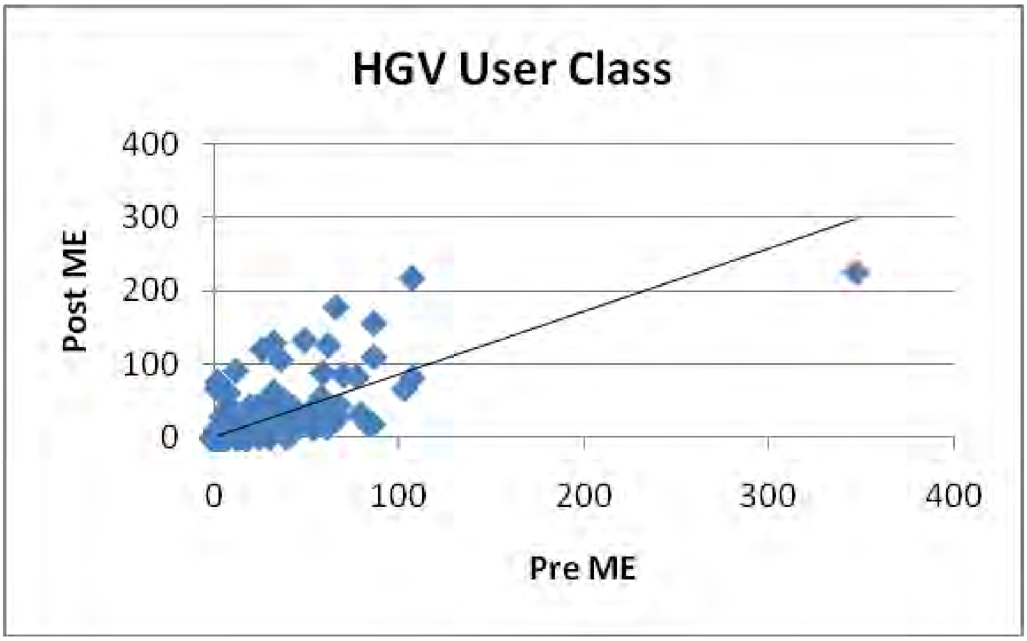


Figure 5-4: Regression Analysis for HGV Demand



5.5 Estimated Matrices

As the calibration-validation process produced satisfactory results, the 'estimated' matrices are considered to be the base year matrices for cars, LGVs and HGVs and totals are as shown in Table 5.2. Copies of the final estimated matrix for each vehicle class are given in **Appendix 5** with and without intrazonals.

TABLE 5.2: PRIOR AND ESTIMATED MATRIX TOTALS

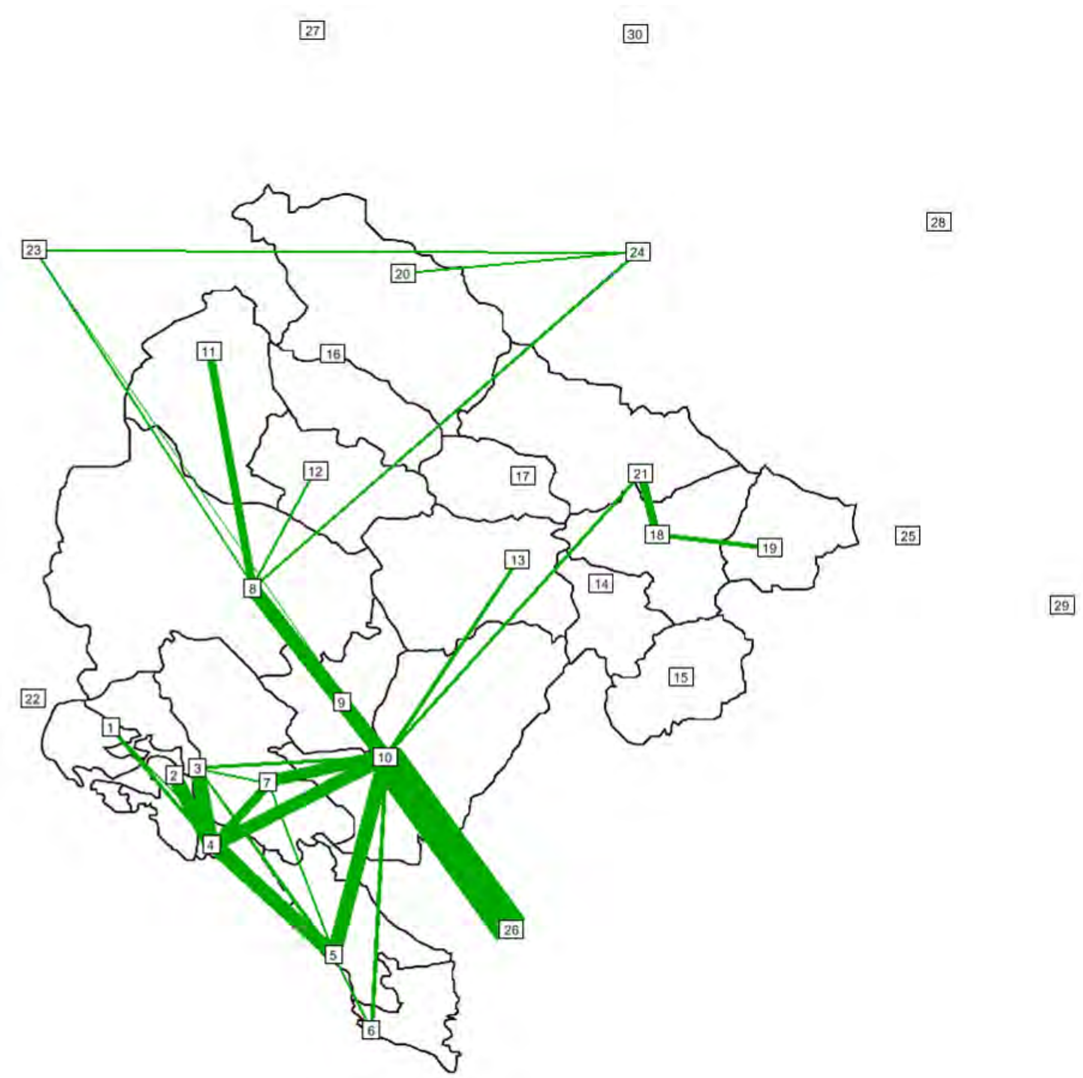
Vehicle Class	Prior		Estimated	
	Total	Intrazonal	Total	Intrazonal
CAR	56,133	44,238	78,926	54,899
LGV	3,509	2,920	4,129	3436
HGV	5,018	4,217	5,245	4409

5.6 Desire Lines and Matrix Based Analysis

Desires lines show the origin-destination movements spatially. The figures below show the main origin-destination movements, post matrix estimations for the three user classes. It should be noted that only the main movements are represented to avoid overloading, hence no representation does not necessarily mean no demand.

Figure 5.5 shows that there are several main corridors of attraction for car. These include the movement along the coastline between Kotor and Bar, the movement between Niksic and Podgorica, Podgorica and the Albanian border as well as the movement between Podgorica and the coastal towns of Budva and Bar. Desire lines in the north of the country and across the northern national borders are a lot less pronounced suggesting a lower demand for travel in these regions.

Figure 5-5: Desire lines for car demand



A specific analysis was undertaken to assess the level of international traffic observed on the Montenegrin road network. Table 5.3 presents the results for cars.

TABLE 5.3 DISTRIBUTION OF INTERNATIONAL CAR TRAFFIC ON MONTENEGRIN ROADS

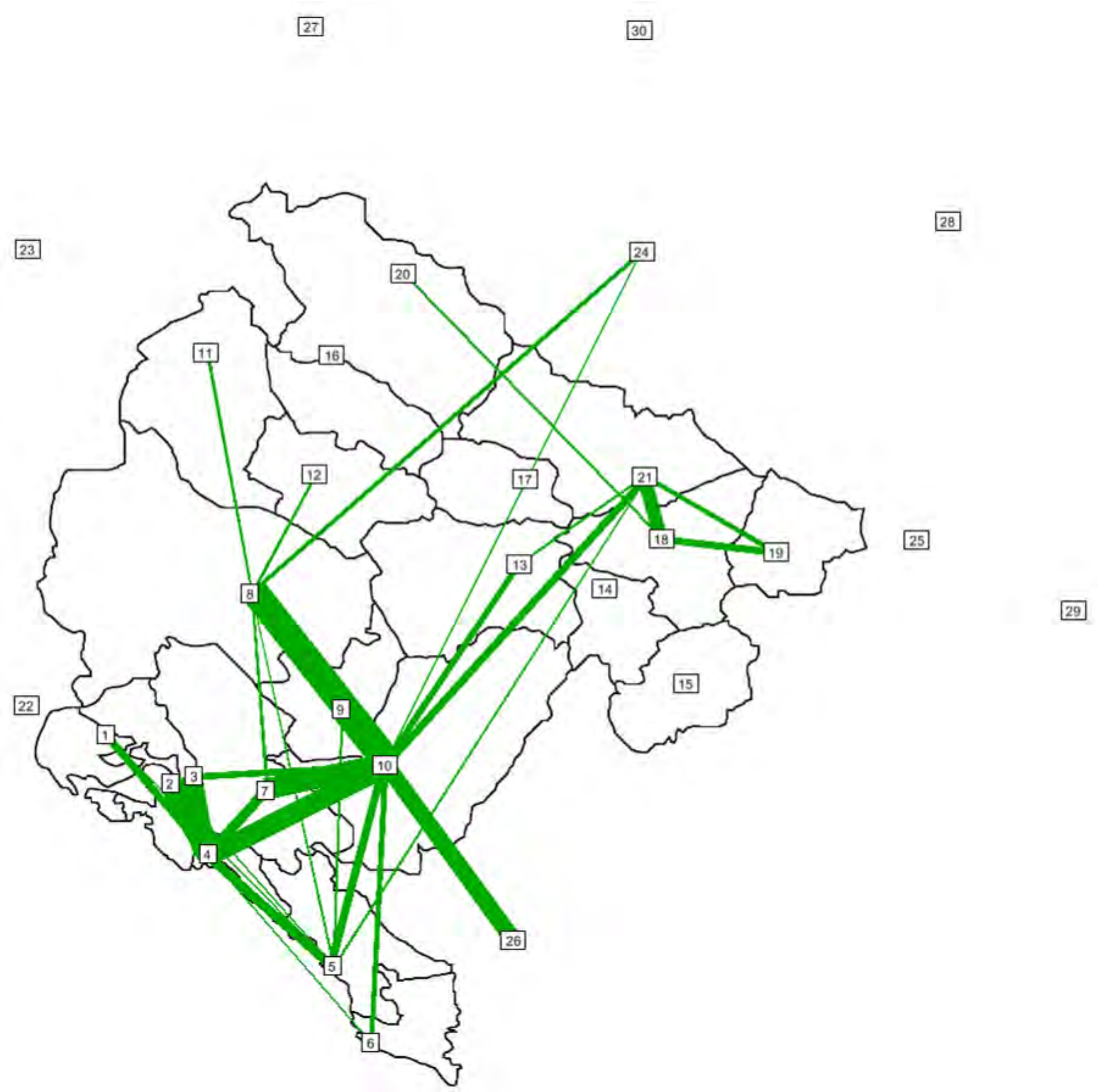
	Monte-negro	Croatia	Bosnia	Serbia	Kosovo	Albania	Slovenia	Bulgaria - Romania	Republic of Macedonia	Rest of Europe	TOTAL
Montenegro	42,496	117	604	1,110	90	3,948	24	0	1	17	48,406
Croatia	163	0	0	1	0	10	0	0	0	0	174
Bosnia	492	0	0	233	0	0	0	0	0	0	725
Serbia	1,272	1	0	0	0	0	0	0	0	0	1,273
Kosovo	53	0	0	0	0	0	0	0	0	15	68
Albania	4,116	0	0	0	4	0	0	0	0	0	4,120
Slovenia	3	0	0	0	6	0	0	0	0	0	9
Bulgaria - Romania	0	0	0	0	0	0	0	0	0	0	0
Republic of Macedonia	6	0	0	0	0	0	0	0	0	0	6
Rest of Europe	26	0	0	7	0	84	0	0	0	0	117
TOTAL	48,628	118	604	1,352	99	4,041	24	0	1	32	54,899

The above table shows that 77% of longer distance movements (inter-municipality excluding very local demand) for cars are local to Montenegro. 42,496 trips are within Montenegro, whilst the rest (12,402) are of international nature.

The two key international generators for cars are Albania (65%) and Serbia (21%). It may be noted that the movements from/to Albania are in fact including movements to localities close to the Montenegro-Albania border (but these are considered minor in terms of trips generated).

For LGVs, summarised in Figure 5.6, the desire lines show a relatively similar picture to cars. The demand is relatively more sprayed than for cars suggesting more long distance movements, particularly towards the north-east of the country and across the national border into Serbia.

Figure 5-6: Desire lines for LGV demand



A per for cars, the level of international traffic observed on the Montenegrin road network has been derived for LGVs as shown in Table 5.4.

TABLE 5.4 DISTRIBUTION OF INTERNATIONAL LGV TRAFFIC ON MONTENEGRIN ROADS

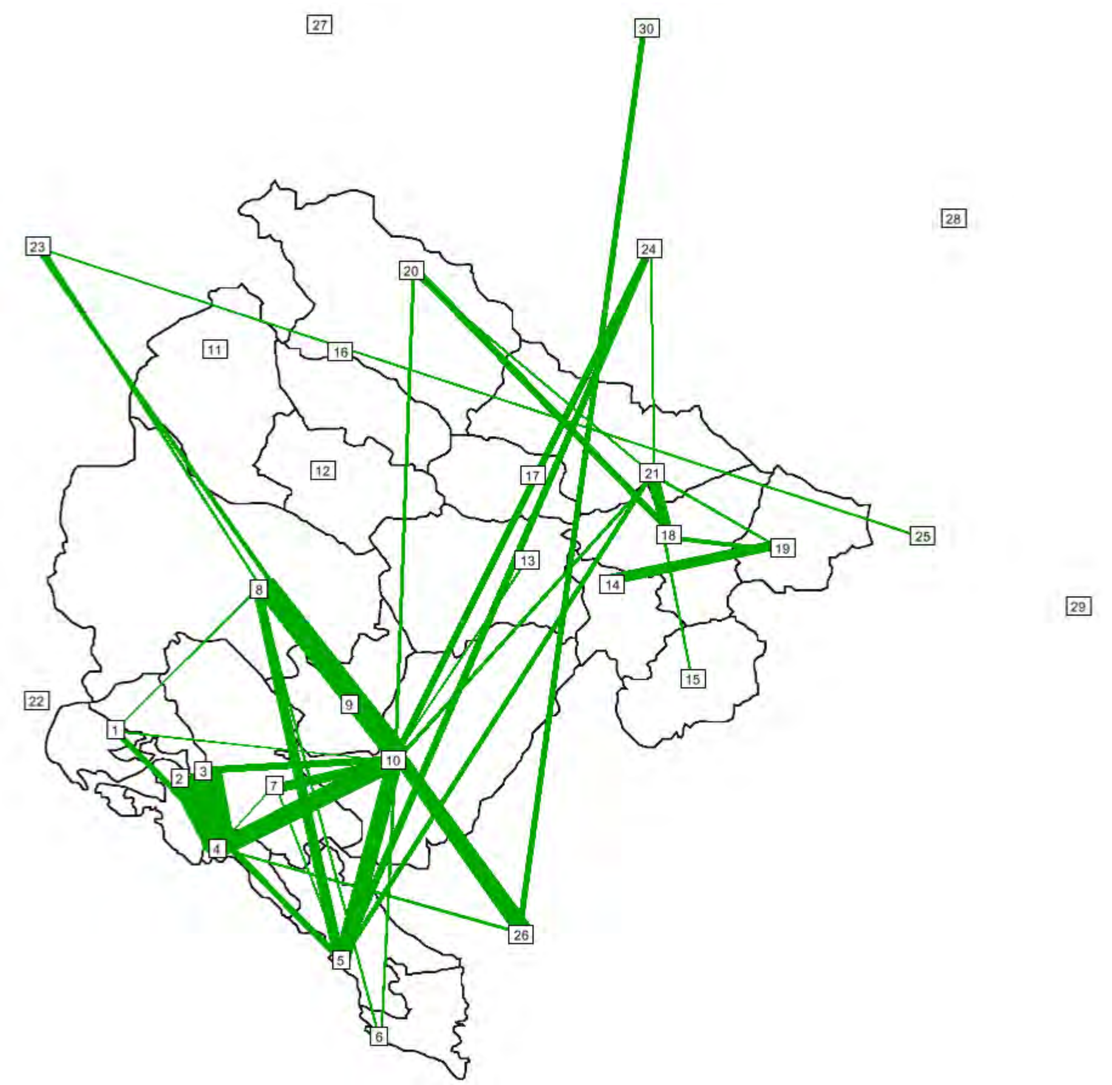
	Monte-negro	Croatia	Bosnia	Serbia	Kosovo	Albania	Slovenia	Bulgaria - Romania	Republic of Macedonia	Rest of Europe	TOTAL
Montenegro	3,059	15	21	49	8	82	3	0	0	0	3,238
Croatia	8	0	0	0	0	0	0	0	0	0	8
Bosnia	31	0	0	0	4	0	0	0	0	0	35
Serbia	57	0	0	0	0	0	0	0	0	0	57
Kosovo	6	0	0	0	0	0	0	0	0	0	6
Albania	86	0	0	0	0	0	0	0	0	6	92
Slovenia	0	0	0	0	0	0	0	0	0	0	0
Bulgaria - Romania	0	0	0	0	0	0	0	0	0	0	0
Republic of Macedonia	0	0	0	0	0	0	0	0	0	0	0
Rest of Europe	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3,248	15	21	49	12	82	3	0	0	6	3,436

The above table shows that 89% of longer distance movements (inter-municipality excluding very local demand) for LGVs are local to Montenegro. 3,056 trips are within Montenegro, whilst the rest (376) are of international nature.

The two key international generators for LGVs are Albania (46%) and Serbia (28%). It may be noted that the movements from/to Albania are in fact including movements to localities close to the Montenegro-Albania border (but these are considered minor in terms of trips generated).

The HGV desire lines are shown in Figure 5.7. The diagram suggests that HGV desire lines are more scattered throughout the network and confirm the existence of relatively long distance and international travel. The main poles of attraction remain Podgorica, Niksic, the coast, Serbia and Albania. The northern areas of Montenegro also indicate a high level of HGV movements, in particular between Bijelo Polje, Berane and Rozane.

Figure 5-7: Desire lines for HGV demand



HGV international traffic observed on the Montenegrin road network has been analysed for HGVs as shown in Table 5.5.

TABLE 5.5 DISTRIBUTION OF INTERNATIONAL HGV TRAFFIC ON MONTENEGRIN ROADS											
	Monte-negro	Croatia	Bosnia	Serbia	Kosovo	Albania	Slovenia	Bulgaria - Romania	Republic of Macedonia	Rest of Europe	TOTAL
Montenegro	3,479	39	70	190	1	0	24	0	0	13	3,816
Croatia	4	0	0	0	0	0	0	0	0	0	4
Bosnia	28	0	0	0	37	66	0	0	0	0	131
Serbia	152	0	18	0	9	0	0	0	0	0	179
Kosovo	0	0	0	0	0	0	0	0	0	0	0
Albania	197	1	0	0	0	0	0	0	0	0	197
Slovenia	2	0	0	0	0	0	0	0	0	0	2
Bulgaria - Romania	2	0	0	0	0	0	0	0	0	0	2
Republic of Macedonia	0	0	0	0	0	0	0	0	0	0	0
Rest of Europe	0	0	0	0	0	76	0	0	0	0	76
TOTAL	3,866	40	88	190	46	143	24	0	0	13	4,409

The above table shows that 79% of longer distance movements (inter-municipality excluding very local demand) for HGVs are local to Montenegro. 3,479 trips are within Montenegro, whilst the rest (929) are of international nature.

The two key international generators are Serbia (40%) and Albania (37%). It may be noted that the movements from/to Albania are in fact including movements to localities close to the Montenegro-Albania border (but these are considered minor in terms of trips generated). Limited trips with Kosovo can also be observed.

It should that for HGVs the matrix shows a much bigger spread in terms of origins and destinations. It can for example be seen that international HGV traffic transits through Montenegro for movements such as Bosnia/Albania, Bosnia/Kosovo and the rest of Europe (North West) to Albania.

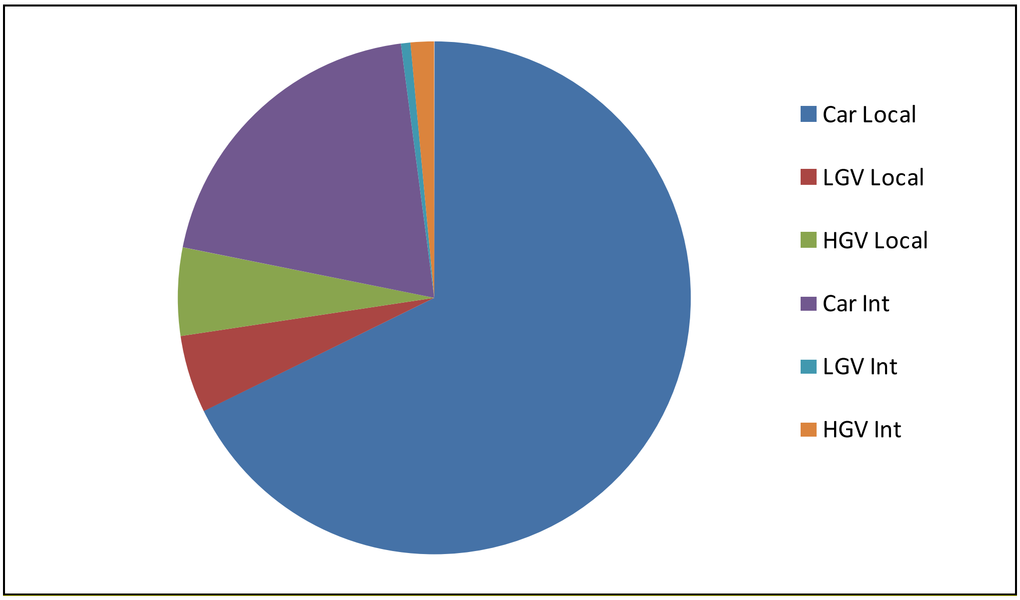
The above analysis demonstrates the strategic nature of the SEETO Route 4 corridor. Three separate sections can clearly be identified:

- The Coast to Podgorica, with very high demand, especially from cars and LGVs using the section for short distance trips. HGVs are also using this section but for more long distance strategic traffic;
- Long distance North-South movements dominate the network, many vehicles using the corridor between Podgorica and Kolasin, a section with a high proportion of HGVs;
- The northern sections to Serbia, both with relatively local traffic between the various urban areas of Bijelo Polje, Berane and Rožaje experience more long distance strategic HGV traffic.

This analysis also shows that about 80% of the inter-municipal movements (excluding very local movement within each locality, for example local Podgorica traffic) are internal to Montenegro.

Most this longer distance demand is for cars (54,000 trips or 87%) whilst HGVs form a small part of the demand (4,409 trips or 7%). Figure 5.8 below further details the split of trips observed on the Montenegrin network by vehicle type and travel (local or international). This shows that the proportion of HGV (freight) international demand is very minor compared to the total trips made.

Figure 5-8: Proportion of local and international traffic in Montenegro by vehicle type

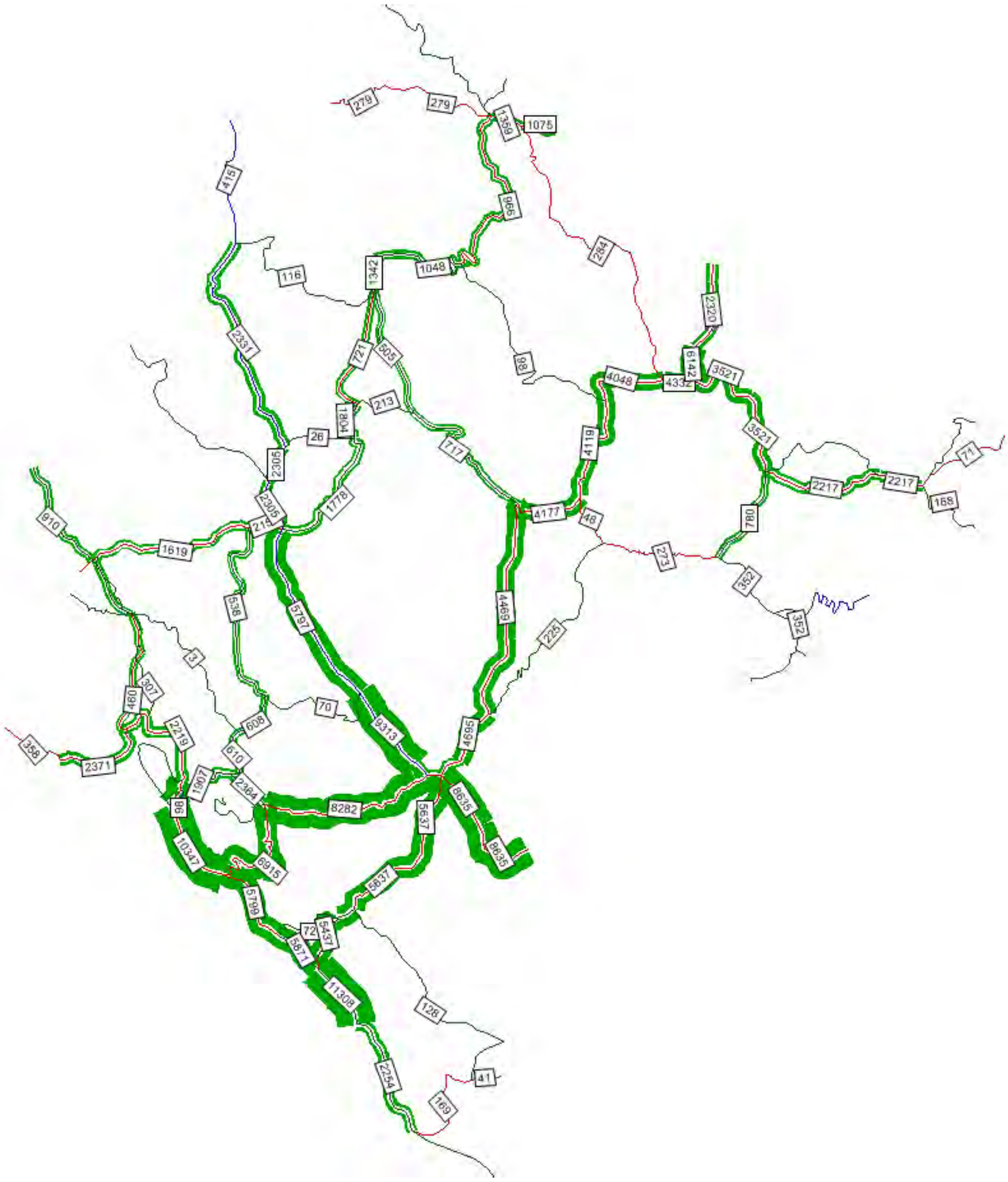


Key international generators for traffic in Montenegro are Albania and Serbia with Albania dominating for cars. For HGVs however, Serbia is a main generator with 40% of international HGV traffic being from/to Serbia. Whilst this represents a large percentage of the HGV demand, it in fact represents less than 0.6% of the overall inter-municipal movements for all vehicles and only few trips in absolute terms (369 trips). Even though these HGVs would highly profit from the improvements to the SEETO Route 4 corridor, the 'economic benefits' linked to these are likely to minor within the wider economic appraisal.

5.7 Assignment Results

Figure 5.9 shows the assignment of the estimated matrix. This shows that matrix estimation has adjusted flows in the vicinity of the studied corridor to match observed volumes. The SEETO Route 4 corridor experiences traffic volumes in the order of 5,000 vehicles AADT throughout its all length.

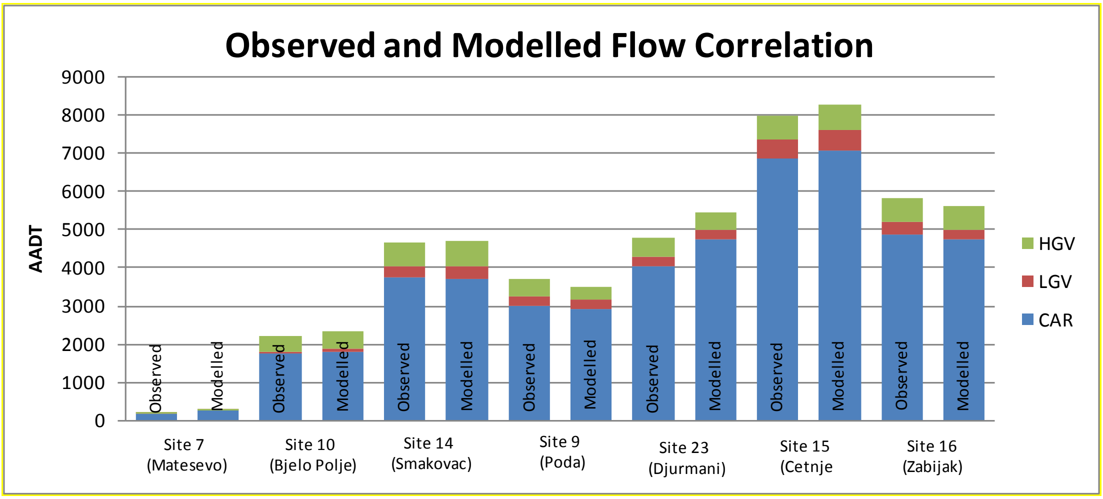
Figure 5-9: Assignment of estimated matrix



5.8 Focus on the Route 4 Corridor

The focus on the study is on the Route 4 motorway corridor where the modelled flows for each user class must represent observed closely. Figure 5.10 demonstrates that, on the corridor, modelled flows matched closely with observed flows for all cars, LGVs and HGVs. It also shows that the volume of strategic traffic using the corridor tends to be higher towards the coast than in the North.

Figure 5-10: Correlation between observed and modelled flows along the Route 4 corridor



5.9 Validation

No validation of the model has been carried out due to the lack of reliable count data available outside those used for calibration. The available data was limited to the regional roads for a limited period of time and was therefore considered to be a ‘spot’ count rather than a comprehensive data set which would enable model validation.

However, the lack of validation is not considered important because the counts used for calibration are well spread across the network and therefore offer a comprehensive coverage of the entire country-wide network and provide a robust set of observed information for comparison with the modelled outputs.

6 FUTURE NETWORKS

Following the successful calibration of the VISUM model highway network and of the base year trip matrices for the SEETO Road Route 4 study, future networks have been developed.

A number of scenarios have been identified in discussion with the transport economist. All scenarios have been run for the base year and the two forecast years 2020 and 2035.

A Do-Minimum (DM) scenario has been developed including the most likely developments outside the corridor of interest. Then, the Do-Something scenarios relating to the Route 4 corridor, have been developed based on the DM, and have been assessed so as to fully understand the effects of introducing the differentiating elements of each scenario, for the proposed motorway.

Further details of the scenarios are presented in the following sections.

6.1 Do-Minimum Network

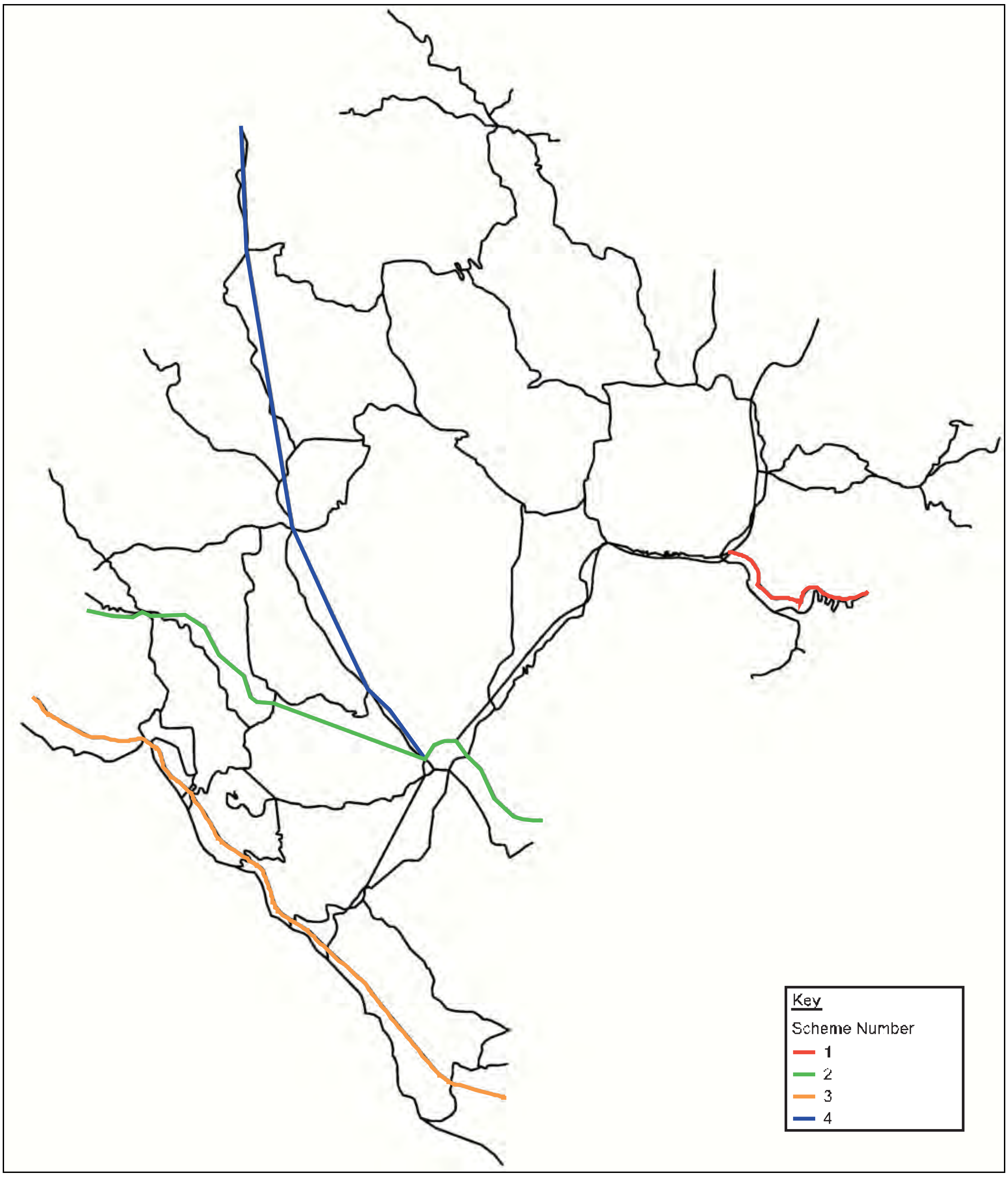
The Do-Minimum supply assumptions remain constant for the two modelled future years except where other road links are likely to be built in Montenegro during the period tested.

Focus has been given on information provided in the *Spatial Plan of Montenegro until 2020*. Based on this four schemes have been identified as major and with the potential to change traffic patterns. As no specific opening years are given in the spatial plan, the consultant has estimated, based on information provided by the Government of Montenegro, in which modelled year these should be included. Table 6.1 summarises the schemes with Figure 6.1 showing their location nationally.

TABLE 6.1: PROPOSED SCHEMES FOR INCLUSION IN THE DO MINIMUM SCENARIO

Number	Scheme	Years modelled
1	Part of the motorway from the connection to the highway Beograd - Bar to the border with Kosovo (Kosovo and Metohija): Andrijevica – Murino – Čakor - Bjeluha.	2035
2	Part of the Adriatic-Ionnian motorway: border with Bosnia and Herzegovina (in region of Nudola) – Grahovo–Cevo – Podgorica (bypass) – the tunnel through Dečić (border with Albania).	2035
3	Adriatic highway for fast motor vehicle traffic: Debeli brijeg (border with Croatia) – Herceg Novi (crossing over Bokokotorski Bay)– Tivat – Budva – Bar – Ulcinj – Fraskanjela region (Albanian state border).	Not included
4	Šćepan Polje (border with Bosnia and Herzegovina) – Plužine – Nikšić – Podgorica.	2020, 2035

Figure 6-1: Location of proposed schemes for inclusion in Do-Minimum



The other scenarios have all been developed using the Do-Minimum networks as a basis.

6.2 Do-Something Network

The Do-Something scenarios have been developed by testing each section independently, as single lane, Combination - Partial Dual 2 and Partial Single 2, and dual 2 (S1 to S14) and then by producing rolling programmes of sections considered logical from the traffic and construction perspective (S15 to S20).

The definition of the scenarios was driven by the minimum proposed construction layouts developed by the design team replicated in **Appendix 6**. This show that for some sections, it is more sensible to build the new road as a mixture of single 2 and dual 2 for constructability reasons.

Table 6.2 outlines which section of the proposed motorway was tested as part of each scenario. The diagram also makes a distinction between dual, combination and single road links included to as part of the proposed route.

TABLE 6.2 ROUTE 4 SECTIONS BY TEST SCENARIO

Section		SI	SII-1		SII-2		SIII			SIV		SV	SVI		SVII-1	SVIIa-4-1	
sub-sections between Interchanges		Djurmani-Virpazar	Virpazar-Zabljak	Zabljak-Farmaci	Virpazar-Cetinje int.	Cetinje int.-Farmaci	Farmaci-Tolosi	Tolosi-Niksic	Niksic-Smokovac/Strganica	Smokovac/ Strganica-Pelev	Pelev-Matesevo	Matesevo-Andrijevica	Andrijevica-Berane	Berane-Poda	Poda-Boljare	Poda-Bijelo Polje	Bijelo Polje-Serbia
Scenarios	DM																
	S1																
	S2																
	S2a																
	S3																
	S4																
	S5																
	S6																
	S7																
	S8																
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	S10																
	S11																
	S12																
	S13																
	S14																
	S15																
	S16																
	S17																
	S18																
	S19																
	S20																

Single 2
Combination - Partial Dual 2 and Partial Single 2
Dual 2

The proposed motorway (Dual 2) sections have been coded as dual two links (two lanes in each direction). Within the model, the motorway has been given the following characteristics:

- Two lanes in each direction;
- Design speed of 100 kilometres per hour, except in specific locations where the design speed was given as 80kph; and
- Capacity of 30,000 vehicles per day per direction.

The proposed new Single 2 sections have been coded as one lane in each direction. Within the model, this new road has been given the following characteristics:

- One lane in each direction;
- Design speed of 100 kilometres per hour, except in specific locations where the design speed was given as 80kph; and
- Capacity of 15,000 vehicles per day per direction.

Where additional connections to the existing network were required, these have been assumed to be single 2.

In order to accurately represent driving behaviours of the three categories included in the model, maximum travelling speeds have been capped for each user class independently of road classification:

- Passenger car – maximum 120 km/h;
- LGV – maximum 100 km/h; and
- HGV – maximum 80 km/h.

Connections to Belgrade are not explicitly modelled, and only represented as centroid connectors at the edge of the model. These exist in both the Do-Minimum and Do-Something networks. This underlies the assumption that the motorway from Belgrade to Boljare is assumed to be open by the time the northernmost section of the SEETO Route 4 between Berane and Boljare is completed. It should be noted that the only impact of this would be on traffic generation[1] which forms a relatively small element of the corridor demand.

Around Podgorica, accesses to the new road are also made through centroid connectors. This approach is reasonable for assessing long distance strategic traffic, which is the main purpose of the model. This however makes the model less suitable to assess the Podgorica bypass section represented by scenario 3, this is not seen as a key issue as it is understood that the Podgorica bypass is currently under study and to be funded by the City.

6.3 Impedance and Generalised Costs

The same impedance formulations have been used for the forecast years as for the base year with only an increase in values of time in line with GDP growth using an elasticity of 0.7.

[1] Trip generation/induction presented in section 7.6 of this report

7 FORECAST TRIP MATRICES

Forecast matrices have been developed for two different years, namely 2020 and 2035. A Do-Minimum forecast has been developed for each year, then for each scenario and year, induced traffic has been derived.

7.1 General Methodology

The methodology used includes growth and redistribution of the trips based on population as well as on GDP per capita (representing employment).

The method selected was to forecast future trip ends for origins and destinations and to apply a Furness using these figures to the base year matrix, to arrive at the forecast matrices.

7.2 Population Forecasts

Any increases or decreases in population or in the distribution of population will have a direct influence on the amount of traffic and on traffic patterns.

A census of population was carried out in 2011 and provides more recent population data than that used in previous studies. In the IFC study, the base population was derived from the census of 2003 and forecast on the basis of the Spatial Plan of Montenegro to 2020. This has been updated by introducing new base data for 2011 and adjusting the forecast data accordingly. The new forecast based on 2011 is shown in Table 7.1.

TABLE 7.1: POPULATION FORECAST BY MUNICIPALITY ADJUSTED TO THE CENSUS OF 2011

Zone Number	Region Name	Population			Population Growth (%)	
		2012	2020	2035	2012-2020	2012-2035
1	HERCEG NOVI	31,008	31,809	32,940	2.6%	6.2%
2	TIVAT	14,122	14,659	15,197	3.8%	7.6%
3	KOTOR	22,710	23,321	24,152	2.7%	6.3%
4	BUDVA	19,468	21,091	21,958	8.3%	12.8%
5	BAR	42,449	44,956	46,699	5.9%	10.0%
6	ULCINJ	20,100	21,209	22,024	5.5%	9.6%
7	CETINJE	16,670	16,675	17,225	0.0%	3.3%
8	NIKSIC	73,183	77,852	80,906	6.4%	10.6%
9	DANILOVGRAD	18,536	18,870	19,526	1.8%	5.3%
10	PODGORICA	188,851	208,125	217,039	10.2%	14.9%
11	PLUZINE	3,248	3,243	3,349	-0.2%	3.1%
12	SAVNIK	2,064	2,015	2,077	-2.4%	0.6%

13	KOLASIN	8,384	8,366	8,640	-0.2%	3.1%
14	ANDRIJEVICA	5,072	5,078	5,251	0.1%	3.5%
15	PLAV	13,274	14,343	14,929	8.1%	12.5%
16	ZABLJAK	3,570	3,562	3,678	-0.2%	3.0%
17	MOJKOVAC	8,695	9,146	9,494	5.2%	9.2%
18	BERANE	34,429	37,418	38,967	8.7%	13.2%
19	ROZAJE	23,516	27,354	28,677	16.3%	21.9%
20	PLJEVLJE	30,935	31,771	32,904	2.7%	6.4%
21	BIJELO POLJE	46,584	49,991	51,997	7.3%	11.6%

Source: IFC study of Bar - Boljare Motorway, 2008, based on Spatial Plan of Montenegro until 2020, Table 11; population census of 2011 (http://www.monstat.org/eng/page.php?id=394&pageid=57); Consultant's analysis

Interpolating the data used previously between 2007 and 2016 resulted in a total population for the country of 662,239 in 2011. The census shows that in fact the population was 620,029 in 2011. The following differences between the estimated and observed 2011 populations may be noted:

- Overall, the population in 2011 was 94% of that previously estimated.
- The estimated populations of Bar, Podgorica and Tivat were very close to the observed population.
- The estimated populations of Budva and Danilovgrad were about 10% below the observed.
- The estimated populations of Pluzine and Savnik were 25% above the observed.
- The estimated populations of other municipalities were 5 - 20% above the observed.

Traffic to external zones is essentially traffic to Serbia. Forecasts of population in Serbia indicate that it is expected to remain more or less constant for the next 20 to 30 years (EPTISA 2007). Based on this assumption, population growth forecasts for all external zones have been assumed to remain at zero.

7.3 GDP per Capita Forecasts

Traffic levels are forecast to grow as the GDP increases over time. The table below shows the forecast GDP/capita used in the IFC study and the latest forecasts available from the IMF[2]. While the actual growth in 2008 was higher than forecast, the data for subsequent years clearly reflects the recent economic downturn. Furthermore, it can be seen that the most recent IMF forecast (April 2012) is far more pessimistic than that made 6 months previously.

[2] www.imf.org

TABLE 7.2: GDP/CAPITA ANNUAL % CHANGE IN MONTENEGRO

Year	IFC Study	IMF Forecast	
		Sept 2011	Apr 2012
2008	5.4	6.9	6.6
2009	2.0	-5.7	-6.1
2010	2.0	1.1	2.0
2011	4.0	2.0	6.6
2012	4.5	3.5	-0.1
2013	4.5	3.7	1.2
2014	4.0	3.7	1.7
2015	4.5	3.8	1.7
2016	4.5	3.8	1.7
2017	4.5	-	1.9

Source: IFC study of Bar - Boljare Motorway, 2008
www.imf.org

Beyond 2017, the IFC study forecast GDP/capita growth of 4.5% per year to 2026, 2.5% from 2027 to 2036 and 2.4% from 2037 to 2046. This has been revised downwards to a constant growth rate of 2.5% per year from 2018 for the current study.

In the traffic model, 60.7% of traffic to and from external zones is traffic to or from Albania, 21.7% is to or from Serbia and 11.2% is to or from Bosnia and Herzegovina. The IMF forecasts of GDP for these countries until 2017 is shown in the table below. The SEETO route 4 is also expected to be important for traffic to and from Kosovo in the future. However, the IMF data does not include a GDP forecast for Kosovo and so the forecast for Serbia is assumed. Forecasts of GDP/capita for all other countries, for which the traffic makes up less than 5% of the total, has been assumed to be 2.0% per year.

TABLE 7.3: GDP/CAPITA ANNUAL % CHANGE IN NEIGHBOURING COUNTRIES

Year	Albania	Bosnia	Serbia
2012	0.0	0.2	0.3
2013	1.2	1.2	2.8
2014	2.0	2.7	3.8
2015	2.0	3.7	3.8
2016	2.0	3.7	3.8
2017	2.0	3.8	3.3

Source: www.imf.org

Beyond 2017, a constant growth rate of 2.5% per year has been assumed for all external zones. The resulting annual growth rates are summarised in Table 7.4.

TABLE 7.4: SUMMARY OF GDP PER CAPITA FORECAST GROWTH RATES

Period	Montenegro	Albania	Bosnia	Serbia	Other
2013 - 2020	2.0%	2.1%	2.8%	3.1%	2.0%
2021 - 2035	2.5%	2.5%	2.5%	2.5%	2.5%
2036 - 2050	2.5%	2.5%	2.5%	2.5%	2.5%

GDP growth in Montenegro is forecast to vary by region, and summarised in the table below. Further details on the derivation of these can be found in the economic report. Table 7.5 shows the expected regional variation in GDP per capital growth across the whole of Montenegro.

TABLE 7.5: EXPECTED REGIONAL VARIATIONS IN ECONOMIC DEVELOPMENT

Northern Region	Central Region	Coastal Region	Capital Area
-15%	**0%**	**+15%**	**+30%**
Plužine	Niksic	Herceg Novi	Podgorica
Šavnik	Danilovgrad	Tivat	
Kolasin		Kotor	
Andrijevica		Budva	
Plav		Bar	
Žabljak		Ulcinj	
Mojkovac		Cetinje	
Berane			
Rožaje			
Pljevlja			
Bijelo Polje			

7.4 Demand Forecast

The general formula for each zone, and each attractions and production is as follows:

$$\text{Forecast trip end} = \text{existing trip end} \times \frac{\text{future population}}{\text{existing population}} \times \text{GDP per capita growth} \times \text{elasticity}$$

An elasticity of 1.2 has been assumed for cars in the growth in trip making with respect to the growth in GDP per capita while it has been assumed to be 1.0 for freight traffic. Income elasticity of demand was assumed to be 1.5 until 2017, decreasing to 1.3 afterwards. While it is true that high elasticities have been observed for short periods in neighbouring countries as they entered periods of change, an elasticity of 1.2 has typically been found to be appropriate for passenger cars in the central and east European region.

An analysis of the current transport of commodities, as presented in section 2.6 of this report, showed that the transport industry was not relying heavily on particular commodities. This means that the freight traffic forecast does not need to be derived from any expected changes in production of some of the commodities over the next 30 years, but can be considered to be in line with GDP. Furthermore, analyses of freight traffic in Europe have shown that on average freight traffic can be assumed to grow directly with GDP per capita (i.e. with an elasticity of 1.0). These rates are supported by an analysis of growth in GDP and corresponding growth in passenger and freight transport based on IRF World Road Statistics for the UK, France and Germany for the period 1970 to 1990. Further analysis can be found in the economic report.

Further adjustments have been considered focussing especially on the potentials of the port of Bar and railway.

The Port of Bar is a potential generator of traffic for the proposed road corridor. It currently handles about 1.6m tonnes of freight per year, an amount that has declined since 2007. In 2011 approximately 20 percent of freight was containerised; container traffic increased from 27,095 TEU in 2007 to 34,722 in 2011, but peaked at 43,708 TEU in 2008. RO-RO traffic constitutes about 3 percent of total freight traffic. In 2011, about 60,000 passengers used the port, down from 85,000 in 2007.

The current capacity of the port is about 5m tonnes per year. Restructuring of the organisation of the port was finished at the end of 2009. Formally, the decision was put into force on 1 October 2009. The restructuring process resulted in the forming of two terminal operators:

- Port of Bar (handling liquids, dry bulk, RO-RO and passenger traffic; managing some warehouses and cold storage facilities for general cargoes; and also operating the Free Zone); and
- Container and General Cargo Terminal (handling containers and general cargoes).

Four daughter companies of the Port of Bar (Maritime Affairs, Security and Fire Fighting Service, IT, and Hotel Sidro) were also established. Maritime Affairs was privatised and is now operated by an Italian consortium. The plan is to continue the privatisation process and the tendering procedure for the Container and General Cargo Terminal is under preparation.

The last two years have seen the realisation of the first phase of planned investment in equipment and infrastructure. Newly acquired equipment includes seven wheel loaders and a mobile harbour crane for operations with dry bulk. Investment is planned to continue this year with the acquisition of three forklifts and two material handlers. Reconstruction of the cold storage facility is also planned. Investment in port infrastructure has not yet begun. However, given that the investment made so far has been directed towards the replacement of obsolete equipment, no significant increase in overall port capacity has occurred.

It can be assumed that without an improvement in the strategic road infrastructure, the development of the Port of Bar will be restricted. With improvement of the road infrastructure, development would be encouraged but would certainly not be guaranteed. For this reason, further development of the port is not included in the base assumptions of the current study. However, the assumptions of the sensitivity tests that relate to traffic are sufficient to take account of traffic resulting from any eventual development.

The railway in Montenegro consists of 250km of single track. The 160km main line from Bar to the Serbian border forms the backbone of the network and is electrified. The running speed along the line is 70-90 km/h, except between Podgorica and Kolasin where it drops to 40-50 km/h.

The remainder of the network is the unelectrified line from Niksic - Podgorica - Tuzi which is used for freight only at present.

There are two international passenger trains per day in the Bar - Serbian border corridor. In 2011 a total of 692,000 passengers were carried, down from 755,000 in 2010. This represents a significant decline from 10 years ago, largely due to a decline in international traffic which now constitutes about 50% of the total. The main cause of this decline is quoted by the railways as being due to poor maintenance on the Serbian side of the border, resulting in journey times that are longer than parallel journeys made by road.

In 2011, freight trains carried a total of 1.05 million tonnes on the network as a whole, down from 1.21 million tonnes in 2010. The decline is due to a reduction in the production of steel and a general downturn resulting from the economic situation.

The railway has significant spare capacity and there are various plans to improve the infrastructure. During the next two years, loans from IFIs including EIB and EBRD will be used to make speed improvements to 80 km/h and improve reliability (through slope stabilisation reducing landslides) on the line between Kolasin and Bijelo Polje. It is also expected that a customs agreement with Serbia will result in reduced border crossing delays from 2013.

Since the splitting up of the state owned railway company in 2008, rail transport has been operated by four separate companies, which independently handle railway infrastructure, passenger transport, freight transport and the maintenance of rolling stock. There are plans to privatise Montecargo, the rail freight transport company, which could potentially result in an increase in productivity.

While investment in and reorganisation of the rail sector could lead to an increase in rail passenger and rail freight traffic, investment in the road sector could have an inverse effect. However, the numbers above show that in either case, the overall impact would be rather small.

The number of rail passengers carried in the corridor in 2011 was 692,000, equivalent to an average of 1896 per day. If all of these passengers travelled by private car, they would add a maximum of 886 cars per day to the traffic. In reality, of course, this would only happen if the railway was closed. Furthermore, some passengers transferring to road would be likely to use buses rather than private cars.

It is not known how much of the total freight traffic on the railway is carried in the study corridor, but if it is assumed to be 50% then the 2011 tonnes of freight would be equivalent to an average of 1438 tonnes per day. This volume of freight could generate 144 truck journeys per day, assuming average truck loadings including trucks returning empty. This compares with 370 international truck journeys between Montenegro and Serbia and 0.2% of the overall traffic.

7.5 Final Do-Minimum Demand

Table 7.6 shows the matrix totals for the Do-Minimum vehicle demand (excluding trip generation) for the various forecast years. This demand includes the population growth forecasts, including regional variations for Montenegro and external zone growth. The calculation also takes into account the GDP per capita growth for Montenegro as well as the neighbouring countries.

TABLE 7.6: DO MINIMUM FORECAST DEMAND AND GROWTH 2012-2035		
Base 2012		
Mode	**Demand**	**Growth**
CAR	54,889	-
LGV	3,436	-
HGV	4,409	-
TOTAL	**62,734**	**-**
Do Minimum 2020		
Mode	**Demand**	**Growth (2012-2020)**
CAR	83,372	52%
LGV	4,418	28%
HGV	5,656	29%
TOTAL	**93,446**	**49%**
Do Minimum 2035		
Mode	**Demand**	**Growth (2012-2035)**
CAR	110,942	102%
LGV	5,860	72%
HGV	7,585	71%
TOTAL	**124,387**	**98%**

It should be noted that at this stage, all the intrazonal demand (which cannot be assigned) has been removed from the matrices.

7.6 Representation of Induced Traffic

Construction of a new major road may lead to the generation of “induced traffic”, that is, traffic resulting from trips which would not have been made had the facility not been constructed.

In the current study, an estimate has been made of the amount of induced traffic which might be generated for each scenario for each forecast year. It represents, therefore, what might be expected to be the most likely amount of traffic induced.

A simple approach has been adopted which relates the traffic generated to the change in travel time resulting from the construction of the motorway for each origin-destination pair in the matrix. The form of the relationship is:

$Dem_{DS} = Dem_{DM} \times (c_1/c_0)^b$

where Dem_{DM} is the Do-Minimum demand as presented in section 7.5;

Dem_{DS} is the Do-Something demand including generated traffic;

c_0 is the journey time without the motorway, or Do-Minimum time skim;

c_1 is the journey time with the motorway, or Do-Something time skim; and

b is an elasticity.

An elasticity of -0.24 has been assumed, which is the value recommended for off-peak inter urban trips in the UK. This methodology has been used for other east European countries (Poland for example) to represent the expected trips generated due to the addition of new motorway links and hence reduced travel costs.

The advantages of this technique are that it considers possible generation for all origin-destination pairs independently. Thus, origin-destination pairs away from the infrastructure improvements and not likely to use it will not produce any induced demand while origin-destination pairs directly close to the project will enjoy high induction. Furthermore, long distance trips where time savings are likely to be significant will benefit from greater induction than short distance trips for which time savings are minimal.

This induction of traffic in fact reflects three possible changes in behaviour towards travelling, these are:

- Trip distribution also called destination choice, or long term relocation of either or both home, work or shopping locations as the result of the motorway increasing accessibility to certain areas;
- Mode shift, which corresponds to people's willingness to change mode as the result of an improvement. For example trips being transferred from rail or air to road as the quality of travel improves thanks to the motorway; and
- Trip frequency or the willingness to travel as the result of transport infrastructure improvements. While before travelling from A to B was considered too long to be worthwhile new travel times make the trip possible.

8 FUTURE YEAR ASSIGNMENTS

After completing the development of the various forecast networks and matrices, assignments were carried out and analysed. For each scenario and year, two assignments were carried out, first the Do-Minimum matrix was assigned to the Do-Something scenario before extracting the travel time skim. Then the model of generated traffic was run to derive the additional demand which was assigned to the Do-Something scenario.

Post assignment, including generated traffic, old road and proposed road flows, speeds and travel times were extracted for analysis. Only the results from the most representative scenarios are presented and discussed here, although all the assignments undertaken were used as input to the economic analysis process. The scenarios discussed in this section are:

- Scenario 1: Road section between Virpazar and Farmaci via Zabijak, connecting the newly constructed Sozina Tunnel to Podgorica;
- Scenario 2: An alternative connection between Virpazar and Farmaci via Cetinje, using a section of existing road west of Podgorica;
- Scenario 3: The Podgorica bypass section of the route, between Farmaci, Tolosi Niksic and Smokovac;
- Scenario 4: The section of the proposed road connecting Podgorica to Matesevo via Smokovac and Pelev;
- Scenario 5: Route 4 section between Matesevo and Andrijevica;
- Scenario 6: Route section connecting Andrijevica to Poda via Berane in the north of the country;
- Scenario 7: The first one of the two proposed alternatives for the northern-most section of Route 4, between Poda and the Serbian Border en route to Boljare;
- Scenario 8: The second alternative for the northern-most part of the route, connecting Poda to the Serbian border via Bijelo Polje;
- Scenario 15: The southern section of the road combining road sections tested in the second and third scenarios, from Virpazar to Farmaci via Cetinje and including the Podgorica bypass via Farmaci, Tolosi and Niksic to Smokovac; and
- Scenario 20: The complete proposed route from Virpazar.

8.1 Generated Demand

The derivation of generated traffic has been detailed in the previous chapter of this report. The table below presents the outputs in terms of generated demand for each user class. It shows that the level of generated demand is much higher when the entire corridor is in place. It shows that in scenario 3 in particular but also in scenarios 1, 2, 5, 6 and 7, time savings for the origin-destination pairs using this corridor are small hence limiting the level of generated traffic. In comparison, once the entire corridor is in place, time savings are significant enough, thus generating relatively high demand. It also shows that generated traffic increases over time between 2012 and 2035 because of the congestion build up.

TABLE 8.1 GENERATED DEMAND LEVELS

Scenario		Mode	Demand			Absolute Difference			% Difference		
			2012	2020	2035	2012	2020	2035	2012	2020	2035
DM		Car	54,899	83,372	110,942	-	-	-	-	-	-
		LGV	3,436	4,418	5,860	-	-	-	-	-	-
		HGV	4,409	5,656	7,585	-	-	-	-	-	-
		Total	**62,744**	**93,446**	**124,387**	-	-	-	-	-	-
DS	Scenario 1	Car	55,249	83,985	111,979	350	613	1,037	0.6%	0.7%	0.9%
		LGV	3,460	4,456	5,914	24	38	54	0.7%	0.9%	0.9%
		HGV	4,435	5,693	7,644	26	37	59	0.6%	0.7%	0.8%
		Total	**63,144**	**94,134**	**125,537**	**400**	**688**	**1,150**	**0.6%**	**0.7%**	**0.9%**
	Scenario 2	Car	55,324	84,114	111,831	425	742	889	0.8%	0.9%	0.8%
		LGV	3,462	4,452	5,896	26	34	36	0.8%	0.8%	0.6%
		HGV	4,443	5,700	7,642	34	44	57	0.8%	0.8%	0.8%
		Total	**63,229**	**94,266**	**125,369**	**485**	**820**	**982**	**0.8%**	**0.9%**	**0.8%**
	Scenario 3	Car	54,921	83,485	111,116	22	113	174	0.0%	0.1%	0.2%
		LGV	3,437	4,420	5,864	1	2	4	0.0%	0.0%	0.1%
		HGV	4,409	5,656	7,590	0	0	5	0.0%	0.0%	0.1%
		Total	**62,767**	**93,561**	**124,570**	**23**	**115**	**183**	**0.0%**	**0.1%**	**0.1%**
	Scenario 4	Car	55,258	84,064	111,734	359	692	792	0.7%	0.8%	0.7%
		LGV	3,466	4,458	5,911	30	40	51	0.9%	0.9%	0.9%
		HGV	4,448	5,706	7,658	39	50	73	0.9%	0.9%	1.0%
		Total	**63,172**	**94,228**	**125,303**	**428**	**782**	**916**	**0.7%**	**0.8%**	**0.7%**
	Scenario 5	Car	55,069	83,642	111,386	170	270	444	0.3%	0.3%	0.4%
		LGV	3,449	4,436	5,884	13	18	24	0.4%	0.4%	0.4%
		HGV	4,423	5,671	7,609	14	15	24	0.3%	0.3%	0.3%
		Total	**62,941**	**93,749**	**124,879**	**197**	**303**	**492**	**0.3%**	**0.3%**	**0.4%**
	Scenario 6	Car	55,093	83,676	111,422	194	304	480	0.4%	0.4%	0.4%
		LGV	3,450	4,437	5,885	14	19	25	0.4%	0.4%	0.4%
		HGV	4,424	5,672	7,612	15	16	27	0.3%	0.3%	0.4%
		Total	**62,967**	**93,785**	**124,919**	**223**	**339**	**532**	**0.4%**	**0.4%**	**0.4%**
	Scenario 7	Car	55,061	83,631	111,366	162	259	424	0.3%	0.3%	0.4%
		LGV	3,449	4,435	5,882	13	17	22	0.4%	0.4%	0.4%
		HGV	4,422	5,674	7,611	13	18	26	0.3%	0.3%	0.3%
		Total	**62,932**	**93,740**	**124,859**	**188**	**294**	**472**	**0.3%**	**0.3%**	**0.4%**
	Scenario 8	Car	55,184	83,806	111,583	285	434	641	0.5%	0.5%	0.6%
		LGV	3,456	4,445	5,894	20	27	34	0.6%	0.6%	0.6%
		HGV	4,437	5,688	7,629	28	32	44	0.6%	0.6%	0.6%
		Total	**63,077**	**93,939**	**125,106**	**333**	**493**	**719**	**0.5%**	**0.5%**	**0.6%**
	Scenario 15	Car	55,378	84,224	111,925	479	852	983	0.9%	1.0%	0.9%
		LGV	3,467	4,460	5,907	31	42	47	0.9%	1.0%	0.8%
		HGV	4,447	5,709	7,658	38	53	73	0.9%	0.9%	1.0%
		Total	**63,292**	**94,393**	**125,490**	**548**	**947**	**1,103**	**0.9%**	**1.0%**	**0.9%**
	Scenario 20	Car	55,723	84,959	112,816	824	1,587	1,874	1.5%	1.9%	1.7%
		LGV	3,497	4,502	5,971	61	84	111	1.8%	1.9%	1.9%
		HGV	4,494	5,778	7,764	85	122	179	1.9%	2.2%	2.4%
		Total	**63,714**	**95,239**	**126,551**	**970**	**1,793**	**2,164**	**1.5%**	**1.9%**	**1.7%**

Figures 8.1 and 8.2 present the areas most affected by the trip induction for scenario 20 for 2012 and 2035. These validate two things:

- Highest levels of induction occur around Podgorica and to the south of the capital;
- Both figures show induction not only along the corridor but throughout Montenegro and across the Serbian border. As induction can be directly related to time savings, it substantiates the fact that the proposed motorway is of strategic importance as it would improve accessibility to most parts of Montenegro and neighbouring countries.

Figure 8-1: Impact of generated traffic on demand – scenario 20 – year 2012

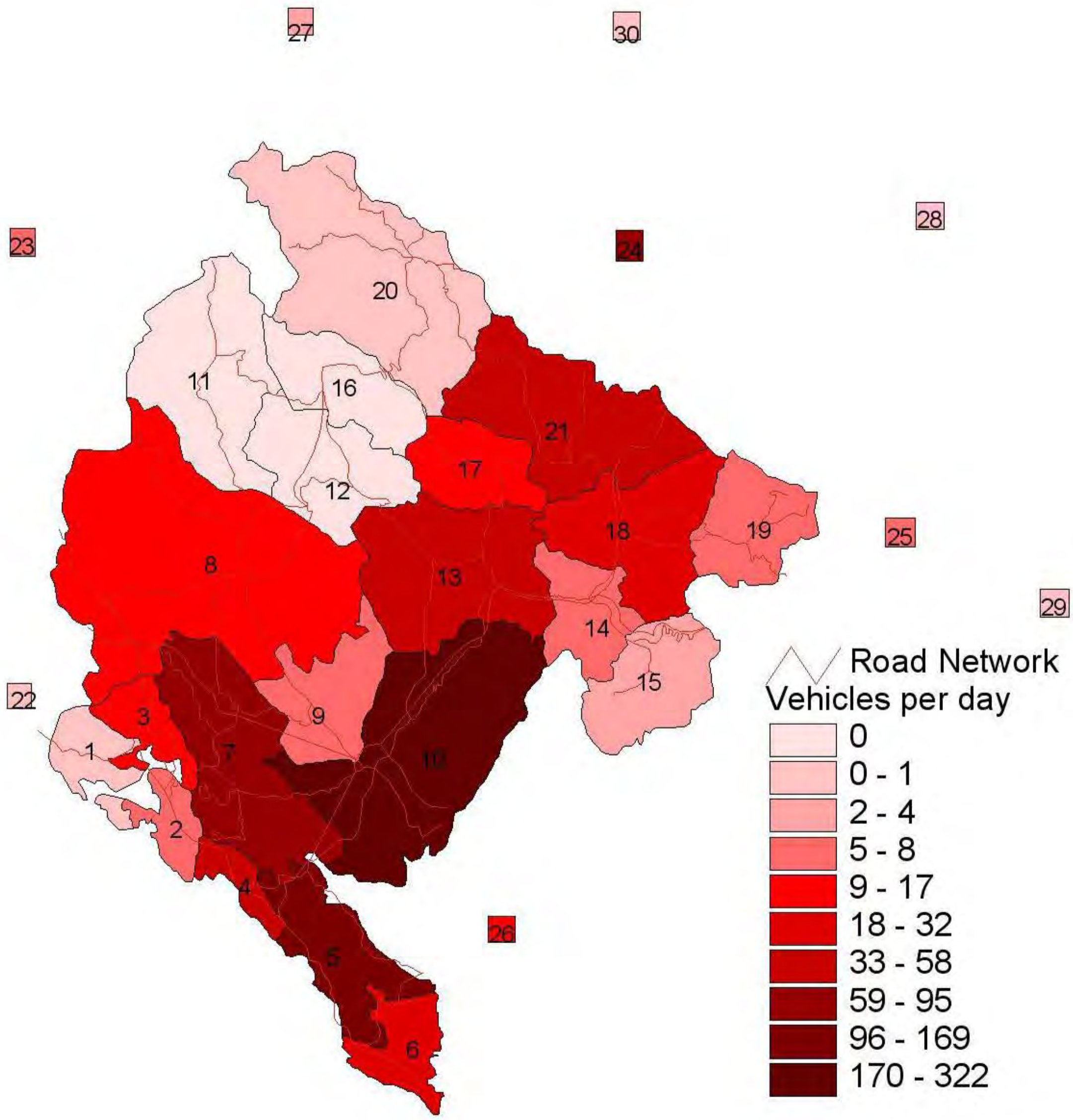


Figure 8-2: Impact of generated traffic on demand – scenario 20 – year 2035

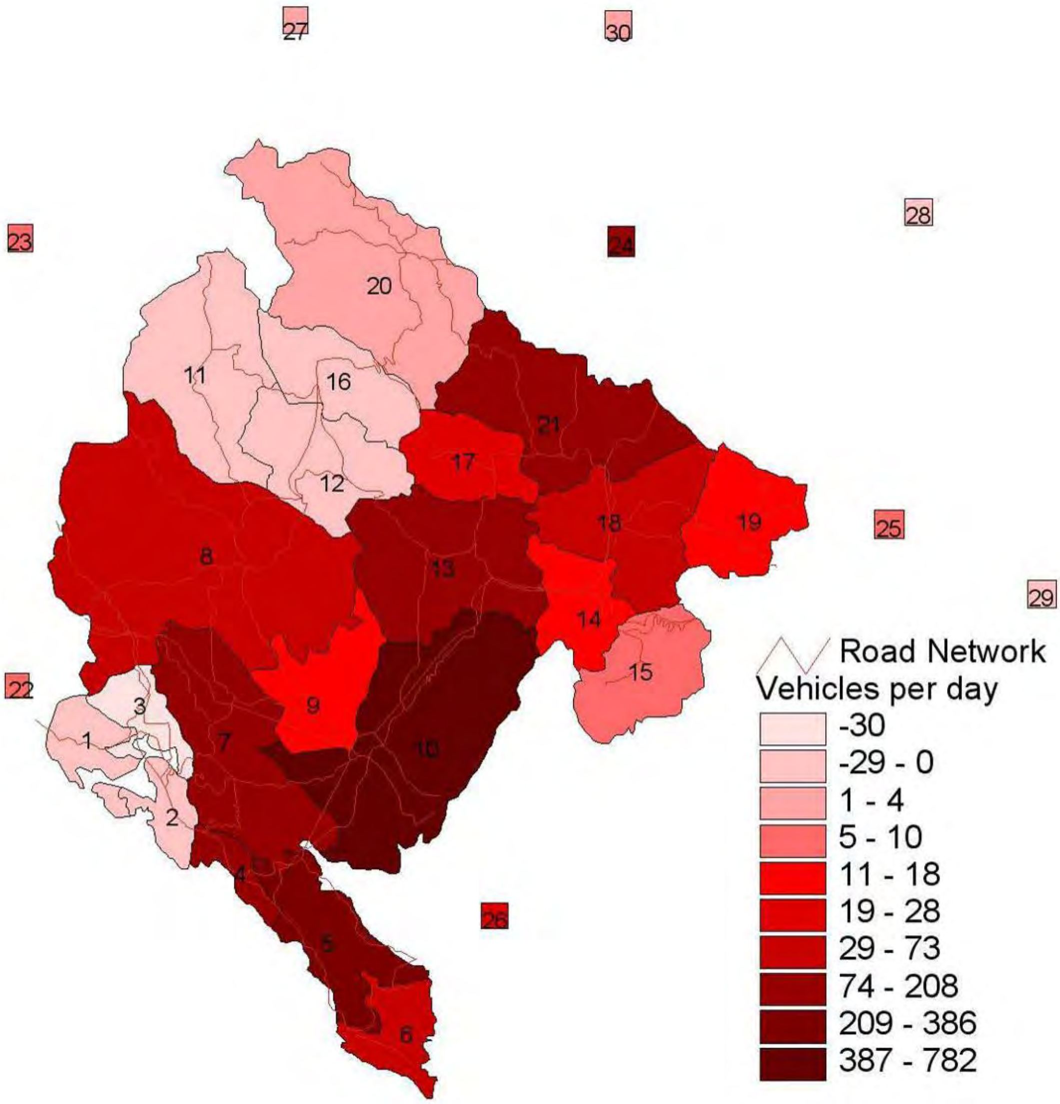
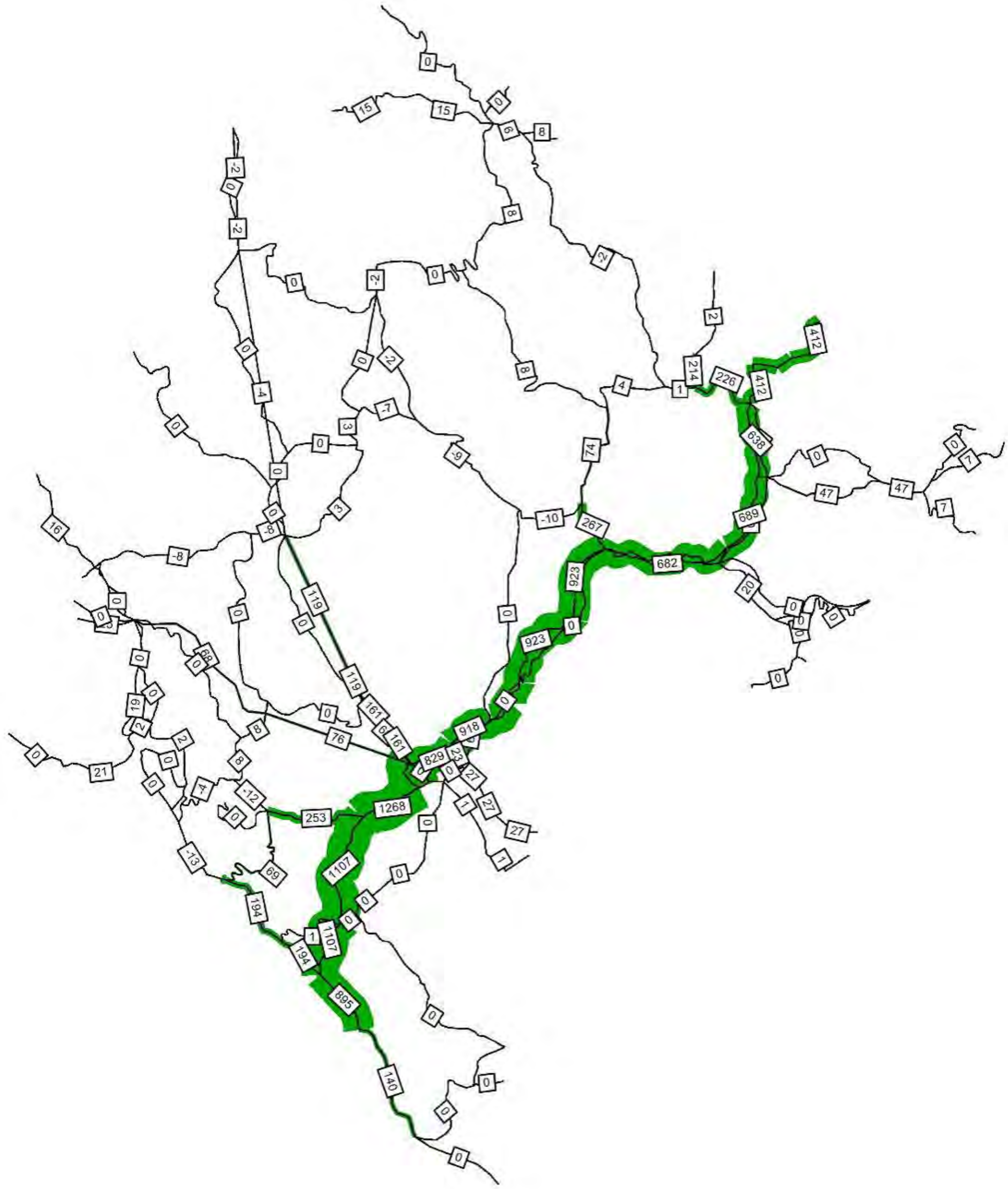


Figure 8.3 shows the impact of generated traffic on the motorway flow. It focuses on scenario 20 for year 2036. It shows that due to overall reductions in travel times across the network, generated demand is mainly along the proposed Route 4 motorway corridor but also extends further west as for example some of the generated traffic uses the existing road network around Podgorica.

The highest levels of generated traffic are around Podgorica and between Podgorica and the port of Bar (about 1,250 vehicles a day). This clearly emphasizes the strategic nature of the corridor. No marked reductions in traffic volumes are evident anywhere on the network suggesting that no area will experience a reduction in traffic levels.

Figure 8-3: Impact of generated traffic on demand – scenario 20 – year 2035



8.2 Corridor Traffic Flows

It is clear from the above that Route 4 motorway will be beneficial, as it will improve traffic conditions throughout Montenegro. An analysis focusing specifically on the alignment of Route 4 has been carried out. AADT flows have been extracted on the corridor for both the existing route and the proposed route.

TABLE 8.2 2012 AADT FLOWS BY ROUTE SEGMENT

Section		SI	SII-1		SII-2		SIII			SIV		SV	SVI		SVII-1	SVIIa-4-1	
sub-sections between Interchanges		Djurmani-Virpazar	Virpazar-Zabljak	Zabljak-Farmaci	Virpazar-Cetinje int.	Cetinje int.-Farmaci	Farmaci-Tolosi	Tolosi-Niksic	Niksic-Smokovac/Strganica	Smokovac/ Strganica-Pelev	Pelev-Matesevo	Matesevo-Andrijevica	Andrijevica-Berane	Berane-Poda	Poda-Boljare	Poda-Bijelo Polje	Bijelo Polje-Serbia
Scenarios	DM	5437	5508	5637	-	8282	-	-	-	4695	225	273	780	3521	-	6142	2320
	S1	9467	9605	9734	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2	6285	-	-	6353	15054	-	-	-	-	-	-	-	-	-	-	-
	S2a	6285	-	-	6353	15054	-	-	-	-	-	-	-	-	-	-	-
	S3	5461	-	-	-	-	8826	769	769	-	-	-	-	-	-	-	-
	S4	5503	-	-	-	-	-	-	-	5432	5859	-	-	-	-	-	-
	S5	5476	-	-	-	-	-	-	-	-	-	750	-	-	-	-	-
	S6	5474	-	-	-	-	-	-	-	-	-	-	792	3546	-	-	-
	S7	5470	-	-	-	-	-	-	-	-	-	-	-	-	1475	-	-
	S8	5482	-	-	-	-	-	-	-	-	-	-	-	-	-	6275	2367
	S9	5466	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S10	5504	-	-	-	-	-	-	-	5442	5869	-	-	-	-	-	-
	S11	5476	-	-	-	-	-	-	-	-	-	750	-	-	-	-	-
	S12	5474	-	-	-	-	-	-	-	-	-	-	792	3547	-	-	-
	S13	5470	-	-	-	-	-	-	-	-	-	-	-	-	1475	-	-
	S14	5482	-	-	-	-	-	-	-	-	-	-	-	-	-	6279	2368
	S15	6316	-	-	6384	15199	14403	1561	1561	-	-	-	-	-	-	-	-
	S16	6378	-	-	6446	15334	14937	5542	5542	6119	6176	5322	5830	8550	2740	-	-
	S17	6324	-	-	6392	15206	14410	1562	1562	-	-	-	-	-	-	-	-
	S18	6363	-	-	6431	15307	14907	5340	5340	5910	5965	-	-	-	-	-	-
	S19	6365	-	-	6432	15309	14909	5351	5351	5921	5977	-	-	-	-	-	-
	S20	6389	-	-	6456	15345	14949	5561	5561	6140	6197	5339	5847	7569	2748	-	-

Single 2
Combination - Partial Dual 2 and Partial Single 2
Dual 2

Table 8.2 summarises the 2012 vehicle volumes (AADT) at each route section for each of the 20 tested scenarios for 2012. Table 8.3 outlines the corresponding AADT values for 2020 with the AADT results for 2035 summarised in Table 8.4.

TABLE 8.3 2020 AADT FLOWS BY ROUTE SEGMENT

Section		SI	SII-1		SII-2		SIII			SIV		SV	SVI		SVII-1	SVIIa-4-1	
sub-sections between Interchanges		Djurmani-Virpazar	Virpazar-Zabljak	Zabljak-Farmaci	Virpazar-Cetinje int.	Cetinje int.-Farmaci	Farmaci-Tolosi	Tolosi-Niksic	Niksic-Smokovac/Strganica	Smokovac/ Strganica-Pelev	Pelev-Matesevo	Matesevo-Andrijevica	Andrijevica-Berane	Berane-Poda	Poda-Boljare	Poda-Bijelo Polje	Bijelo Polje-Serbia
Scenarios	DM	8562	8625	8797	-	12741	-	-	-	7154	283	339	1054	5208	-	9068	3430
	S1	15195	15314	15488	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2	9775	-	-	9833	23130	-	-	-	-	-	-	-	-	-	-	-
	S2a	9775	-	-	9833	23130	-	-	-	-	-	-	-	-	-	-	-
	S3	8600	-	-	-	-	13695	1171	1171	-	-	-	-	-	-	-	-
	S4	8662	-	-	-	-	-	-	-	8192	8735	-	-	-	-	-	-
	S5	8623	-	-	-	-	-	-	-	-	-	1110	-	-	-	-	-
	S6	8620	-	-	-	-	-	-	-	-	-	-	1085	5231	-	-	-
	S7	8613	-	-	-	-	-	-	-	-	-	-	-	-	2269	-	-
	S8	8630	-	-	-	-	-	-	-	-	-	-	-	-	-	9264	3500
	S9	8616	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S10	8665	-	-	-	-	-	-	-	8225	8769	-	-	-	-	-	-
	S11	8623	-	-	-	-	-	-	-	-	-	1110	-	-	-	-	-
	S12	8620	-	-	-	-	-	-	-	-	-	-	1085	5235	-	-	-
	S13	8613	-	-	-	-	-	-	-	-	-	-	-	-	2269	-	-
	S14	8631	-	-	-	-	-	-	-	-	-	-	-	-	-	9277	3502
	S15	9832	-	-	9891	23387	22391	2354	2354	-	-	-	-	-	-	-	-
	S16	9920	-	-	9979	23552	23068	8405	8405	9150	9231	7966	8682	11193	4103	-	-
	S17	9860	-	-	9917	23412	22415	2355	2355	-	-	-	-	-	-	-	-
	S18	9915	-	-	9972	23527	23038	8104	8104	8837	8916	-	-	-	-	-	-
	S19	9919	-	-	9976	23532	23045	8138	8138	8874	8953	-	-	-	-	-	-
	S20	9958	-	-	10015	23591	23107	8468	8468	9217	9298	8021	8738	11256	4134	-	-

Single 2
Combination - Partial Dual 2 and Partial Single 2
Dual 2

TABLE 8.4 2035 AADT FLOWS BY ROUTE SEGMENT

Section	SI	SII-1		SII-2		SIII			SIV		SV	SVI		SVII-1	SVIIa-4-1	
sub-sections between Interchanges	Djurmani-Virpazar	Virpazar-Zabljak	Zabljak-Farmaci	Virpazar-Cetinje int.	Cetinje int.-Farmaci	Farmaci-Tolosi	Tolosi-Niksic	Niksic-Smokovac/Strganica	Smokovac/ Strganica-Pelev	Pelev-Matesevo	Matesevo-Andrijevica	Andrijevica-Berane	Berane-Poda	Poda-Boljare	Poda-Bijelo Polje	Bijelo Polje-Serbia
DM	11732	11770	12004	-	14185	-	2339	2339	9781	525	582	1452	6105	-	11710	5018
S1	19570	19689	19926	-	-	-	-	-	-	-	-	-	-	-	-	-
S2	14280	-	-	14383	30027	-	-	-	-	-	-	-	-	-	-	-
S2a	14280	-	-	14383	30027	-	-	-	-	-	-	-	-	-	-	-
S3	11783	-	-	-	-	14084	3479	3479	-	-	-	-	-	-	-	-
S4	11864	-	-	-	-	-	-	-	11468	12024	-	-	-	-	-	-
S5	11816	-	-	-	-	-	-	-	-	-	1380	-	-	-	-	-
S6	11813	-	-	-	-	-	-	-	-	-		1526	6097	-	-	-
S7	11083	-	-	-	-	-	-	-	-	-	-	-	-	3436	-	-
S8	11825	-	-	-	-	-	-	-	-	-	-	-	-	-	12036	5204
S9	11829	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S10	11872	-	-	-	-	-	-	-	11638	12112	-	-	-	-	-	-
S11	11816	-	-	-	-	-	-	-	-	-	1380	-	-	-	-	-
S12	11813	-	-	-	-	-	-	-	-	-	-	1527	6103	-	-	-
S13	11803	-	-	-	-	-	-	-	-	-	-	-	-	3436	-	-
S14	11826	-	-	-	-	-	-	-	-	-	-	-	-	-	12064	5211
S15	15156	-	-	15262	31752	30023	5128	5128	-	-	-	-	-	-	-	-
S16	15190	-	-	15297	31872	30575	12880	12880	12346	12475	10766	11635	14607	6042	-	-
S17	16148	-	-	16246	31976	30241	5132	5132	-	-	-	-	-	-	-	-
S18	16197	-	-	16296	32082	30780	12461	12461	11910	12027	-	-	-	-	-	-
S19	16208	-	-	16307	32096	30794	12543	12543	11998	12115	-	-	-	-	-	-
S20	16281	-	-	16380	32186	30884	13032	13032	12519	12638	10915	11787	14736	6113	-	-

Scenarios

Single 2
Combination - Partial Dual 2 and Partial Single 2
Dual 2

The tables indicate that there is very little difference in AADT variation between scenarios testing single and dual carriageway layouts for Route 4. As such, scenario 5 as compared with scenario 11 displays no variation in AADT values. The two scenarios test the addition of the same road section (Section 5) between Matesevo and Andrijevica, with a single carriageway being tested in Scenario 5 and a dual carriageway tested in Scenario 11. This clearly highlights that the predicted flows are generally low in comparison with capacity of the new proposed route, even in its single 2 configuration.

The same low level of variation between dual and single carriageway tests is also visible in the comparison of scenarios 4 and 10 for section 4 (Smokovac – Matesevo), scenarios 6 and 12 for section 6 (Andrijevica – Poda), and both variations of section 7 (Poda – Serbian border) tested in scenarios 7 and 13 as well as 8 and 14 respectively.

The tables also indicate an increase of AADT volumes over time between 2012 and 2035. The increase is more pronounced in scenarios which test longer sections of the proposed road. Thus, the AADT in 2012 for the existing road network results in volumes of 4695 vehicles for route section 4 (Smokovac – Pelev).

The demand then increases to an AADT of 5432 as part of Scenario 4 where a new road section is introduced at this location alone, indicating a 15% growth in traffic. In contrast, introducing this road section as part of a much longer motorway corridor, as tested in scenario 20 (Virpazar – Boljare) results in an AADT increase of 30%, to 6140.

A similar trend is evident in the 2020 and 2035 analysis, with the overall AADT flows considerably higher to account for overall demand growth on the network.

Based on current traffic conditions, as per modelled year 2012, no section of the road would exceed 15,000 vehicles AADT. This would only occur on section 2 between the Cetinje interchange and section 3 on the Podgorica bypass, sections proposed to be dual 2 across most of their length from opening. By 2020, these sections reach traffic levels of about 24,000 vehicles AADT whilst by 2035 these show volumes in the order of 32,000 vehicles AADT. These are well within the capacity of the dual 2 profile proposed.

South of Podgorica, predicted volumes reach a maximum of 20,000 vehicles AADT by 2035. Even without the construction of a second bore at Sozina, the combination of single 2 and dual 2 proposed will cope with the demand.

North of Podgorica, from section 4 onwards, the highest ADDT forecast show a demand of about 14,000 vehicles AADT by 2035, between Berane and Poda. As such, the proposed minimum configuration of single 2 with limited dual 2 sections provides sufficient capacity for such flows and the full dual 2 option is not required even by 2035. It is also clear that there is no benefit to building sections 5, 6 or 7 via Boljare on their own as they are no sufficient connected to the rest of the network to attract demand.

The section between Poda and Bijelo Polje can also be seen as depicting higher AADT flows than sections around, this can be explained by the fact that this section is in fact heavily used by local traffic as a bypass and crossing for the town of Bijelo Polje as the proposed road follows the alignment of the already existing bypass.

As highlighted in section 6.2 of this report, the model is not suitable to test local schemes such as the Podgorica bypass (scenario 3) on its own. The lower volumes on the sections north of Tolosi as predicted for scenario 3 are not realistic and purely a function of the model design in this area. This is not seen as a key issue as it is understood that the Podgorica bypass is currently under study and to be funded by the City. It should be noted that this does not affect the rolling programme scenarios where sections are proposed north of podgorica.

Figure 8.4 shows the traffic levels graphically for the seven sections (including the two alternatives for section 2 and section 7) of the corridor, where direct road connections currently exist.

Figure 8-4: Existing DM AADT flows on the Route 4 Corridor for year 2012

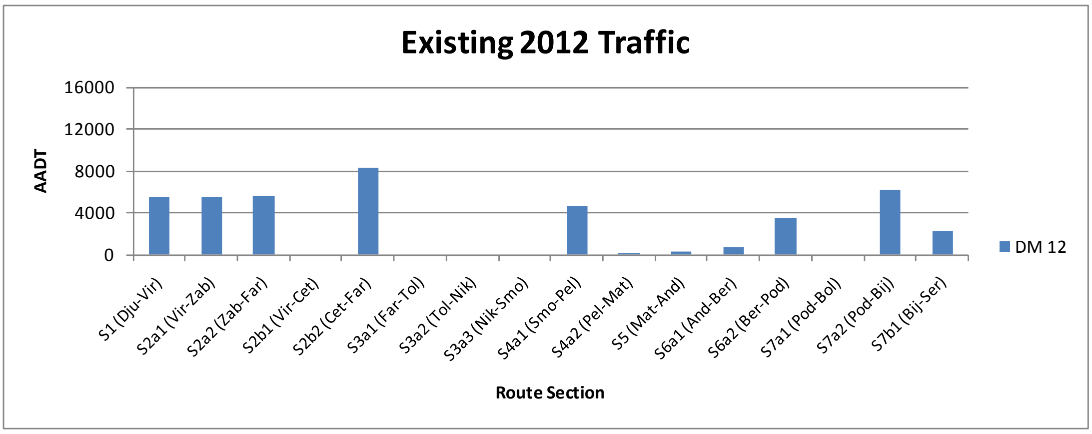
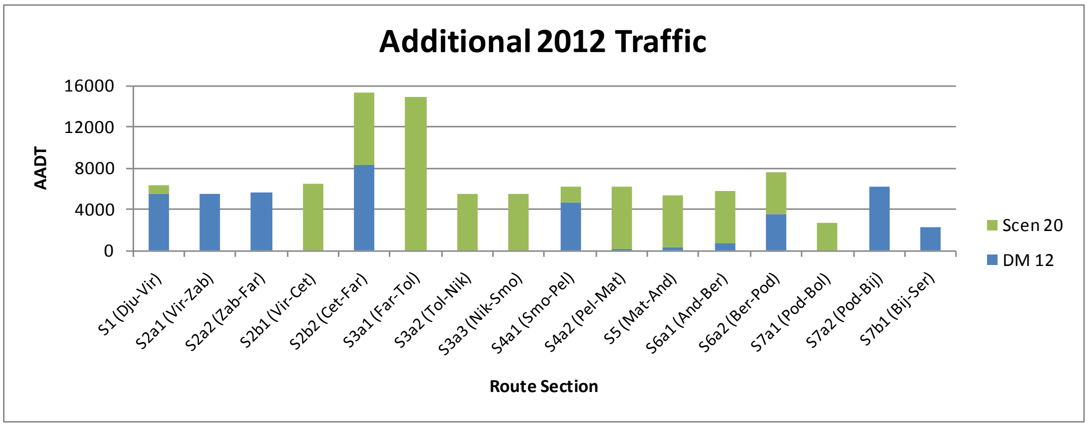


Figure 8.5 considers scenario 20 and shows that along most of the corridor traffic transfers to the new motorway. In the north the old road remains used as it is still the main access to the north west parts of Montenegro from the south especially as the old road remains as an alternative for border crossing into Serbia.

The high demand on the section between the Cetinje interchange and Farmaci (15,000 vehicles AADT) can be explained by the fact that this new section is used by both the existing traffic travelling to Cetinje (8,000 vehicles AADT) but also by traffic which was previously using the old road from Podgorica to the cost via Virpazar (6,000 vehicles AADT). This highlights that alternative 2 for section 2 will bring benefits to more road users than alternative 1 through Zabljak.

A comparison between the two figures also shows that there is an increase in total travel on the corridor in the order of 30%. Experienced AADT levels are still relatively small (up to 15,000 vehicles a day) and do not fully justify the need for a dual two motorway along the corridor.

Figure 8-5: Scenario 20 AADT flows on the Route 4 Corridor for year 2012



Figures 8.6 and 8.7 present similar graphs for year 2035. A similar pattern as for year 2012 tends to emerge. In the DM, the expected flows are below 13,000 suggesting that roads are nearing but have not yet reached full capacity.

Some of the sections of the motorway are predicted to be heavily trafficked by 2035 with levels in excess of 30,000 vehicles AADT. As in 2012, the increase in vehicle volumes is evident along the entire corridor, with particularly marked increases in traffic at the Podgorica bypass section of route.

Figure 8-6: DM AADT flows on the Route 4 Corridor for year 2035

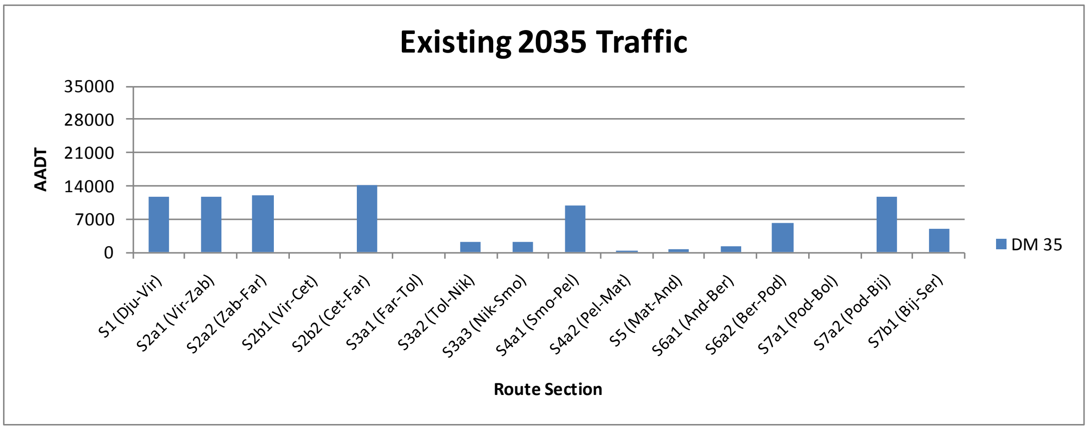
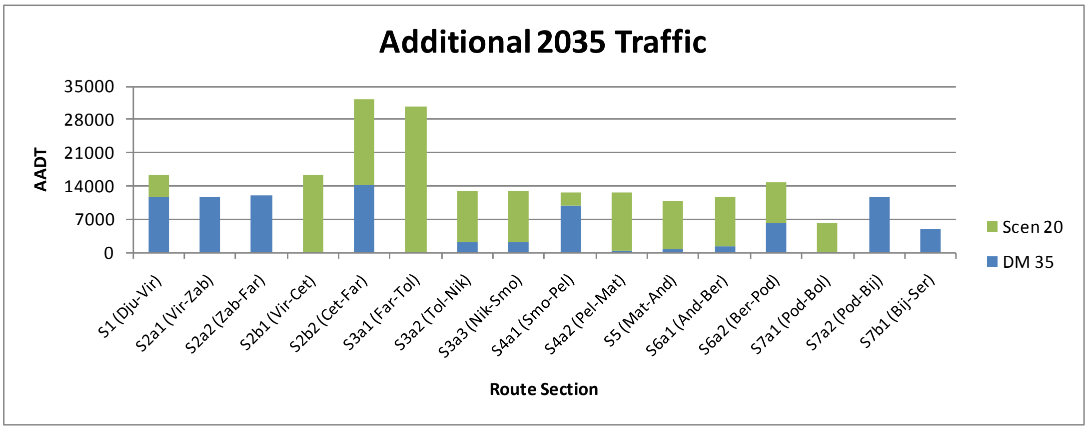


Figure 8-7: Scenario 20 AADT flows on the Route 4 Corridor for year 2035

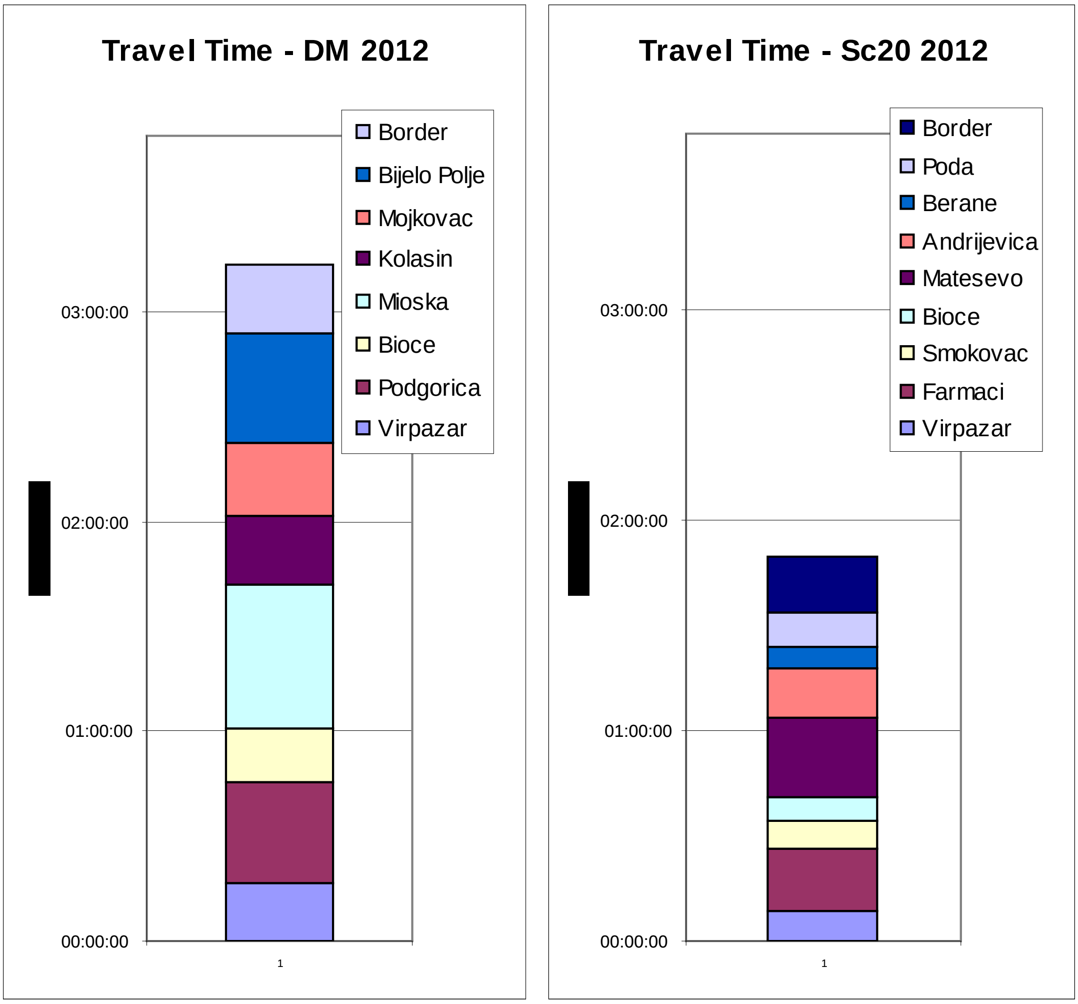


The same analysis, showing an increase in AADT levels for the three analysed years across all 7 sections of the route has been carried out for all 20 scenarios and is summarised in **Appendices 7-9**. In addition wider analysis including AADT volumes, speeds and volume over capacity ratios over the entire network can be found in **Appendices 10-11**.

8.3 Travel Times on the Proposed Motorway

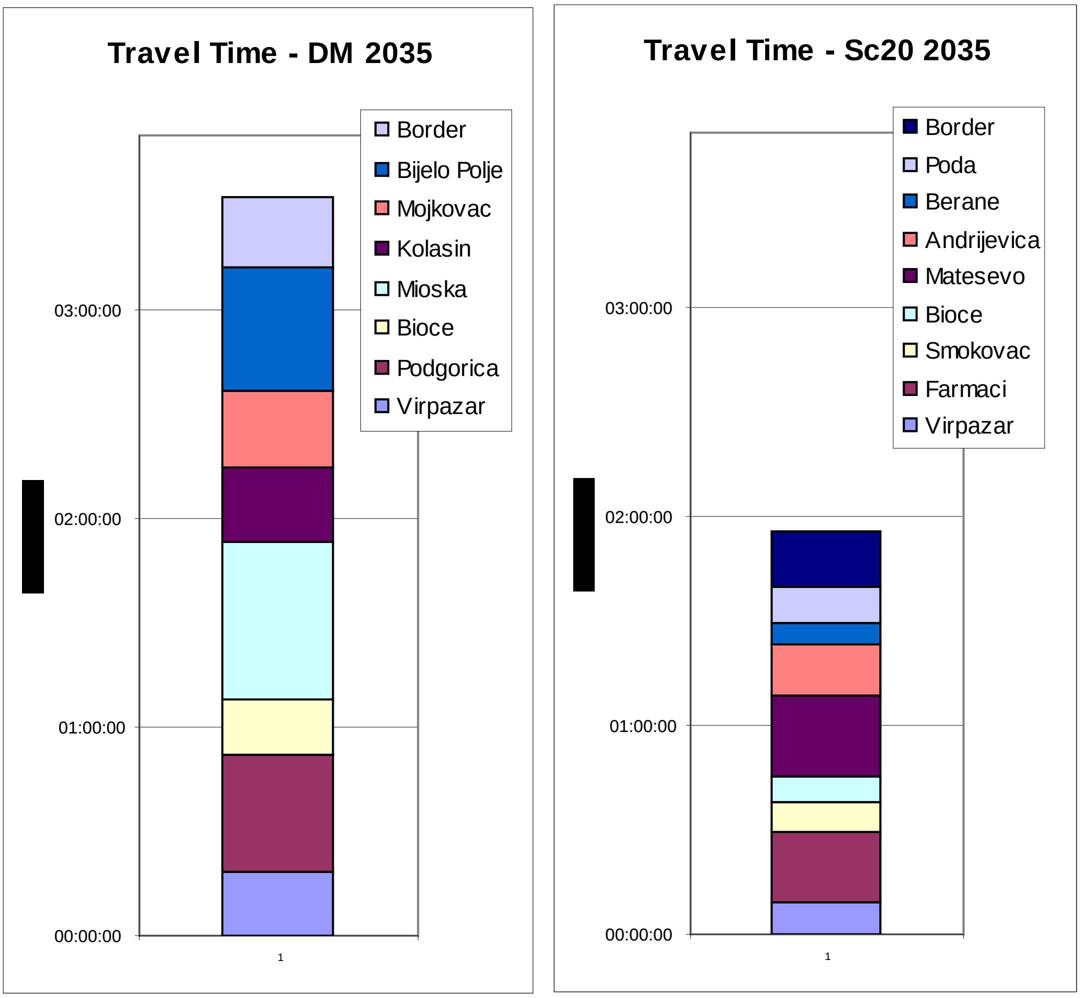
Notional travel times along the corridor have been analysed for year 2012 as depicted in figure 8.8. The diagram shows travel time differences between the Do Minimum scenario and scenario 20, which incorporates the whole length of the proposed motorway. The results show that the new motorway is much faster that the existing road on most sections. Travel time through the entire corridor is expected to be reduced by 40% with the addition of the new proposed road, reducing from 3:13 to 1:49. Travel times decrease at a relatively constant rate, however the greatest reduction in travel time is evident along the Mioska/Bioce and the Bijelo Polje/Berane section. In contrast travel times along the Podgorica/Farmaci section remain relatively unchanged. The small change in the travel time along the Podgorica section could be connected to the increased volumes of traffic and therefore greater levels of congestion in the area.

Figure 8-9: Travel time on the existing road (Route 4 corridor) – year 2012



When considering year 2035, as shown in figures 8.10, again there is a marked reduction in the overall travel time. This is again most pronounced along the Mioska/Bioce and the Bijelo Polje/Berane sections with the Podgorica/Farmaci section remaining relatively unchanged in terms of travel times. The overall travel time for the whole route is expected to be in excess of 3:32 in the 2035 DM scenario. This is reduced to 1:55 with the Route 4 motorway in operation.

Figure 8-10: Travel time on the existing road (Route 4 corridor) – year 2035



Network-wide statistics and additional information on travel times, network speeds and travel distances for Scenarios 1-8, 15 and 20 as well as DM for all three of the analysed years are summarised in **Appendix 12**.

9 OUTPUTS TO ECONOMIC EVALUATION MODEL

This section briefly presents how outputs from the traffic model were processed for input in the economic evaluation model. It includes a description for the model representation, details for the outputs generated and description of the annualisation factors used including specific reference to the impact of road closures.

9.1 Traffic Representation in the Transportation Model

The traffic model represents AADT volumes (Annual Average Daily Traffic). It is the total volume of vehicle traffic of a highway or road for a year divided by 365 days. It is an in between of a weekday and a weekend.

As traffic counts were undertaken towards the end of April 2012 across the Montenegrin road network, adjustments were applied to derive AADT from these April average traffic volumes as detailed in section 4.2 of this report. The adjustments were based on long term trend traffic count data provided by the Montenegrin Road directorate (Crnagoraput) and Monteput d.d.o.

By undertaking this process, issues of seasonal variations have been taken care of. The flows produced by the model are thus lower than those that would be observed during the summer peak but higher than those observed over the winter months when traffic tends to reduce.

9.2 Outputs for Economic Evaluation Model

Traffic data is output directly from the traffic model and includes:

- Vehicle kilometres and vehicle hours;
- For normal and generated (induced) traffic;
- For the Do-Minimum and Do-Something scenarios;
- By type of vehicle, category of road, type of terrain and category of speed;
- For each year modelled in the traffic model (2012, 2020, 2035).

For the situation where the final year of the appraisal period is beyond the final year of data output from the traffic model, the economic model can be set up to either extrapolate benefits or to hold them constant.

9.3 Sensitivity Analysis

All sensitivity analyses were undertaken in the economic evaluation model. The sensitivity analysis reports the EIRR and NPV for percentage variations in:

- Traffic volume (50-150%);
- Generated traffic (0-100%);
- VOC benefits (50-150%);
- VOT benefits (50-150%);
- Investment cost (75-150%);
- O&M costs (75-150%);
- Residual value (0-100%); and
- Accident benefits (50-150%).

9.4 Annualisation Factors

The direct implication of the use of AADT is that the annualisation factor to be used in the economic appraisal should be 365, as used in the current study.

A number of elements, such as the impact of road closure due to bad winter conditions and accidents have been mentioned as potential generators of benefits would the proposed motorway be built. It is important to understand the following:

Over the course of a full year, as considered in the economic appraisal, is the road closure such a major event that it reduces the total number of trips made? Three options are offered to road users, from the most likely to the less likely:

1. Rerouting towards another route to reach their final destinations
2. Delaying, postponing their travel until the road is opened again
3. Cancelling completely their trip or significantly changing their final destinations

Option 1, the most common if available would generate some small disbenefit, increased travel time, increased distance travel, but averaged over the year this would be minimal.

Option 2, can also happen in particular if the road users are well informed of the situation (more likely for winter closures than road accidents). If so no real economic disbenefit can be observed except for those already on the road went the incident (accident) happened, a minimal proportion of travellers.

Option 3, is the one by which some disbenefits could be produced, but this is less likely option (if considered through the course of a full year, not a small period such as a day).

In fact, the disbenefits associated with these three options are minimal. The key element to be considered is the element of reliability and its impact. This is mostly related to delaying departure for a trip knowing that the new road would be quicker and less prone to incidents. This reliability could also generate what is called induced demand, new demand for travel resulting from improvements in travel time, safety and reliability. The current study has calculated such induced demand (section 7.6 of this report) and its associated benefits have been included in the economic appraisal.

10 CONCLUSION

This report has provided details on the development of a VISUM traffic model for the SEETO Road Route 4 motorway scheme in Montenegro.

The base year model, developed from a variety of data sources including RSI, counts and WTP surveys, has been successfully calibrated against observed traffic data fro year 2012.

Following the development of the base year model, forecast networks and matrices were produced for two modelling years 2020 and 2035. These networks and matrices were created for a variety of scenarios, representing individual sections as well as rolling programmes. The test assignments also looked at different cross sections considering single 2, Combination - Partial Dual 2 and Partial Single 2, and dual 2 options, to determine the effects of capacity on the proposed road usage.

The SEETO Road Route 4 motorway has a clear strategic role to play in the regional highway network. It will offer a superior connection of the Montenegrin capital to the remainder of the country's road network as well as offering a link to other countries in the region. This will potentially encourage the growth of the tourist industry and overall economic growth as well as providing the infrastructure for fast, safe and reliable travel.

The traffic predictions have shown that traffic travelling along the SEETO Route 4 corridor will also use roads which make up the existing key road network, in order to access or egress the proposed route.

The traffic model predictions suggest alternative 2 for section 2 will bring benefits to more road users than alternative 1 through Zabljak as this new section will be used by both the existing traffic travelling to Cetinje (8,000 vehicles AADT) but also by traffic which was previously using the old road from Podgorica to the cost via Virpazar.

Otherwise, south of Podgorica, predicted volumes reach a maximum of 20,000 vehicles AADT by 2035. Even without the construction of a second bore at Sozina, the combination of single 2 and dual 2 proposed will cope with the demand.

North of Podgorica, from section 4 onwards, the highest ADDT forecast show a demand of about 14,000 vehicles AADT by 2035, between Berane and Poda. As such, the proposed minimum configuration of single 2 with limited dual 2 sections provides sufficient capacity for such flows and the full dual 2 option is not required even by 2035. It is also clear that there is no benefit to building sections 5, 6 or 7 via Boljare on their own as they are not sufficiently connected to the rest of the network to attract demand.

The section between Poda and Bijelo Polje can also be seen as depicting higher AADT flows than sections around, this can be explained by the fact that this section is in fact heavily used by local traffic as a bypass and crossing for the town of Bijelo Polje as the proposed road follows the alignment of the already existing bypass.

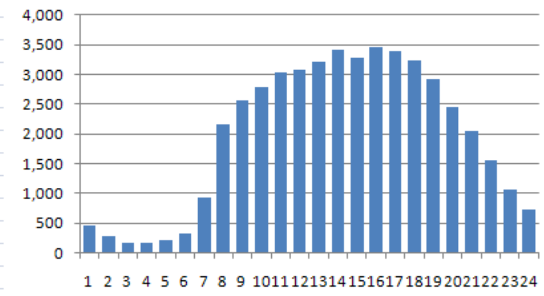
Would the entire SEETO Route 4 corridor be built, journeys currently taking about 3 hours:30 minutes from the coast to the Serbian border can be expected to be reduced to under 2 hours.

It is concluded that the VISUM traffic model was developed successfully and is producing results that are both robust and sensible. Data from the model is therefore considered to be suitable for use in the economic appraisal of the SEETO Route 4 scheme.

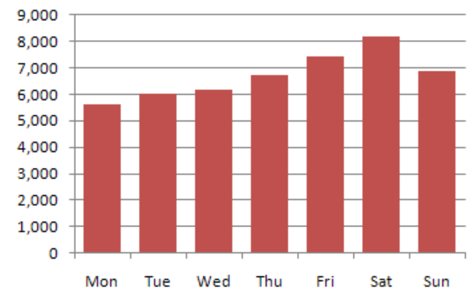
APPENDIX 1 ATC AND TRAFFIC COUNT RESULTS

Count Site 1	Between Budva and Cetinje								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.00	1.08
Car	4,863	5,082	5,249	5,737	6,388	7,253	6,317	40,889	5841	5825	6303
Light van/Minibus	367	407	398	425	439	351	213	2,600	371	366	396
Truck/Bus	382	530	523	542	592	569	325	3,463	495	485	525
Total	5,612	6,019	6,170	6,704	7,419	8,173	6,855	46,952	6,707	6,676	7,224

Daily Traffic Distribution, Count Site 1

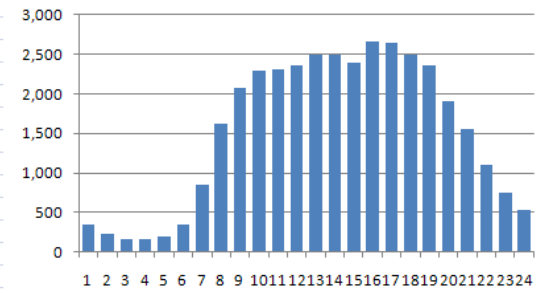


Weekly Traffic Distribution, Count Site 1

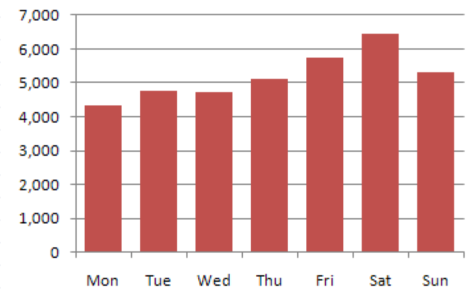


Count Site 2	Between Budva and Petrovac								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.00	1.08
Car	3,842	4,152	4,126	4,479	5,063	5,725	4,954	32,341	4620	4605	4984
Light van/Minibus	230	281	288	323	308	340	176	1,946	278	273	295
Truck/Bus	271	311	297	314	363	376	195	2,127	304	299	324
Total	4,343	4,744	4,711	5,116	5,734	6,441	5,325	36,414	5,202	5,177	5,603

Daily Traffic Distribution, Count Site 2

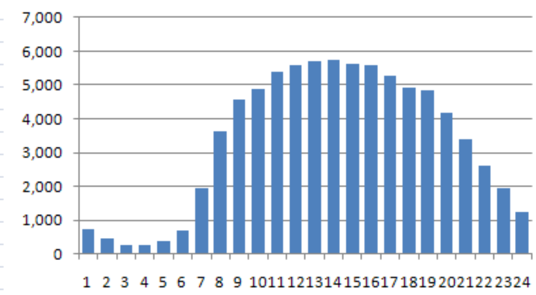


Weekly Traffic Distribution, Count Site 2

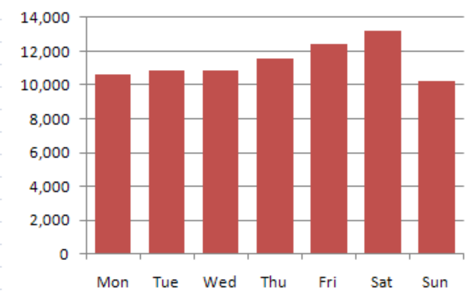


Count Site 3	Between Petrovac and Bar								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.99	1.08
Car	9,500	9,683	9,633	10,319	11,154	11,941	9,517	71,747	10250	10200	11038
Light van/Minibus	457	515	490	522	522	575	319	3,400	486	479	519
Truck/Bus	655	669	722	731	747	674	367	4,565	652	643	696
Total	10,612	10,867	10,845	11,572	12,423	13,190	10,203	79,712	11,387	11,322	12,252

Daily Traffic Distribution, Count Site 3

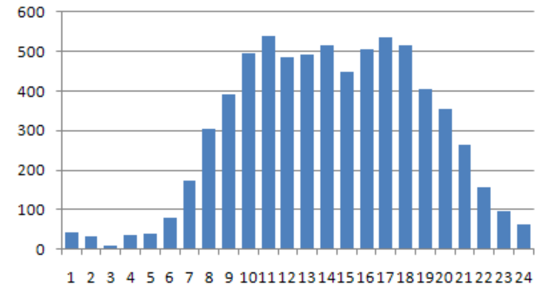


Weekly Traffic Distribution, Count Site 3

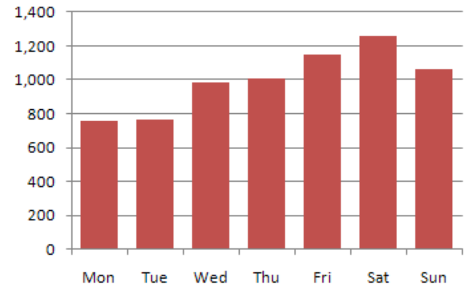


Count Site 4	Old Road between Virpazar and Petrovac								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.99	1.08
Car	604	587	791	829	945	1,071	974	**5,801**	829	826	894
Light van/Minibus	44	57	66	77	61	77	27	**409**	58	57	62
Truck/Bus	112	123	123	98	140	108	61	**765**	109	108	117
Total	**760**	**767**	**980**	**1,004**	**1,146**	**1,256**	**1,062**	**6,975**	**996**	**991**	**1,072**

Daily Traffic Distribution, Count Site 4

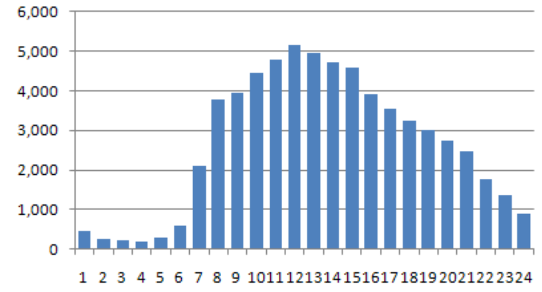


Weekly Traffic Distribution, Count Site 4

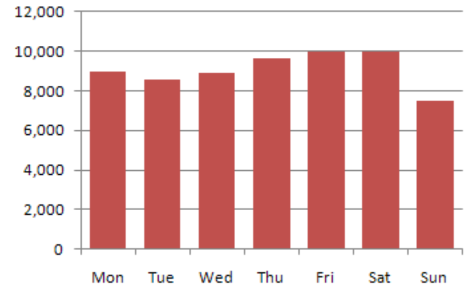


Count Site 5	Between Podgorica and Tuzi								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.99	1.08
Car	8,309	7,875	8,218	8,900	9,212	9,322	7,155	**58,991**	8427	8381	9069
Light van/Minibus	239	231	218	265	268	299	113	**1,633**	233	229	248
Truck/Bus	434	453	450	470	487	371	198	**2,863**	409	403	436
Total	**8,982**	**8,559**	**8,886**	**9,635**	**9,967**	**9,992**	**7,466**	**63,487**	**9,070**	**9,013**	**9,754**

Daily Traffic Distribution, Count Site 5

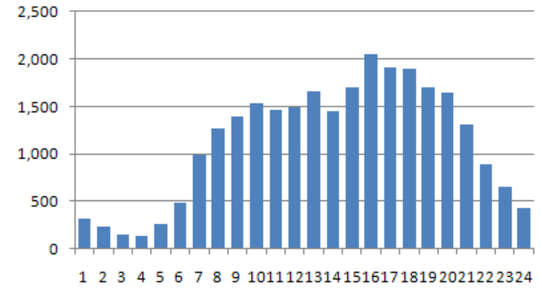


Weekly Traffic Distribution, Count Site 5

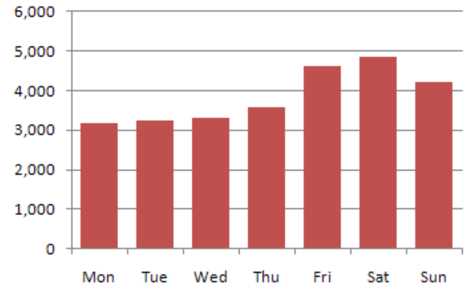


Count Site 6	Between Crkvine and Kolašin								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.00	1.08
Car	2,276	2,336	2,278	2,547	3,537	3,999	3,599	**20,572**	2939	2939	3180
Light van/Minibus	265	278	318	306	345	302	220	**2,034**	291	287	311
Truck/Bus	623	622	719	728	720	565	401	**4,378**	625	618	669
Total	**3,164**	**3,236**	**3,315**	**3,581**	**4,602**	**4,866**	**4,220**	**26,984**	**3,855**	**3,844**	**4,160**

Daily Traffic Distribution, Count Site 6

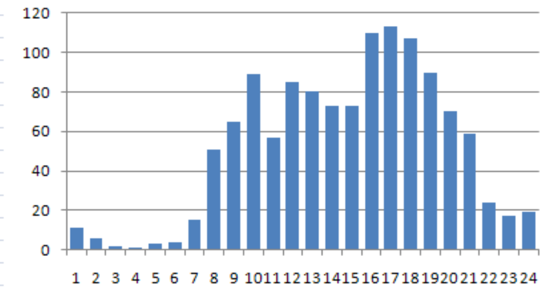


Weekly Traffic Distribution, Count Site 6

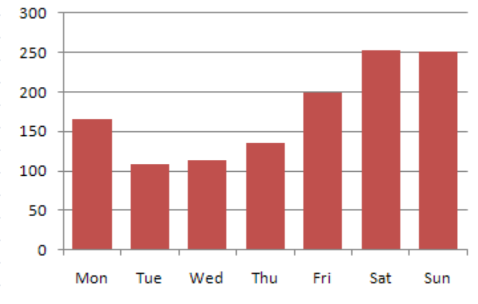


Count Site 7	Between Mateševo and Kraljske Bare								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.01	1.08
Car	160	106	104	129	190	249	249	1,187	170	172	186
Light van/Minibus	2	1	4	4	9	1	2	23	3	3	3
Truck/Bus	4	1	5	2	0	2	0	14	2	2	2
Total	**166**	**108**	**113**	**135**	**199**	**252**	**251**	**1,224**	**175**	**177**	**192**

Daily Traffic Distribution, Count Site 7

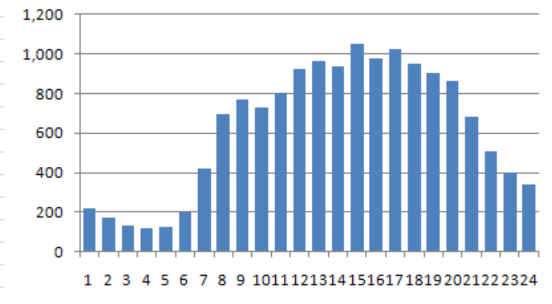


Weekly Traffic Distribution, Count Site 7

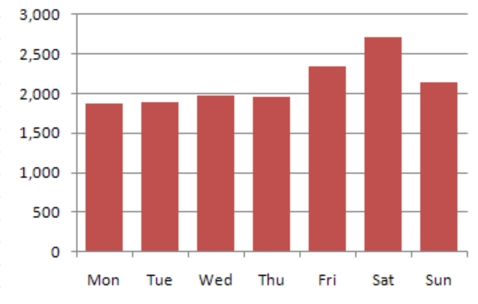


Count Site 8	Between Berane and Rožaje								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.00	1.08
Car	1,488	1,431	1,475	1,508	1,847	2,189	1,804	11,742	1677	1675	1813
Light van/Minibus	110	143	158	137	185	171	122	1,026	147	145	156
Truck/Bus	275	314	347	319	319	353	217	2,144	306	302	327
Total	**1,873**	**1,888**	**1,980**	**1,964**	**2,351**	**2,713**	**2,143**	**14,912**	**2,130**	**2,122**	**2,296**

Daily Traffic Distribution, Count Site 8

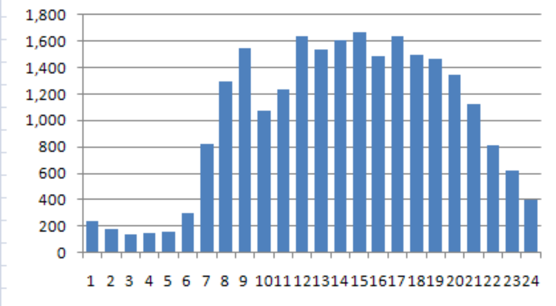


Weekly Traffic Distribution, Count Site 8

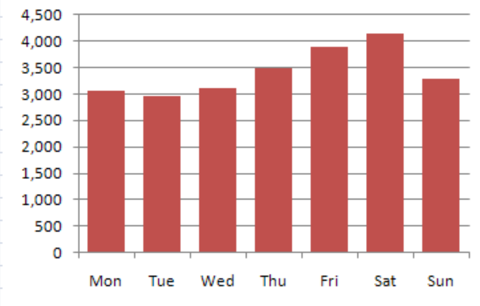


Count Site 9	Interchange "Ribarevine"								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.00	1.08
Car	2,521	2,300	2,413	2,781	3,158	3,435	2,830	**19,438**	2777	2770	2998
Light van/Minibus	193	273	285	287	295	296	177	**1,806**	258	253	274
Truck/Bus	358	388	423	427	436	413	277	**2,722**	389	384	416
Total	**3,072**	**2,961**	**3,121**	**3,495**	**3,889**	**4,144**	**3,284**	**23,966**	**3,424**	**3,407**	**3,687**

Daily Traffic Distribution, Count Site 9

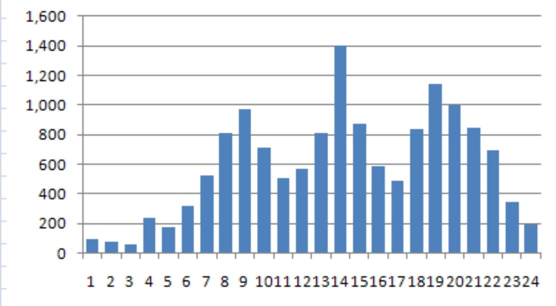


Weekly Traffic Distribution, Count Site 9

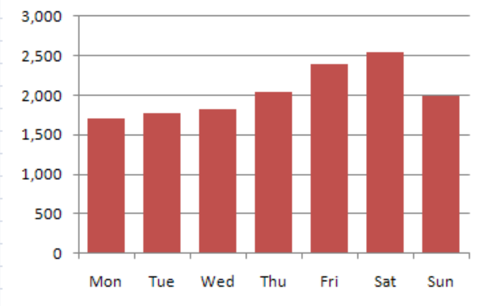


Count Site 10	Between Bijelo Polje and border								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.99	1.08
Car	1,327	1,344	1,359	1,508	1,906	2,181	1,743	**11,368**	1624	1618	1751
Light van/Minibus	52	61	55	80	83	58	46	**435**	62	61	66
Truck/Bus	333	374	416	448	411	302	208	**2,492**	356	350	379
Total	**1,712**	**1,779**	**1,830**	**2,036**	**2,400**	**2,541**	**1,997**	**14,295**	**2,042**	**2,030**	**2,196**

Daily Traffic Distribution, Count Site 10

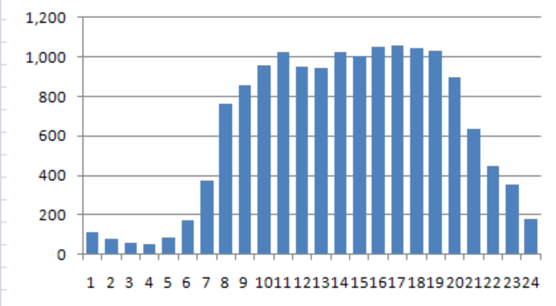


Weekly Traffic Distribution, Count Site 10

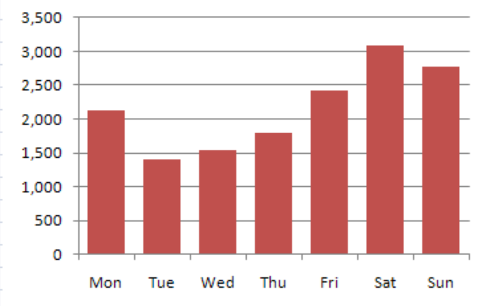


Count Site 11	Between Nikšić and Jasenovo Polje								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.01	1.08
Car	1,864	1,195	1,303	1,543	2,106	2,808	2,559	**13,378**	1911	1931	2090
Light van/Minibus	124	78	102	100	121	113	108	**746**	107	107	116
Truck/Bus	148	135	143	148	199	161	104	**1,038**	148	147	159
Total	**2,136**	**1,408**	**1,548**	**1,791**	**2,426**	**3,082**	**2,771**	**15,162**	**2,166**	**2,185**	**2,365**

Daily Traffic Distribution, Count Site 11

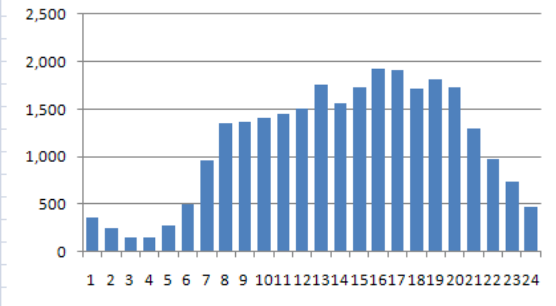


Weekly Traffic Distribution, Count Site 11

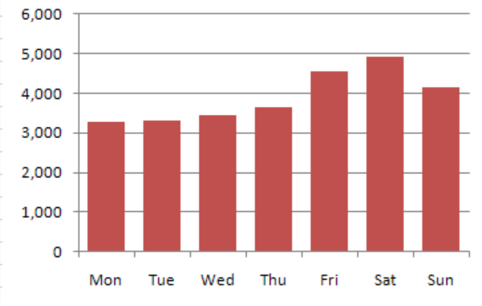


Count Site 12	Between Kolašin and Mojkovac								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.00	1.08
Car	2,414	2,393	2,449	2,610	3,537	4,029	3,527	**20,959**	2994	2993	3238
Light van/Minibus	210	241	305	288	305	285	186	**1,820**	260	256	277
Truck/Bus	636	687	690	746	707	610	443	**4,519**	646	639	691
Total	**3,260**	**3,321**	**3,444**	**3,644**	**4,549**	**4,924**	**4,156**	**27,298**	**3,900**	**3,887**	**4,206**

Daily Traffic Distribution, Count Site 12

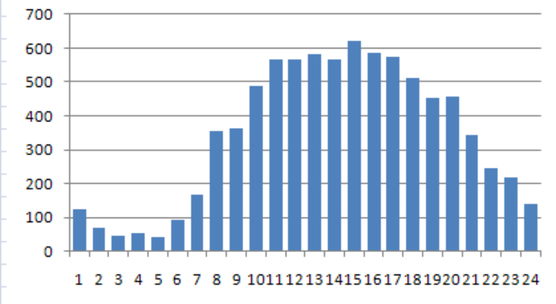


Weekly Traffic Distribution, Count Site 12

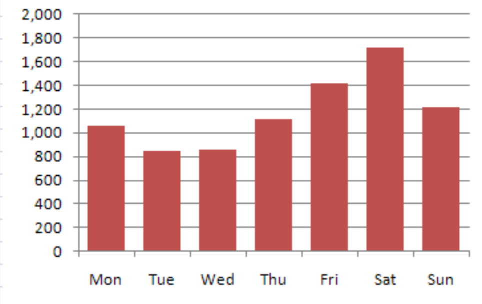


Count Site 13	Between Pljevlja and serbian border								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	1.00	1.08
Car	954	736	766	972	1,225	1,625	1,148	**7,426**	1061	1060	1147
Light van/Minibus	72	50	27	58	83	31	29	**350**	50	50	54
Truck/Bus	36	65	64	79	110	67	38	**459**	66	64	69
Total	**1,062**	**851**	**857**	**1,109**	**1,418**	**1,723**	**1,215**	**8,235**	**1,176**	**1,174**	**1,270**

Daily Traffic Distribution, Count Site 13

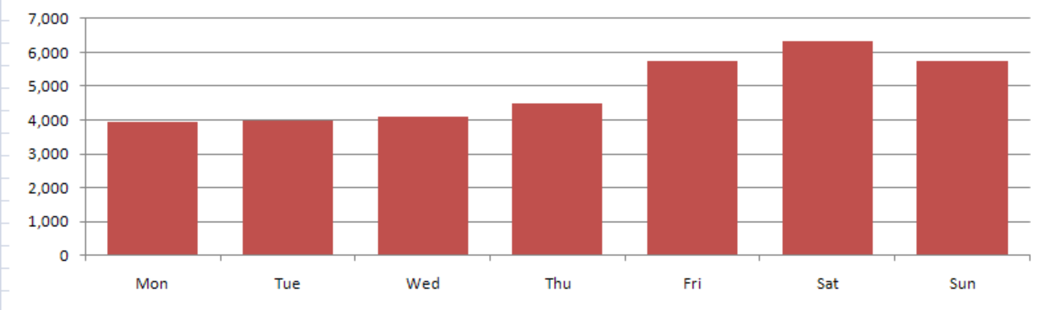


Weekly Traffic Distribution, Count Site 13



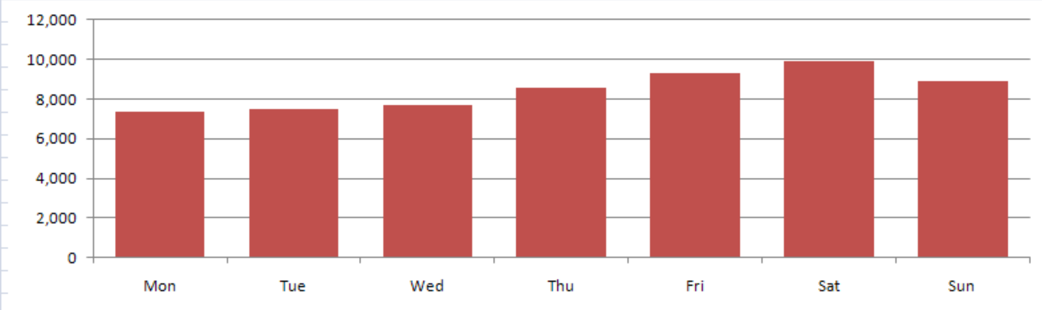
Count Site 14	M-2 Podgorica - Kolašin								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.88	1.08
Car	3,170	3,208	3,302	3,614	4,602	5,097	4,631	27,624	3946	3459	3743
Light van/Minibus	241	244	251	275	350	388	353	2,103	300	263	285
Truck/Bus	530	537	552	604	770	852	774	4,620	660	578	626
Total	**3,941**	**3,989**	**4,106**	**4,493**	**5,722**	**6,337**	**5,758**	**34,346**	**4,907**	**4,301**	**4,654**

Weekly Traffic Distribution, Count Site 14



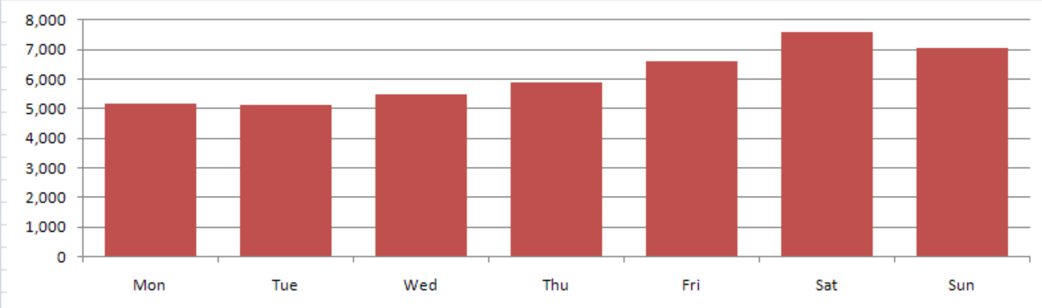
Count Site 15	M-2.3 Podgorica - Cetinje								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.87	1.08
Car	6,360	6,454	6,619	7,377	8,003	8,514	7,649	50,976	7282	6337	6857
Light van/Minibus	481	488	500	557	605	643	578	3,852	550	479	518
Truck/Bus	548	556	570	636	690	734	659	4,393	628	546	591
Total	**7,389**	**7,498**	**7,690**	**8,570**	**9,297**	**9,891**	**8,886**	**59,221**	**8,460**	**7,361**	**7,966**

Weekly Traffic Distribution, Count Site 15



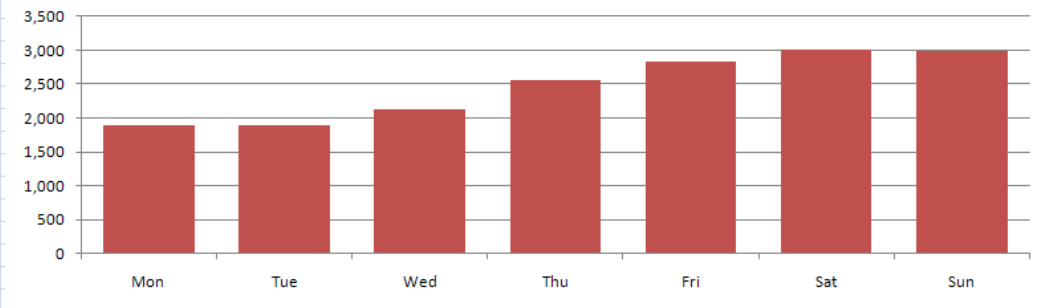
Count Site 16	M-2 Virpazar - Podgorica								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.88	1.08
Car	4,312	4,281	4,602	4,907	5,507	6,341	5,892	35,841	5120	4487	4856
Light van/Minibus	291	289	311	331	372	428	398	2,421	346	303	328
Truck/Bus	558	554	596	635	713	821	763	4,640	663	581	629
Total	**5,161**	**5,124**	**5,508**	**5,874**	**6,592**	**7,590**	**7,053**	**42,902**	**6,129**	**5,371**	**5,812**

Weekly Traffic Distribution, Count Site 16



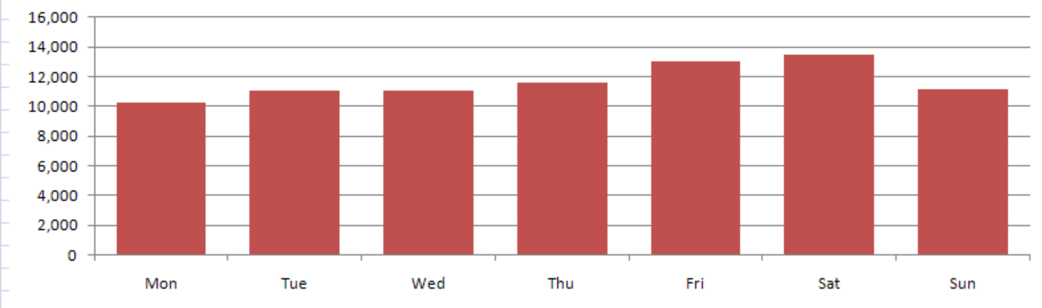
Count Site 17	M-6 Vilusi - Nikšić								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.89	1.08
Car	1,616	1,618	1,819	2,179	2,417	2,571	2,548	**14,768**	2110	1882	2037
Light van/Minibus	49	49	55	66	73	77	77	**444**	63	57	61
Truck/Bus	227	227	255	306	339	361	358	**2,074**	296	264	286
Total	**1,892**	**1,894**	**2,129**	**2,551**	**2,829**	**3,009**	**2,982**	**17,286**	**2,469**	**2,203**	**2,384**

Weekly Traffic Distribution, Count Site 17



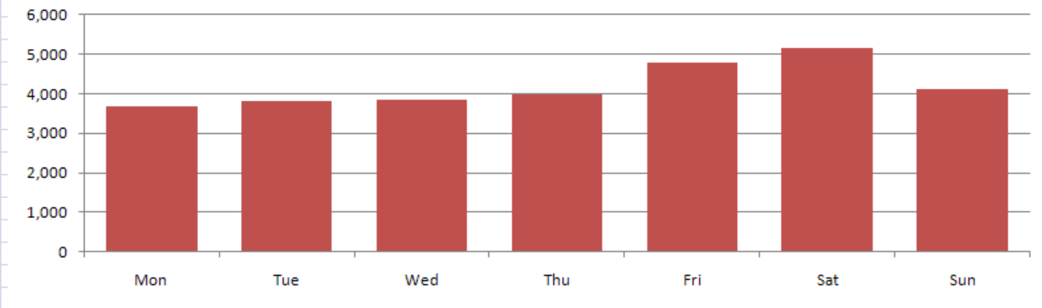
Count Site 18	M-2 Tivat - Budva								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.89	1.08
Car	8,595	9,262	9,321	9,708	10,919	11,301	9,383	**68,490**	9784	8660	9371
Light van/Minibus	674	726	731	761	856	886	735	**5,368**	767	679	734
Truck/Bus	969	1,044	1,051	1,094	1,231	1,274	1,058	**7,720**	1103	976	1056
Total	**10,238**	**11,032**	**11,102**	**11,563**	**13,006**	**13,461**	**11,176**	**81,578**	**11,654**	**10,314**	**11,162**

Weekly Traffic Distribution, Count Site 18



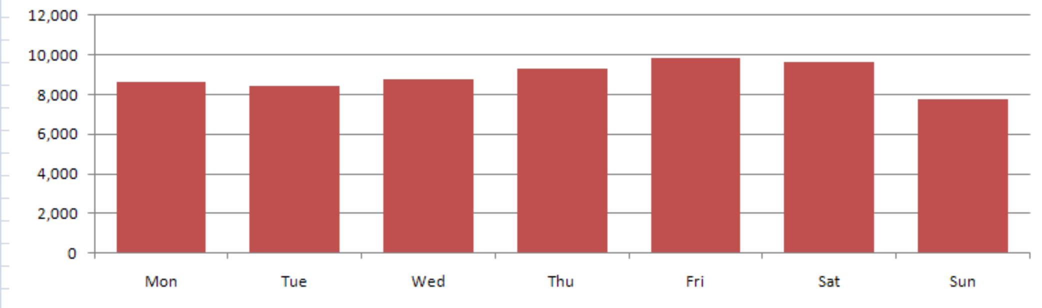
Count Site 19	M-2 Mojkovac - Ribarevina								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.91	1.08
Car	2,879	2,985	3,009	3,113	3,750	4,024	3,229	**22,989**	3284	2973	3218
Light van/Minibus	262	271	274	283	341	366	294	**2,091**	299	270	293
Truck/Bus	537	557	561	581	699	751	602	**4,288**	613	555	600
Total	**3,678**	**3,813**	**3,844**	**3,977**	**4,790**	**5,141**	**4,125**	**29,368**	**4,195**	**3,799**	**4,111**

Weekly Traffic Distribution, Count Site 19



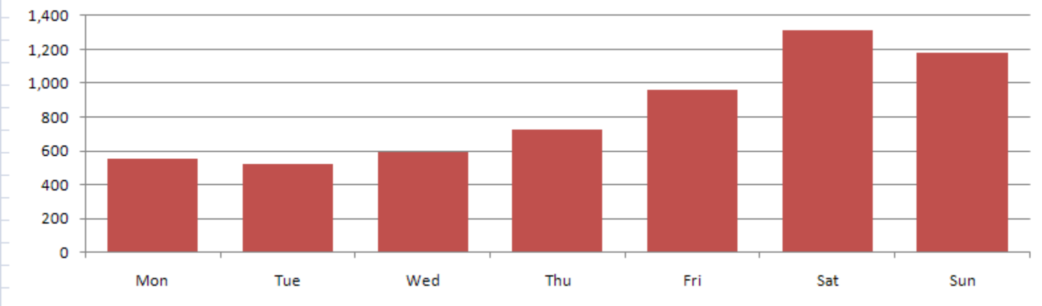
Count Site 20	M-18 Danilovgrad - Podgorica								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.93	1.08
Car	7,300	7,163	7,429	7,902	8,306	8,164	6,587	**52,851**	7550	6984	7558
Light van/Minibus	625	613	636	676	711	699	564	**4,523**	646	598	647
Truck/Bus	699	686	711	756	795	781	630	**5,059**	723	669	723
Total	**8,624**	**8,461**	**8,776**	**9,334**	**9,812**	**9,644**	**7,781**	**62,432**	**8,919**	**8,251**	**8,928**

Weekly Traffic Distribution, Count Site 20



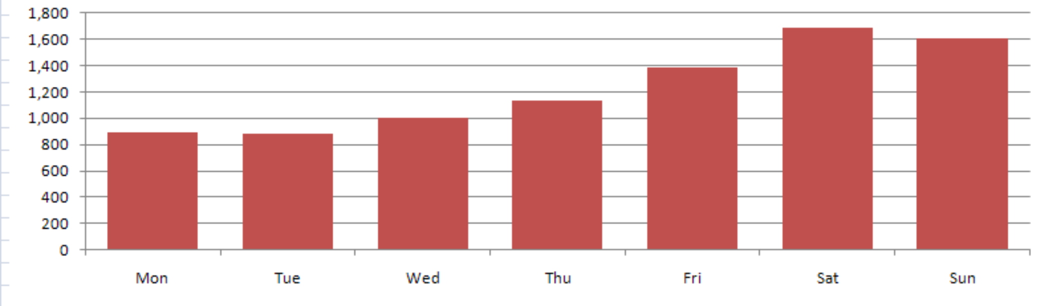
Count Site 21	novi put Šavnik - Žabljak								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.80	1.08
Car	484	440	497	623	836	1,195	1,088	**5,164**	738	584	632
Light van/Minibus	32	29	39	40	48	48	46	**282**	40	34	36
Truck/Bus	38	50	55	60	79	69	44	**394**	56	47	51
Total	**555**	**519**	**590**	**723**	**963**	**1,312**	**1,178**	**5,840**	**834**	**664**	**719**

Weekly Traffic Distribution, Count Site 21



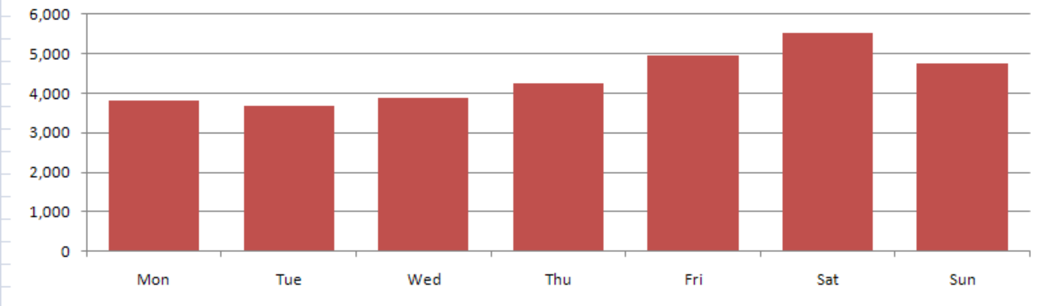
Count Site 22	novi put Lipci - Grahovo - Vilusi								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		1.00	0.88	1.08
Car	760	758	859	965	1,186	1,446	1,373	**7,347**	1050	920	995
Light van/Minibus	23	23	26	29	36	43	41	**221**	32	28	30
Truck/Bus	107	106	121	136	167	203	193	**1,032**	147	129	140
Total	**890**	**887**	**1,006**	**1,130**	**1,388**	**1,692**	**1,607**	**8,600**	**1,229**	**1,077**	**1,165**

Weekly Traffic Distribution, Count Site 22



Count Site 23	Sozina Tunnel								Factors		
Date	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	Total	AWDT	AMDT	AADT
Vehicle Type	Mon	Tue	Wed	Thu	Fri	Sat	Sun		2.00	0.99	1.08
Car	3,204	3,060	3,201	3,534	4,193	4,793	4,194	**26,178**	3740	3709	4014
Light van/Minibus	205	211	227	244	274	264	199	**1,624**	232	229	248
Truck/Bus	400	418	445	461	503	484	363	**3,074**	439	433	468
Total	**3,809**	**3,688**	**3,873**	**4,240**	**4,970**	**5,540**	**4,756**	**30,877**	**4,411**	**4,371**	**4,730**

Weekly Traffic Distribution, Count Site 23



APPENDIX 2 DESCRIPTION OF COMMODITY GROUPS

Chapter	NST/R groups	Description
0	1	Cereals
	02, 03	Potatoes, other fresh or frozen fruit and vegetables
	00, 06	Live animals, sugar beet
	5	Wood and cork
	04, 09	Textiles, textile articles and man-made fibres, other raw animal and vegetable materials
1	11, 12, 13, 14, 16, 17	Foodstuffs and animal fodder
	18	Oil seeds and oleaginous fruits and fats
2	21, 22, 23	Solid mineral fuels
3	31	Crude petroleum
	32, 33, 34	Petroleum products
4	41, 46	Iron ore, iron and steel waste and blast furnace dust
	45	Non-ferrous ores and waste
5	51, 52, 53,54, 55, 56	Metal products
6	64, 69	Cement, lime, manufactured building materials
	61, 62, 63,65	Crude and manufactured minerals
7	71, 72	Natural and chemical fertilizers
8	83	Coal chemicals, tar
	81, 82, 89	Chemicals other than coal chemicals and tar
	84	Paper pulp and waste paper
9	91, 92, 93	Transport equipment, machinery, apparatus, engines, whether or not assembled, and parts thereof
	94	Manufactures of metal
	95	Glass, glassware, ceramic products
	96, 97	Leather, textile, clothing, other manufactured articles
	99	Miscellaneous articles

APPENDIX 3 DOUBLE COUNTING MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	0	0	0	1	3	3	2	1	1	3	2	2	4	5	5	2	5	6	7	2	5	0	0	6	7	4	6	6	7	6	87
2	0	0	0	1	3	3	2	0	4	3	1	1	4	5	5	4	5	6	7	4	5	0	0	6	7	4	6	6	7	6	98
3	0	0	0	1	3	3	2	0	4	3	1	1	4	5	5	4	5	6	7	4	5	0	0	6	7	4	6	6	7	6	105
4	1	1	1	0	2	2	1	1	3	2	2	2	3	4	4	3	4	4	4	3	4	1	1	4	4	3	4	4	4	4	80
5	3	3	3	2	0	0	3	1	1	0	2	2	1	2	2	1	2	2	2	1	2	3	2	2	2	1	2	2	2	2	53
6	3	3	3	2	0	0	3	1	1	0	2	2	1	2	2	1	2	2	2	1	2	3	2	2	2	0	2	2	2	2	52
7	2	2	2	1	3	3	0	0	2	1	1	3	2	3	3	2	3	3	3	2	3	2	1	3	3	2	3	3	3	3	67
8	1	0	0	3	1	1	2	0	0	1	1	1	2	3	3	1	3	3	5	1	3	1	1	1	5	2	1	4	5	4	59
9	1	4	4	3	1	1	2	0	0	1	1	1	2	3	3	1	3	4	5	1	3	1	1	4	5	2	4	4	5	4	74
10	3	3	3	2	0	0	1	1	1	0	2	2	1	2	2	1	2	3	4	1	2	3	2	3	4	1	3	3	4	3	62
11	2	1	1	4	2	2	3	1	1	2	0	0	0	1	1	0	1	2	3	0	1	2	0	0	3	3	0	2	3	2	43
12	2	1	1	4	2	2	3	1	1	2	0	0	0	1	1	0	1	2	3	0	1	2	0	0	3	3	0	2	3	2	43
13	4	4	4	3	1	1	2	2	2	1	0	0	0	1	1	0	1	2	3	1	1	4	0	2	3	2	2	2	3	2	54
14	5	5	5	4	2	2	3	3	3	2	1	1	1	0	0	1	1	0	1	1	1	5	1	2	1	3	2	2	1	2	61
15	5	5	5	4	2	2	3	3	3	2	1	1	1	0	0	1	1	0	1	1	1	5	1	2	1	3	2	2	1	2	61
16	2	4	4	3	1	1	2	1	1	1	0	0	0	1	1	0	0	1	2	0	0	2	0	0	2	2	0	1	2	1	35
17	5	5	5	4	2	2	3	3	3	2	1	1	1	1	1	0	0	1	2	0	0	5	0	1	2	3	1	1	2	1	58
18	6	6	6	5	3	3	4	4	4	3	2	2	2	0	0	1	1	0	1	1	1	6	1	2	1	4	2	2	1	2	76
19	7	7	7	6	4	4	5	5	5	4	3	3	3	1	1	2	2	1	0	2	2	7	2	3	0	5	3	3	0	3	100
20	2	4	4	3	1	1	2	1	1	1	0	0	1	1	1	0	0	1	2	0	0	2	0	0	2	2	0	1	2	1	36
21	5	5	5	4	2	2	3	3	3	2	1	1	1	1	1	0	0	1	2	0	0	5	0	1	2	3	1	1	2	1	58
22	0	0	0	1	3	3	2	1	1	3	2	2	4	5	5	2	5	6	7	2	5	0	0	6	7	4	6	6	7	6	101
23	0	0	0	1	2	2	1	1	1	2	0	0	0	1	1	0	0	1	2	0	0	0	0	0	3	3	0	1	3	1	26
24	6	6	6	5	3	3	4	1	4	3	0	0	2	2	2	0	1	2	3	0	1	6	0	0	3	4	0	0	3	0	70
25	7	7	7	6	4	4	5	5	5	4	3	3	3	1	1	2	2	1	0	2	2	7	3	3	0	5	3	3	0	3	101
26	4	4	4	3	1	0	2	2	2	1	3	3	2	3	3	2	3	4	5	2	3	4	3	4	5	0	4	4	5	4	89
27	6	6	6	5	3	3	4	1	4	3	0	0	2	2	2	0	1	2	3	0	1	6	0	0	3	4	0	0	3	0	70
28	6	6	6	5	3	3	4	4	4	3	2	2	2	2	2	1	1	2	3	1	1	6	1	0	3	4	0	0	3	0	80
29	7	7	7	6	4	4	5	5	5	4	3	3	3	1	1	2	2	1	0	2	2	7	3	3	0	5	3	3	0	3	101
30	6	6	6	5	3	3	4	4	4	3	2	2	2	2	2	1	1	2	3	1	1	6	1	0	3	4	0	0	3	0	80
	101	105	105	95	58	57	82	55	74	62	37	39	54	61	61	33	58	71	92	36	58	101	26	66	93	89	66	76	93	76	2080

APPENDIX 4 PRIOR MATRICES

CAR PRIOR MATRIX - AADT IN VEHICLES - INCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	7	44	29	235	159	27	58	257	65	266	11	0	4	0	1	0	4	12	1	18	11	7	31	25	1	2	0	0	0	0	1275
2	0	43	7	1040	100	5	71	215	10	185	0	0	0	0	0	2	0	8	0	2	8	0	0	20	0	0	0	0	0	0	1717
3	0	11	7	1032	227	50	152	248	15	410	0	0	8	0	4	5	1	16	1	2	21	0	0	27	0	4	0	0	0	0	2242
4	210	1205	1222	1859	1152	142	615	504	43	1090	0	5	13	0	4	7	2	29	3	19	18	57	62	70	0	4	2	0	0	2	8339
5	78	91	132	786	2401	176	75	157	87	885	0	0	11	8	0	32	3	53	46	40	55	15	17	100	0	0	0	0	2	0	5249
6	11	29	19	81	66	22	12	22	11	225	0	0	0	0	0	0	0	3	32	0	27	5	0	29	32	0	0	0	0	0	625
7	46	51	99	508	96	13	9	114	36	955	0	0	4	0	2	0	2	2	0	0	8	0	14	11	2	0	0	0	0	0	1974
8	269	109	206	126	434	44	91	916	22	1322	194	129	20	10	6	86	10	26	3	75	15	11	151	69	0	0	0	0	0	0	4342
9	31	7	10	32	0	0	9	0	104	1355	22	0	5	0	2	0	0	0	0	0	13	0	0	3	0	0	0	0	0	0	1593
10	243	139	450	1020	1313	311	1631	1816	1741	8924	11	22	336	43	35	54	66	175	36	89	211	21	122	128	16	129	11	0	0	0	19093
11	0	0	0	0	11	5	0	194	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	237
12	0	0	0	0	22	0	0	366	0	43	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	442
13	4	0	2	27	22	33	5	27	11	315	0	0	599	35	14	0	174	37	3	7	64	0	0	33	2	0	0	0	2	0	1415
14	3	2	0	0	5	0	0	0	0	10	0	0	83	0	0	0	0	9	19	0	19	0	0	7	0	0	0	0	0	0	157
15	0	0	0	0	0	0	0	4	0	44	0	0	0	0	0	0	0	0	19	0	54	0	9	5	10	0	2	0	0	5	152
16	0	0	3	5	0	0	0	194	0	108	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	319
17	2	1	1	3	11	11	7	14	0	68	0	0	111	0	9	0	0	45	5	0	14	0	11	0	0	0	0	0	0	0	315
18	5	2	5	18	37	7	5	16	0	132	0	0	5	0	0	0	45	306	331	9	426	2	11	68	29	0	2	0	0	0	1460
19	3	1	1	8	1	10	2	0	0	16	0	0	2	0	24	0	11	311	0	5	74	0	5	0	0	2	0	0	0	0	477
20	21	15	5	5	25	44	0	11	11	74	0	0	0	0	0	0	0	18	0	0	5	4	11	0	0	0	0	0	0	0	248
21	15	4	5	14	9	11	7	20	20	156	0	0	58	14	18	0	36	545	55	5	1883	0	32	124	7	0	0	0	0	5	3041
22	0	7	0	25	54	29	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	0	0	0	0	145
23	0	29	14	11	13	11	7	43	0	75	0	0	7	0	0	0	0	18	7	0	0	0	11	14	0	0	0	0	0	0	260
24	20	11	19	41	87	21	3	68	8	93	0	0	0	9	5	0	0	50	0	10	152	1	0	0	0	0	0	0	0	0	597
25	0	2	0	1	0	17	0	0	0	14	0	0	2	0	10	0	0	10	0	0	5	0	0	0	0	0	0	0	0	8	67
26	0	0	0	3	22	7	0	65	0	215	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	313
27	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	5
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	5	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	11
30	2	0	2	2	0	3	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	0	0	0	24
	968	1803	2239	6885	6271	998	2764	5271	2184	17035	237	155	1265	118	136	187	356	1684	560	291	3087	122	485	738	107	145	17	0	4	19	56133

CAR PRIOR MATRIX - AADT IN VEHICLES - EXCLUDING INTRAZONAL TRIPS

1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	0	27	22	273	126	24	58	180	74	270	6	0	4	0	2	0	5	14	2	21	15	9	37	37	2	2	0	0	0	0	1211
2	0	0	9	1232	86	6	75	203	12	210	0	0	0	0	0	2	0	12	0	2	9	0	0	26	0	0	0	0	0	0	1884
3	0	12	0	1214	197	36	153	248	16	445	0	0	8	0	7	3	2	21	2	2	27	0	0	37	0	4	0	0	0	0	2436
4	248	1438	1456	0	850	94	530	512	53	1051	0	4	11	0	6	4	3	45	2	16	27	68	57	84	0	3	3	0	0	2	6567
5	70	94	119	594	0	106	59	155	96	575	0	0	12	12	0	24	6	68	54	32	48	13	10	126	0	0	0	0	4	0	2277
6	11	27	20	66	40	0	11	27	14	151	0	0	0	0	0	0	0	6	41	0	18	6	0	40	37	0	0	0	0	0	515
7	39	60	99	442	73	10	0	135	48	1381	0	0	5	0	4	0	4	4	0	0	12	0	20	18	3	0	0	0	0	0	2357
8	212	117	173	140	332	27	89	0	12	1621	107	71	26	8	8	48	13	37	5	49	20	14	83	97	0	0	0	0	0	0	3309
9	37	9	9	41	0	0	12	0	0	1719	12	0	7	0	4	0	0	0	0	0	17	0	0	3	0	0	0	0	0	0	1870
10	276	163	496	1114	882	208	2270	2196	2205	0	6	12	414	73	61	36	82	242	55	120	288	25	91	212	20	94	7	0	0	0	11650
11	0	0	0	0	6	6	0	107	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138
12	0	0	0	0	12	0	0	202	0	32	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	259
13	4	0	3	28	13	21	6	32	13	386	0	0	0	82	23	0	289	67	4	12	118	0	0	56	3	0	0	0	3	0	1163
14	4	2	0	0	7	0	0	0	0	21	0	0	237	0	0	0	0	13	35	0	43	0	0	13	0	0	0	0	0	0	375
15	0	0	0	0	0	0	0	3	0	63	0	0	0	0	0	0	0	0	35	0	79	0	13	9	17	0	4	0	0	7	229
16	0	0	3	7	0	0	0	107	0	72	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	202
17	2	2	2	3	12	7	8	18	0	89	0	0	185	0	13	0	0	66	9	0	74	0	12	0	0	0	0	0	0	0	503
18	6	3	6	22	33	4	7	20	0	173	0	0	7	0	0	0	66	0	589	13	836	2	12	167	52	0	4	0	0	0	2022
19	3	1	1	12	2	9	2	0	0	25	0	0	3	0	43	0	17	554	0	7	134	0	7	0	0	2	0	0	0	0	824
20	23	17	6	6	35	27	0	12	14	106	0	0	0	0	0	0	0	26	0	0	25	4	14	0	0	0	0	0	0	0	316
21	19	5	6	16	12	7	8	25	25	201	0	0	109	38	26	0	53	899	91	25	0	0	41	390	11	0	0	0	0	25	2030
22	0	9	0	31	34	23	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	132
23	0	34	19	14	17	7	10	24	0	66	0	0	9	0	0	0	0	26	11	0	0	0	0	19	0	0	0	0	0	0	255
24	28	16	22	52	89	26	9	103	16	172	0	0	0	15	9	0	0	141	0	49	614	1	0	0	0	0	0	0	0	0	1364
25	0	3	0	1	0	20	0	0	0	20	0	0	3	0	17	0	0	17	0	0	9	0	0	0	0	0	0	0	0	10	101
26	0	0	0	3	13	9	0	36	0	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	202
27	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	5
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	11
30	2	0	3	1	0	3	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	2	0	0	0	0	29
	985	2039	2475	5314	2875	679	3314	4346	2598	9047	131	87	1039	229	224	117	540	2271	933	363	2418	142	399	1345	151	110	18	0	7	43	44238

LGV PRIOR MATRIX - AADT IN VEHICLES - INCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	6	5	0	19	7	3	5	32	6	35	0	0	1	0	0	0	0	0	0	3	1	3	0	1	0	0	0	0	0	0	126
2	0	0	3	70	3	2	2	11	1	9	0	0	1	0	0	0	0	1	0	0	1	3	0	0	0	0	0	0	0	0	108
3	0	3	5	92	12	6	10	49	0	43	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	223
4	36	120	58	56	58	19	30	20	2	86	0	0	0	0	1	2	0	0	1	0	0	6	6	3	0	0	0	0	0	0	503
5	10	11	7	22	92	0	2	21	17	15	0	0	0	0	0	0	0	12	0	10	9	0	0	3	0	0	0	0	0	0	232
6	3	1	1	6	9	5	2	0	0	20	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	49
7	2	5	5	23	6	2	0	26	5	94	0	0	2	0	0	0	1	0	0	0	0	0	5	0	0	0	2	0	0	0	177
8	28	11	31	9	5	9	5	61	0	49	18	24	0	0	0	0	1	3	1	6	0	0	0	8	0	0	0	0	0	0	270
9	0	0	1	2	0	8	5	6	11	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91
10	22	12	19	47	72	32	131	237	119	229	0	0	14	4	1	6	4	18	4	17	25	0	10	15	2	2	2	0	1	0	1045
11	0	0	0	0	0	0	0	6	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
12	0	0	0	0	0	0	0	12	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
13	1	1	0	1	5	0	2	0	0	46	0	0	27	0	0	0	8	0	0	0	8	0	0	0	0	0	0	0	0	0	100
14	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
15	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	5
16	0	0	0	0	0	0	2	24	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
17	1	0	0	0	2	0	0	7	2	3	0	0	8	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	28
18	0	1	2	1	0	0	1	3	0	8	0	0	0	0	0	0	5	5	23	10	35	0	0	1	5	0	0	0	0	0	99
19	0	0	0	0	2	0	0	0	0	4	0	0	1	0	0	0	0	23	0	0	14	0	0	2	0	0	0	0	0	0	45
20	2	1	0	0	10	5	0	11	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46
21	2	3	0	0	6	0	0	2	4	14	0	0	7	0	10	0	0	52	11	0	92	0	0	6	0	0	0	0	0	0	209
22	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
23	0	0	0	0	2	0	5	6	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	18
24	0	0	0	1	5	0	0	13	1	17	0	0	2	1	0	0	0	2	0	0	7	0	0	0	0	0	0	0	0	0	50
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
26	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	113	174	133	354	297	91	201	548	167	783	18	24	65	5	12	7	20	125	44	47	195	13	20	39	8	2	4	0	1	1	3509

LGV PRIOR MATRIX - AADT IN VEHICLES - EXCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	0	5	0	19	7	3	5	32	6	35	0	0	1	0	0	0	0	0	0	3	1	3	0	1	0	0	0	0	0	0	120
2	0	0	3	70	3	2	2	11	1	9	0	0	1	0	0	0	0	1	0	0	1	3	0	0	0	0	0	0	0	0	108
3	0	3	0	92	12	6	10	49	0	43	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	219
4	36	120	58	0	58	19	30	20	2	86	0	0	0	0	1	2	0	0	1	0	0	6	6	3	0	0	0	0	0	0	447
5	10	11	7	22	0	0	2	21	17	15	0	0	0	0	0	0	0	12	0	10	9	0	0	3	0	0	0	0	0	0	140
6	3	1	1	6	9	0	2	0	0	20	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	45
7	2	5	5	23	6	2	0	26	5	94	0	0	2	0	0	0	1	0	0	0	0	0	5	0	0	0	2	0	0	0	177
8	28	11	31	9	5	9	5	0	0	49	18	24	0	0	0	0	1	3	1	6	0	0	0	8	0	0	0	0	0	0	208
9	0	0	1	2	0	8	5	6	0	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80
10	22	12	19	47	72	32	131	237	119	0	0	0	14	4	1	6	4	18	4	17	25	0	10	15	2	2	2	0	1	0	816
11	0	0	0	0	0	0	0	6	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
12	0	0	0	0	0	0	0	12	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
13	1	1	0	1	5	0	2	0	0	46	0	0	0	0	0	0	8	0	0	0	8	0	0	0	0	0	0	0	0	0	73
14	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
15	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	5
16	0	0	0	0	0	0	2	24	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
17	1	0	0	0	2	0	0	7	2	3	0	0	8	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	28
18	0	1	2	1	0	0	1	3	0	8	0	0	0	0	0	0	5	0	23	10	35	0	0	1	5	0	0	0	0	0	94
19	0	0	0	0	2	0	0	0	0	4	0	0	1	0	0	0	0	23	0	0	14	0	0	2	0	0	0	0	0	0	45
20	2	1	0	0	10	5	0	11	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46
21	2	3	0	0	6	0	0	2	4	14	0	0	7	0	10	0	0	52	11	0	0	0	0	6	0	0	0	0	0	0	117
22	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
23	0	0	0	0	2	0	5	6	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	18
24	0	0	0	1	5	0	0	13	1	17	0	0	2	1	0	0	0	2	0	0	7	0	0	0	0	0	0	0	0	0	50
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
26	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	107	174	128	298	205	86	201	487	156	553	18	24	38	5	12	7	20	120	44	47	103	13	20	39	8	2	4	0	1	1	2920

HGV PRIOR MATRIX - AADT IN VEHICLES - INCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	0	0	0	8	20	12	5	61	0	67	0	0	0	3	0	0	0	7	1	12	3	0	12	6	1	0	0	0	0	0	219
2	17	33	0	50	6	0	9	32	8	24	0	0	0	0	0	0	0	0	0	2	3	0	0	6	0	0	0	0	0	0	189
3	0	8	0	67	9	5	5	84	0	46	0	0	0	0	0	0	0	2	1	2	6	0	0	13	0	0	0	0	0	0	247
4	8	62	107	27	20	0	0	37	3	27	0	0	0	2	0	0	0	0	0	0	2	0	40	1	0	0	0	0	0	0	337
5	35	13	17	36	64	0	12	56	0	87	0	0	0	0	0	0	0	5	5	0	5	0	6	38	14	0	2	0	0	3	397
6	13	4	6	2	0	0	6	8	0	34	0	0	0	0	0	0	0	0	0	6	3	11	2	14	0	0	0	0	0	0	109
7	0	0	0	9	0	5	0	0	4	108	0	0	3	0	0	0	0	0	0	0	0	4	12	3	0	0	0	0	0	0	148
8	80	0	51	1	59	17	0	121	0	32	23	23	0	0	0	0	0	3	7	23	3	23	68	6	0	0	0	0	0	0	540
9	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	47
10	54	18	58	36	71	20	43	347	103	315	4	0	13	0	17	6	12	25	2	64	33	25	46	38	4	0	19	0	0	8	1382
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	2	0	0	0	0	0	0	26	0	0	46	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	79
14	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15	0	0	0	0	17	0	0	2	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
16	5	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
17	0	0	2	0	0	0	0	2	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
18	3	1	7	1	19	2	0	4	2	30	0	0	17	0	0	0	0	65	33	12	8	0	0	0	0	0	0	0	0	0	205
19	0	0	0	0	2	0	0	1	0	3	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39
20	0	0	0	0	4	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	55
21	0	2	3	2	22	0	0	8	0	8	0	0	9	0	35	0	8	78	20	0	107	0	0	41	0	0	0	0	0	0	342
22	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	2	0	0	0	8	0	0	0	0	0	17
23	19	0	0	4	4	2	0	45	0	23	0	0	0	0	0	0	0	0	0	0	0	0	23	0	19	2	0	0	0	0	142
24	7	2	6	8	58	12	0	86	2	59	0	0	8	4	0	0	0	4	0	0	41	1	31	0	12	0	0	0	0	0	340
25	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
26	0	0	0	8	0	0	0	0	0	87	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	97
27	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
28	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
29	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
	241	143	260	260	380	77	79	918	122	1045	27	23	97	42	52	6	21	193	69	122	252	91	240	167	58	4	21	0	0	11	5018

HGV PRIOR MATRIX - AADT IN VEHICLES - EXCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	0	0	0	8	20	12	5	61	0	67	0	0	0	3	0	0	0	7	1	12	3	0	12	6	1	0	0	0	0	0	219
2	17	0	0	50	6	0	9	32	8	24	0	0	0	0	0	0	0	0	0	2	3	0	0	6	0	0	0	0	0	0	156
3	0	8	0	67	9	5	5	84	0	46	0	0	0	0	0	0	0	2	1	2	6	0	0	13	0	0	0	0	0	0	247
4	8	62	107	0	20	0	0	37	3	27	0	0	0	2	0	0	0	0	0	0	2	0	40	1	0	0	0	0	0	0	310
5	35	13	17	36	0	0	12	56	0	87	0	0	0	0	0	0	0	5	5	0	5	0	6	38	14	0	2	0	0	3	333
6	13	4	6	2	0	0	6	8	0	34	0	0	0	0	0	0	0	0	0	6	3	11	2	14	0	0	0	0	0	0	109
7	0	0	0	9	0	5	0	0	4	108	0	0	3	0	0	0	0	0	0	0	0	4	12	3	0	0	0	0	0	0	148
8	80	0	51	1	59	17	0	0	0	32	23	23	0	0	0	0	0	3	7	23	3	23	68	6	0	0	0	0	0	0	418
9	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	47
10	54	18	58	36	71	20	43	347	103	0	4	0	13	0	17	6	12	25	2	64	33	25	46	38	4	0	19	0	0	8	1068
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	2	0	0	0	0	0	0	26	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	32
14	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15	0	0	0	0	17	0	0	2	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
16	5	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
17	0	0	2	0	0	0	0	2	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
18	3	1	7	1	19	2	0	4	2	30	0	0	17	0	0	0	0	0	33	12	8	0	0	0	0	0	0	0	0	0	139
19	0	0	0	0	2	0	0	1	0	3	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39
20	0	0	0	0	4	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	55
21	0	2	3	2	22	0	0	8	0	8	0	0	9	0	35	0	8	78	20	0	0	0	0	41	0	0	0	0	0	0	235
22	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	2	0	0	0	8	0	0	0	0	0	17
23	19	0	0	4	4	2	0	45	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	2	0	0	0	0	119
24	7	2	6	8	58	12	0	86	2	59	0	0	8	4	0	0	0	4	0	0	41	1	31	0	12	0	0	0	0	0	340
25	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
26	0	0	0	8	0	0	0	0	0	87	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	97
27	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
28	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
29	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
	241	110	260	233	316	77	79	797	122	730	27	23	51	42	52	6	21	128	69	122	144	91	218	167	58	4	21	0	0	11	4217

APPENDIX 5 ESTIMATED MATRICES

CAR ESTIMATED MATRIX - AADT IN VEHICLES - INCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	10	62	41	361	209	35	82	69	18	62	9	0	1	0	0	0	1	0	0	1	3	10	3	16	0	10	0	0	0	0	1002
2	0	60	10	1597	131	7	100	58	14	189	0	0	0	0	0	0	0	1	0	0	9	0	0	13	0	0	0	0	0	0	2190
3	0	15	10	1585	298	66	214	67	21	419	0	0	6	0	0	0	1	2	0	0	24	0	0	18	0	84	0	0	0	0	2830
4	242	1387	1406	2613	1386	171	1129	111	33	1453	0	1	12	0	1	0	2	4	0	1	27	66	5	92	0	110	3	0	0	3	10257
5	131	153	222	1616	3375	247	201	51	80	1408	0	0	13	1	0	2	3	8	8	3	99	25	2	157	0	0	0	0	0	0	7805
6	19	49	32	166	93	31	32	7	10	358	0	0	0	0	0	0	0	0	6	0	48	8	0	46	6	0	0	0	0	0	911
7	61	68	131	823	133	18	13	160	21	975	0	0	3	0	0	0	1	0	0	0	9	0	1	11	0	0	0	0	0	0	2430
8	87	35	67	45	131	13	128	1288	31	1604	848	181	17	1	1	25	7	3	0	22	21	4	321	235	0	0	0	0	0	0	5115
9	10	10	14	31	0	0	8	0	146	1645	96	0	4	0	0	0	0	0	0	0	18	0	0	4	0	0	0	0	0	0	1985
10	45	127	411	1137	1568	371	1578	1474	1413	12546	28	37	339	6	5	91	53	24	6	71	334	4	150	178	3	3734	15	0	0	0	25746
11	0	0	0	0	11	5	0	861	0	103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	980
12	0	0	0	0	7	0	0	515	0	55	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	580
13	1	0	1	20	18	27	3	28	6	300	0	0	842	4	2	0	193	4	0	8	141	0	0	64	0	0	0	0	0	0	1663
14	0	0	0	0	1	0	0	0	0	2	0	0	18	0	0	0	0	13	32	0	34	0	0	11	0	0	0	0	0	0	111
15	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	32	0	96	0	16	8	17	0	3	0	0	8	189
16	0	0	0	0	0	0	0	44	0	139	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	213
17	1	1	1	3	11	11	6	18	0	81	0	0	195	0	1	0	0	151	20	0	39	0	15	0	0	0	0	0	0	0	555
18	0	0	1	3	6	1	1	2	0	26	0	0	1	0	0	0	147	430	563	16	756	0	20	106	49	0	3	0	0	0	2131
19	0	0	0	2	0	2	0	0	0	4	0	0	1	0	41	0	44	534	0	11	160	0	11	0	0	10	0	0	0	0	821
20	1	1	0	0	1	2	0	2	2	95	0	0	0	0	0	0	0	30	0	0	7	0	15	0	0	0	0	0	0	0	159
21	8	6	7	24	17	20	11	48	25	342	0	0	188	24	30	0	93	919	112	7	2647	0	45	153	14	0	0	0	0	6	4747
22	0	10	0	38	71	38	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	10	0	0	0	0	174
23	0	6	3	3	3	2	1	169	0	254	0	0	6	0	0	0	0	30	14	0	0	0	15	233	0	0	0	0	0	0	740
24	17	9	16	67	151	37	4	246	9	190	0	0	0	14	8	0	0	79	0	226	200	1	0	0	0	0	0	0	0	0	1273
25	0	0	0	0	0	4	0	0	0	3	0	0	1	0	17	0	0	17	0	0	11	0	0	0	0	0	0	0	0	15	68
26	0	0	0	38	31	10	0	600	0	3437	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4120
27	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	9
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	6
30	1	0	3	3	0	5	6	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	84	0	0	0	0	117
	634	1999	2375	10179	7654	1124	3515	5818	1830	25715	981	220	1647	50	106	119	542	2280	796	368	4687	118	620	1352	99	4041	24	0	1	32	78926

CAR ESTIMATED MATRIX - AADT IN VEHICLES - EXCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1		62	41	361	209	35	82	69	18	62	9	0	1	0	0	0	1	0	0	1	3	10	3	16	0	10	0	0	0	0	992
2	0		10	1597	131	7	100	58	14	189	0	0	0	0	0	0	0	1	0	0	9	0	0	13	0	0	0	0	0	0	2129
3	0	15		1585	298	66	214	67	21	419	0	0	6	0	0	0	1	2	0	0	24	0	0	18	0	84	0	0	0	0	2820
4	242	1387	1406		1386	171	1129	111	33	1453	0	1	12	0	1	0	2	4	0	1	27	66	5	92	0	110	3	0	0	3	7643
5	131	153	222	1616		247	201	51	80	1408	0	0	13	1	0	2	3	8	8	3	99	25	2	157	0	0	0	0	0	0	4430
6	19	49	32	166	93		32	7	10	358	0	0	0	0	0	0	0	0	6	0	48	8	0	46	6	0	0	0	0	0	880
7	61	68	131	823	133	18		160	21	975	0	0	3	0	0	0	1	0	0	0	9	0	1	11	0	0	0	0	0	0	2417
8	87	35	67	45	131	13	128		31	1604	848	181	17	1	1	25	7	3	0	22	21	4	321	235	0	0	0	0	0	0	3827
9	10	10	14	31	0	0	8	0		1645	96	0	4	0	0	0	0	0	0	0	18	0	0	4	0	0	0	0	0	0	1839
10	45	127	411	1137	1568	371	1578	1474	1413		28	37	339	6	5	91	53	24	6	71	334	4	150	178	3	3734	15	0	0	0	13200
11	0	0	0	0	11	5	0	861	0	103		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	980
12	0	0	0	0	7	0	0	515	0	55	0		0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	580
13	1	0	1	20	18	27	3	28	6	300	0	0		4	2	0	193	4	0	8	141	0	0	64	0	0	0	0	0	0	821
14	0	0	0	0	1	0	0	0	0	2	0	0	18		0	0	0	13	32	0	34	0	0	11	0	0	0	0	0	0	111
15	0	0	0	0	0	0	0	0	0	9	0	0	0	0		0	0	0	32	0	96	0	16	8	17	0	3	0	0	8	189
16	0	0	0	0	0	0	0	44	0	139	0	0	0	0	0		0	30	0	0	0	0	0	0	0	0	0	0	0	0	213
17	1	1	1	3	11	11	6	18	0	81	0	0	195	0	1	0		151	20	0	39	0	15	0	0	0	0	0	0	0	555
18	0	0	1	3	6	1	1	2	0	26	0	0	1	0	0	0	147		563	16	756	0	20	106	49	0	3	0	0	0	1701
19	0	0	0	2	0	2	0	0	0	4	0	0	1	0	41	0	44	534		11	160	0	11	0	0	10	0	0	0	0	821
20	1	1	0	0	1	2	0	2	2	95	0	0	0	0	0	0	0	30	0		7	0	15	0	0	0	0	0	0	0	159
21	8	6	7	24	17	20	11	48	25	342	0	0	188	24	30	0	93	919	112	7		0	45	153	14	0	0	0	0	6	2100
22	0	10	0	38	71	38	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0		0	1	0	10	0	0	0	0	174
23	0	6	3	3	3	2	1	169	0	254	0	0	6	0	0	0	0	30	14	0	0	0		233	0	0	0	0	0	0	725
24	17	9	16	67	151	37	4	246	9	190	0	0	0	14	8	0	0	79	0	226	200	1	0		0	0	0	0	0	0	1273
25	0	0	0	0	0	4	0	0	0	3	0	0	1	0	17	0	0	17	0	0	11	0	0	0		0	0	0	0	15	68
26	0	0	0	38	31	10	0	600	0	3437	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4		0	0	0	0	4120
27	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0		0	0	0	9
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
29	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0		0	6
30	1	0	3	3	0	5	6	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	84	0	0	0		117
	624	1939	2365	7566	4279	1093	3503	4530	1684	13169	981	220	805	50	106	119	542	1850	796	368	2040	118	604	1352	99	4041	24	0	1	32	54899

LGV ESTIMATED MATRIX - AADT IN VEHICLES - INCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	7	6	0	31	9	4	6	3	1	6	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	77
2	0	0	4	113	4	3	2	1	1	8	0	0	1	0	0	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	142
3	0	4	6	148	16	8	12	5	0	40	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	241
4	47	157	76	66	57	19	52	2	2	117	0	0	0	0	0	0	0	0	0	0	0	8	0	3	0	0	0	0	0	0	606
5	21	23	14	41	108	0	5	23	18	25	0	0	0	0	0	0	0	1	0	8	24	0	0	4	0	0	0	0	0	0	316
6	6	2	2	11	11	6	5	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76
7	2	6	6	56	12	4	0	31	3	87	0	0	2	0	0	0	1	0	0	0	0	0	9	0	0	0	2	0	0	0	220
8	6	2	6	3	7	12	6	72	0	96	33	28	0	0	0	0	2	0	0	2	0	0	0	19	0	0	0	0	0	0	294
9	0	0	1	6	0	11	8	7	13	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160
10	3	11	18	91	59	26	123	184	92	269	0	0	17	0	0	3	5	1	0	10	48	0	12	14	0	82	2	0	0	0	1072
11	0	0	0	0	0	0	0	12	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
12	0	0	0	0	0	0	0	14	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
13	0	1	0	2	3	0	1	0	0	43	0	0	32	0	0	0	9	0	0	0	15	0	0	0	0	0	0	0	0	0	106
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
16	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
17	0	0	0	0	2	0	0	1	2	4	0	0	12	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	32
18	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	16	6	36	17	59	0	0	1	8	0	0	0	0	0	144
19	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	33	0	0	29	0	0	2	0	0	0	0	0	0	69
20	0	0	0	0	4	2	0	1	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
21	0	6	0	0	10	0	0	0	6	33	0	0	21	0	15	0	0	77	22	0	108	0	0	4	0	0	0	0	0	0	302
22	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
23	0	0	0	0	0	0	10	12	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	35
24	0	0	0	2	4	0	0	19	1	21	0	0	3	1	0	0	0	2	0	0	5	0	0	0	0	0	0	0	0	0	57
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	6
26	0	0	0	0	0	0	0	0	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	92
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	92	218	133	573	310	95	231	389	139	1027	33	28	94	1	15	4	34	137	62	36	291	15	21	49	12	82	3	0	0	6	4129

LGV ESTIMATED MATRIX - AADT IN VEHICLES - EXCLUDING INTRAZONAL TRIPS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1		6	0	31	9	4	6	3	1	6	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	70
2	0		4	113	4	3	2	1	1	8	0	0	1	0	0	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	142
3	0	4		148	16	8	12	5	0	40	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	235
4	47	157	76		57	19	52	2	2	117	0	0	0	0	0	0	0	0	0	0	0	8	0	3	0	0	0	0	0	0	540
5	21	23	14	41		0	5	23	18	25	0	0	0	0	0	0	0	1	0	8	24	0	0	4	0	0	0	0	0	0	207
6	6	2	2	11	11		5	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71
7	2	6	6	56	12	4		31	3	87	0	0	2	0	0	0	1	0	0	0	0	0	9	0	0	0	2	0	0	0	220
8	6	2	6	3	7	12	6		0	96	33	28	0	0	0	0	2	0	0	2	0	0	0	19	0	0	0	0	0	0	222
9	0	0	1	6	0	11	8	7		113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147
10	3	11	18	91	59	26	123	184	92		0	0	17	0	0	3	5	1	0	10	48	0	12	14	0	82	2	0	0	0	803
11	0	0	0	0	0	0	0	12	0	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
12	0	0	0	0	0	0	0	14	0	12	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
13	0	1	0	2	3	0	1	0	0	43	0	0		0	0	0	9	0	0	0	15	0	0	0	0	0	0	0	0	0	74
14	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
16	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
17	0	0	0	0	2	0	0	1	2	4	0	0	12	0	0	0		12	0	0	0	0	0	0	0	0	0	0	0	0	32
18	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	16		36	17	59	0	0	1	8	0	0	0	0	0	138
19	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	33		0	29	0	0	2	0	0	0	0	0	0	69
20	0	0	0	0	4	2	0	1	0	9	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	16
21	0	6	0	0	10	0	0	0	6	33	0	0	21	0	15	0	0	77	22	0		0	0	4	0	0	0	0	0	0	194
22	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	8
23	0	0	0	0	0	0	10	12	0	10	0	0	0	0	0	0	0	0	0	0	0	0		0	4	0	0	0	0	0	35
24	0	0	0	2	4	0	0	19	1	21	0	0	3	1	0	0	0	2	0	0	5	0	0		0	0	0	0	0	0	57
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0		0	0	0	0	0	6
26	0	0	0	0	0	0	0	0	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	6	92
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
	85	218	127	507	202	89	231	317	126	757	33	28	62	1	15	4	34	131	62	36	183	15	21	49	12	82	3	0	0	6	3436

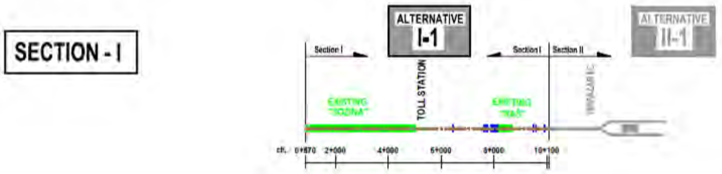
HGV ESTIMATED MATRIX - AADT IN VEHICLES - INCLUDING INTRAZONAL TRIPS

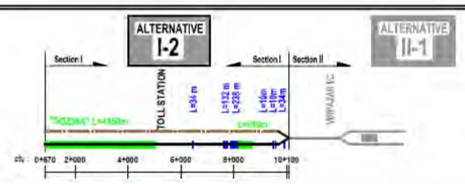
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1	0	0	0	21	43	26	5	14	0	26	0	0	0	0	0	0	0	0	0	1	2	0	0	4	0	0	0	0	0	0	143
2	18	34	0	133	13	0	9	7	8	18	0	0	0	0	0	0	0	0	0	0	3	0	0	5	0	0	0	0	0	0	249
3	0	8	0	178	20	11	5	19	0	35	0	0	0	0	0	0	0	0	0	0	6	0	0	11	0	0	0	0	0	0	293
4	16	126	217	28	17	0	0	16	8	120	0	0	0	0	0	0	0	0	0	0	13	0	0	5	0	0	0	0	0	0	568
5	32	12	16	17	67	0	33	44	0	110	0	0	0	0	0	0	0	0	0	0	29	0	0	51	1	0	3	0	0	4	418
6	12	4	6	1	0	0	17	6	0	38	0	0	0	0	0	0	0	0	0	4	5	10	0	17	0	0	0	0	0	0	118
7	0	0	0	30	0	13	0	0	2	82	0	0	2	0	0	0	0	0	0	0	0	4	8	2	0	0	0	0	0	0	143
8	32	0	20	1	89	30	0	126	0	57	15	24	0	0	0	0	0	0	0	6	9	9	44	19	0	0	0	0	0	0	482
9	0	0	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	52
10	13	17	55	107	85	21	40	225	67	329	2	0	10	0	0	3	18	0	0	35	49	6	18	42	0	0	21	0	0	9	1173
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	2	0	0	0	0	0	0	26	0	0	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
17	0	0	3	0	0	0	0	4	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
18	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	68	62	91	61	0	0	0	0	0	0	0	0	0	283
19	0	0	0	0	0	0	0	0	0	0	0	0	0	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	129
20	0	0	0	0	4	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	37	0	0	0	0	0	0	0	0	0	54
21	0	3	5	10	31	0	0	16	0	14	0	0	16	0	37	0	9	83	38	0	112	0	0	33	0	0	0	0	0	0	407
22	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4
23	0	0	0	0	0	0	0	15	0	13	0	0	0	0	0	0	0	0	0	0	0	0	24	0	37	66	0	0	0	0	155
24	1	1	3	14	42	8	0	19	1	37	0	0	5	2	0	0	0	2	0	0	17	0	18	0	9	0	0	0	0	0	179
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	41	0	0	0	0	0	156	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	197
27	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
28	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	0	0	0	0	76
	126	206	326	580	415	109	111	520	86	1146	16	24	81	131	38	3	27	154	101	136	343	40	112	190	46	143	24	0	0	13	5245

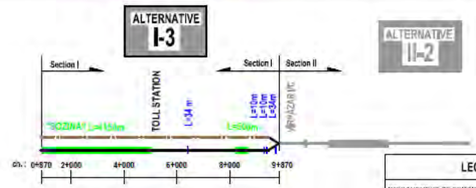
HGV ESTIMATED MATRIX - AADT IN VEHICLES - EXCLUDING INTRAZONAL TRIPS

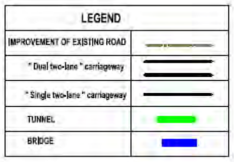
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
1		0	0	21	43	26	5	14	0	26	0	0	0	0	0	0	0	0	0	1	2	0	0	4	0	0	0	0	0	0	143
2	18		0	133	13	0	9	7	8	18	0	0	0	0	0	0	0	0	0	0	3	0	0	5	0	0	0	0	0	0	215
3	0	8		178	20	11	5	19	0	35	0	0	0	0	0	0	0	0	0	0	6	0	0	11	0	0	0	0	0	0	293
4	16	126	217		17	0	0	16	8	120	0	0	0	0	0	0	0	0	0	0	13	0	0	5	0	0	0	0	0	0	539
5	32	12	16	17		0	33	44	0	110	0	0	0	0	0	0	0	0	0	0	29	0	0	51	1	0	3	0	0	4	351
6	12	4	6	1	0		17	6	0	38	0	0	0	0	0	0	0	0	0	4	5	10	0	17	0	0	0	0	0	0	118
7	0	0	0	30	0	13		0	2	82	0	0	2	0	0	0	0	0	0	0	0	4	8	2	0	0	0	0	0	0	143
8	32	0	20	1	89	30	0		0	57	15	24	0	0	0	0	0	0	0	6	9	9	44	19	0	0	0	0	0	0	355
9	0	0	0	0	0	0	0	0		43	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	52
10	13	17	55	107	85	21	40	225	67		2	0	10	0	0	3	18	0	0	35	49	6	18	42	0	0	21	0	0	9	844
11	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	2	0	0	0	0	0	0	26	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
14	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	9	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
17	0	0	3	0	0	0	0	4	0	22	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	29
18	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0		62	91	61	0	0	0	0	0	0	0	0	0	216
19	0	0	0	0	0	0	0	0	0	0	0	0	0	129	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	129
20	0	0	0	0	4	0	0	0	0	14	0	0	0	0	0	0	0	0	0		37	0	0	0	0	0	0	0	0	0	54
21	0	3	5	10	31	0	0	16	0	14	0	0	16	0	37	0	9	83	38	0		0	0	33	0	0	0	0	0	0	296
22	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1		0	0	0	0	0	0	0	0	4
23	0	0	0	0	0	0	0	15	0	13	0	0	0	0	0	0	0	0	0	0	0	0		0	37	66	0	0	0	0	131
24	1	1	3	14	42	8	0	19	1	37	0	0	5	2	0	0	0	2	0	0	17	0	18		9	0	0	0	0	0	179
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
26	0	0	0	41	0	0	0	0	0	156	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0		0	0	0	0	197
27	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	2
28	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	2
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	0	0	0		76
	126	171	326	552	348	109	111	394	86	817	16	24	33	131	38	3	27	86	101	136	231	40	88	190	46	143	24	0	0	13	4409

APPENDIX 6 ROUTE SECTION SINGLE/DUAL STATUS





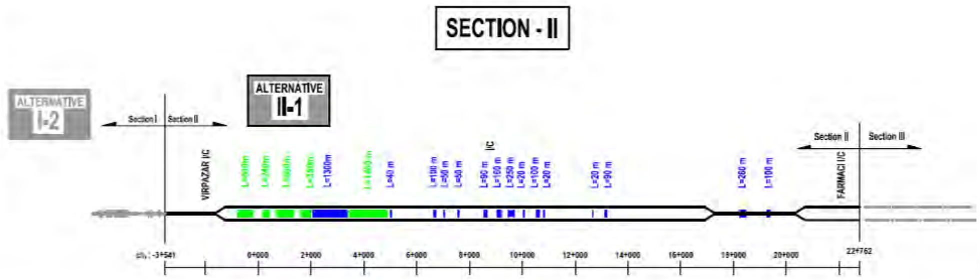


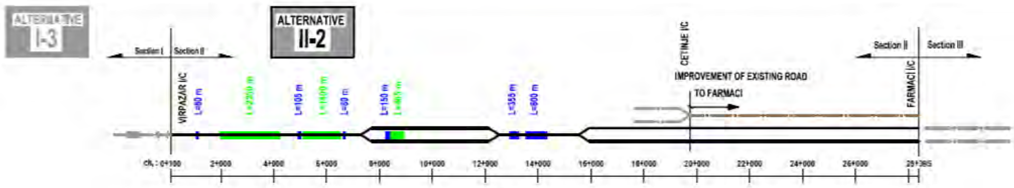


NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. I - 1	Alt. I - 2	Alt. I - 3
"Single two-lane" (m) / (%)	9,230 / (100%)	0 / (00,0%)	0 / (00,0%)
" Dual two-lane" (m)	0	9.230	9.000
Total Length (m)	9,230	9,230	9,000

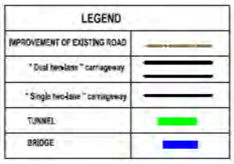


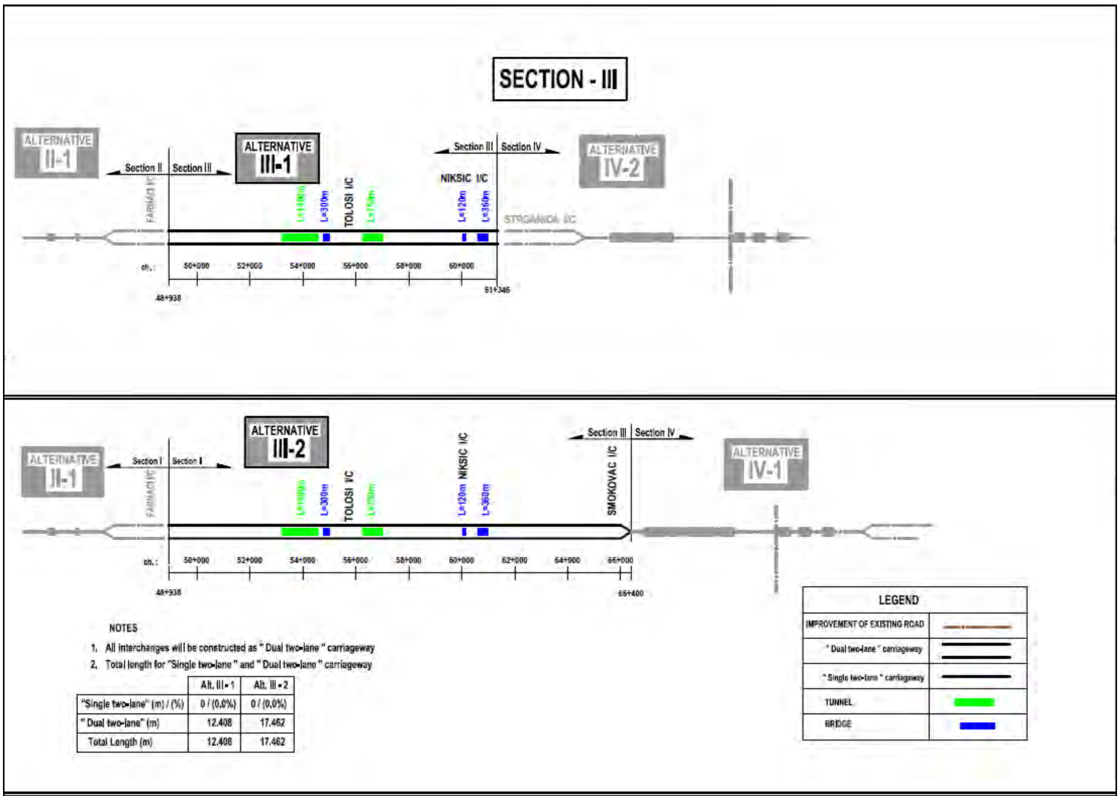


NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. II - 1	Alt. II - 2
"Single two-lane" (m) / (%)	4.900 / (18.6%)	9,180 / (32.4%)
" Dual two-lane" (m)	21,403	19,115
Total Length (m)	26.303	28.295

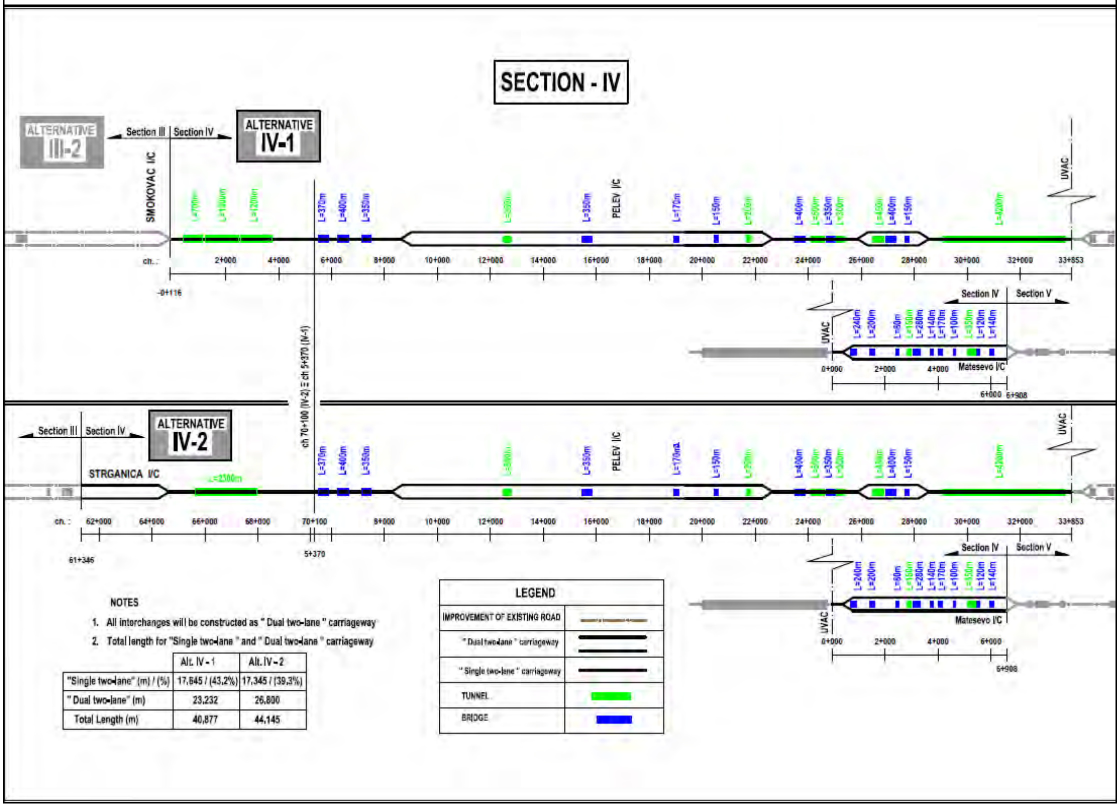




NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. III - 1	Alt. III - 2
"Single two-lane" (m) / (%)	0 / (0,0%)	0 / (0,0%)
" Dual two-lane" (m)	12,408	17,462
Total Length (m)	12,408	17,462

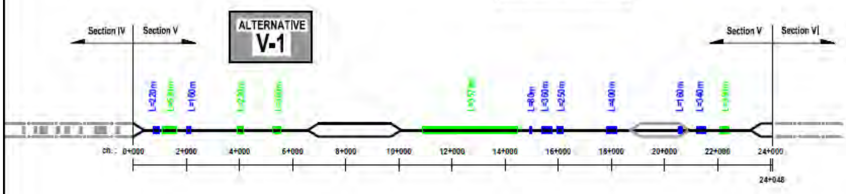


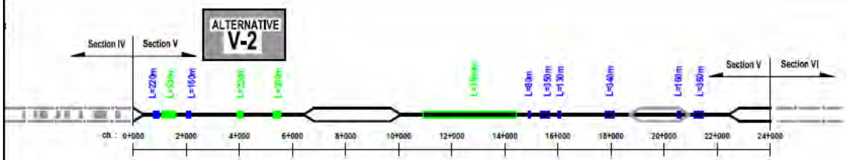
NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. IV - 1	Alt. IV - 2
"Single two-lane" (m) / (%)	17,645 / (43,2%)	17,345 / (39,3%)
" Dual two-lane" (m)	23,232	26,800
Total Length (m)	40,877	44,145

SECTION - V





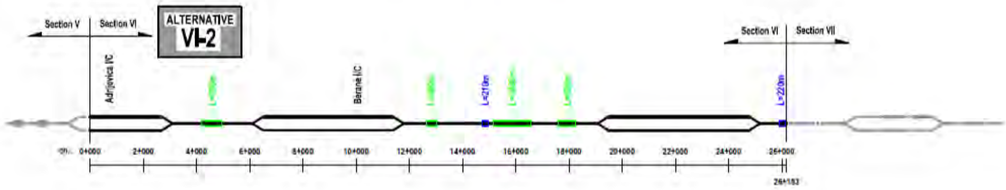
NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. V - 1	Alt. V-2
"Single two-lane" (m) / (%)	17,053 / (70,9%)	16,109 / (67,1%)
" Dual two-lane" (m)	6,995	7,891
Total Length (m)	24,048	24,000

LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

SECTION - VI

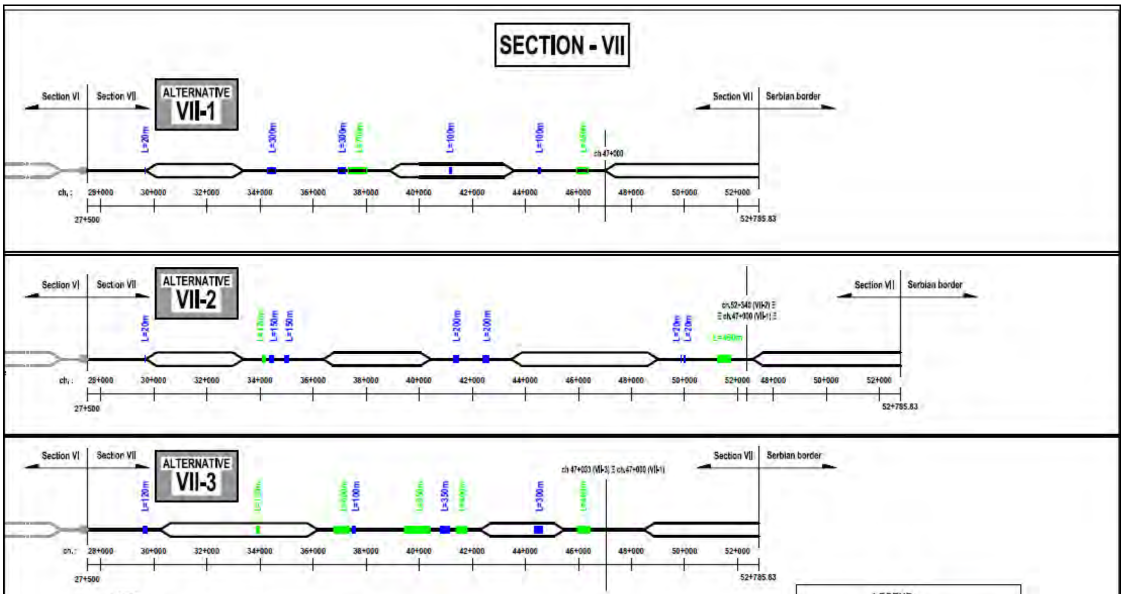


NOTES

1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

	Alt. VI - 2
"Single two-lane" (m) / (%)	11.300 / (43.2%)
" Dual two-lane" (m)	14.883
Total Length (m)	26.183

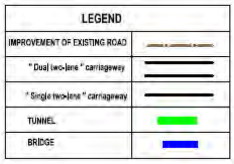
LEGEND	
IMPROVEMENT OF EXISTING ROAD	
" Dual two-lane " carriageway	
" Single two-lane " carriageway	
TUNNEL	
BRIDGE	

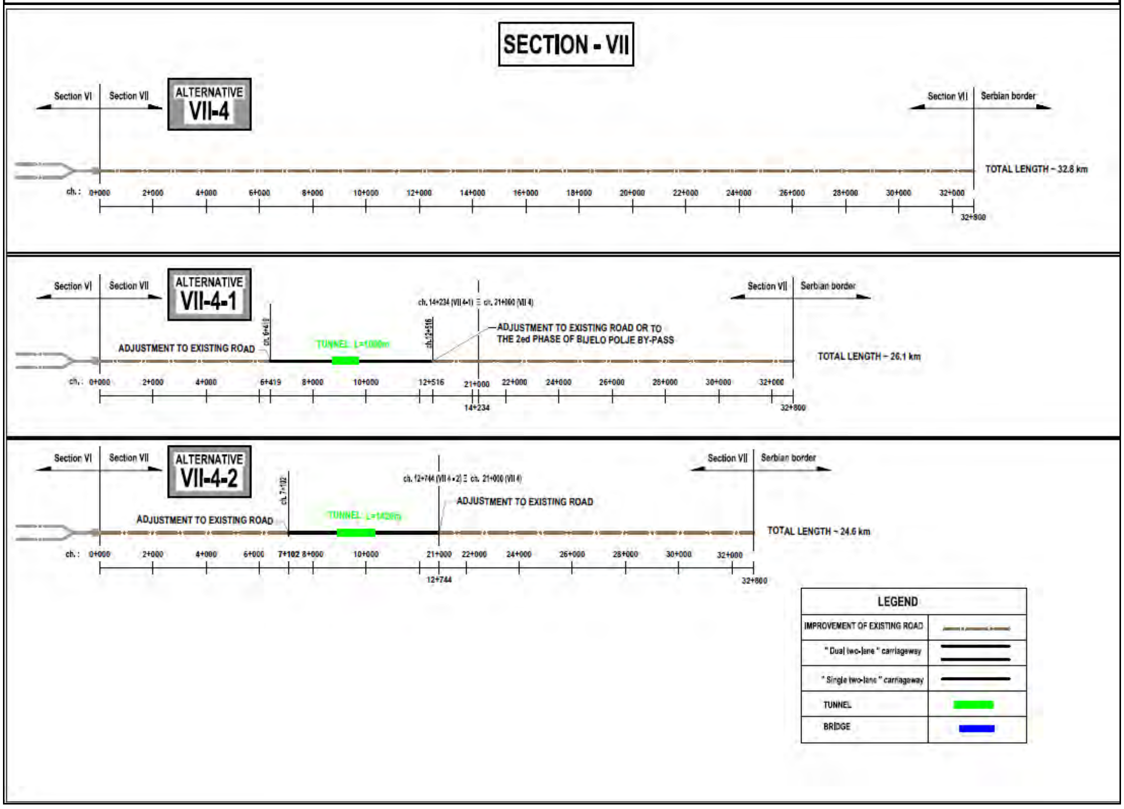


NOTES

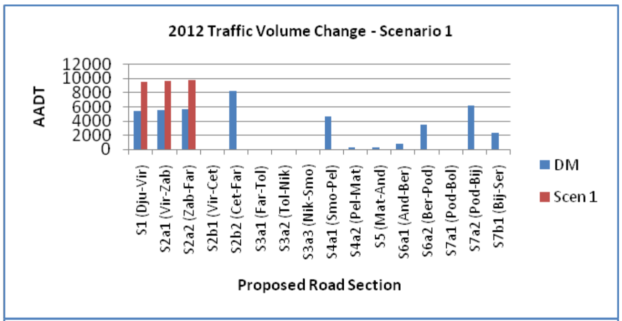
1. All interchanges will be constructed as " Dual two-lane " carriageway
2. Total length for "Single two-lane " and " Dual two-lane " carriageway

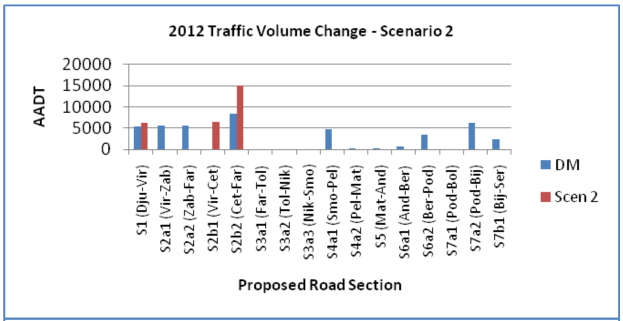
	Alt. VII - 1	Alt. VII - 2	Alt. VII - 3
"Single two-lane" (m) / (%)	11.130 / (44.0%)	11.760 / (38.4%)	11.840 / (46.8%)
" Dual two-lane" (m)	14.156	18.866	13.479
Total Length (m)	25.286	30.626	25.319

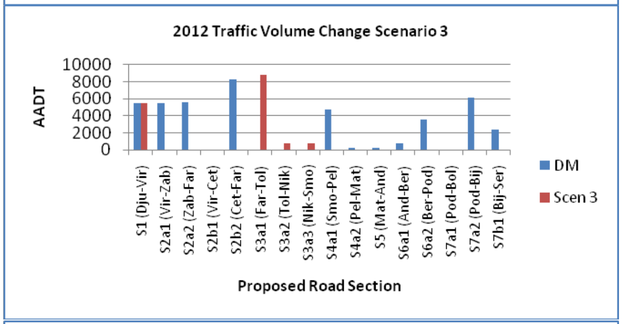


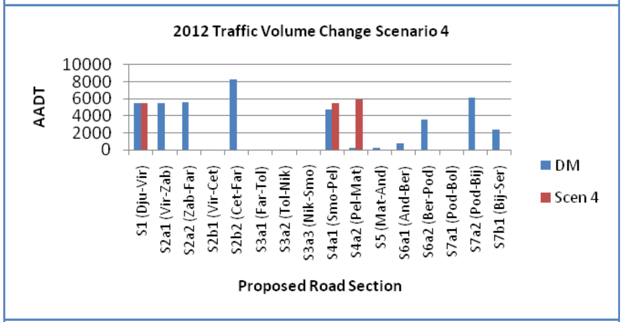


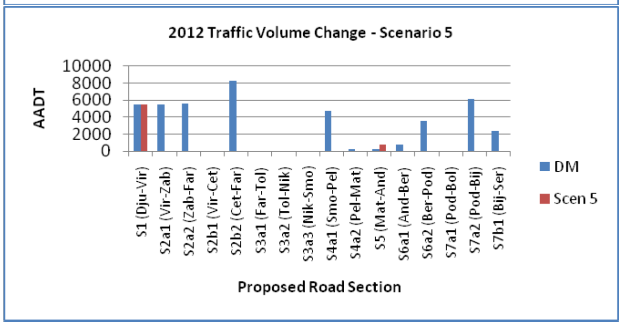
APPENDIX 7 YEAR 2012 TRAFFIC FLOWS

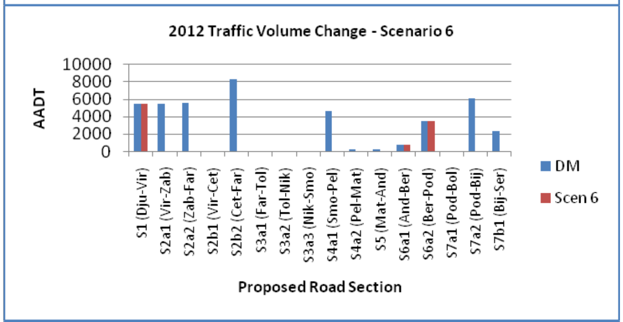

2012 Traffic Volume Change - Scenario 1
AADT
12000
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 1
Proposed Road Section

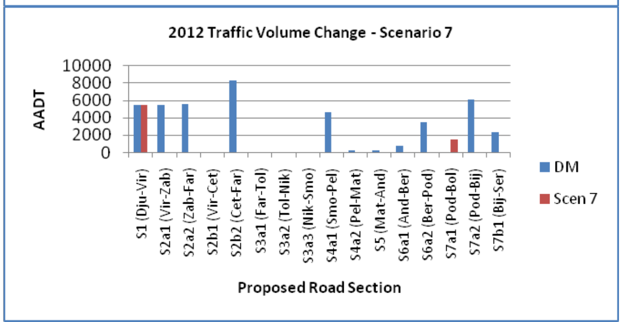

2012 Traffic Volume Change - Scenario 2
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 2
Proposed Road Section

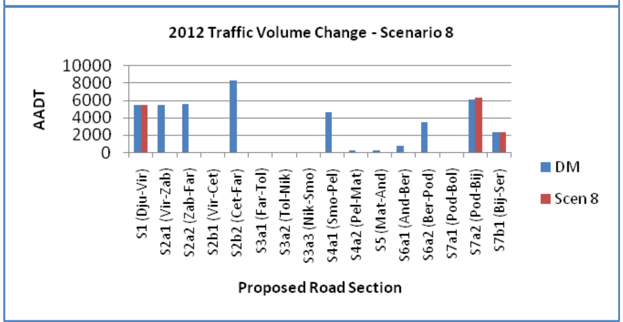

2012 Traffic Volume Change Scenario 3
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 3
Proposed Road Section

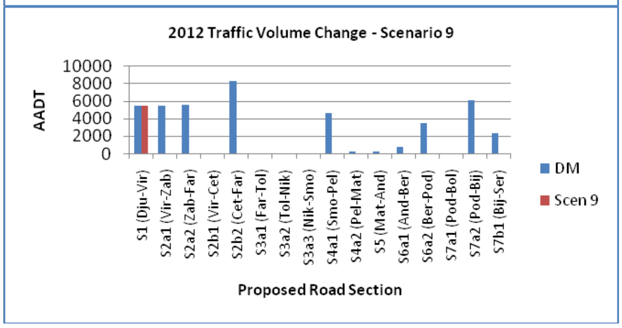

2012 Traffic Volume Change Scenario 4
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 4
Proposed Road Section

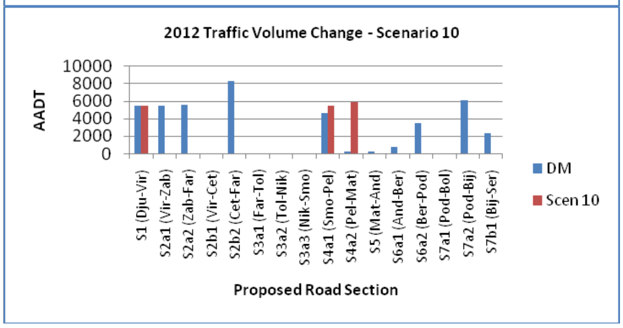

2012 Traffic Volume Change - Scenario 5
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 5
Proposed Road Section

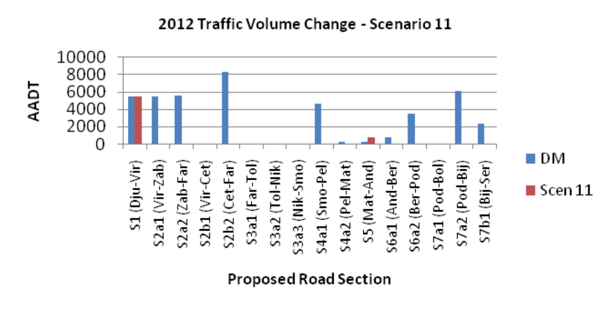

2012 Traffic Volume Change - Scenario 6
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 6
Proposed Road Section

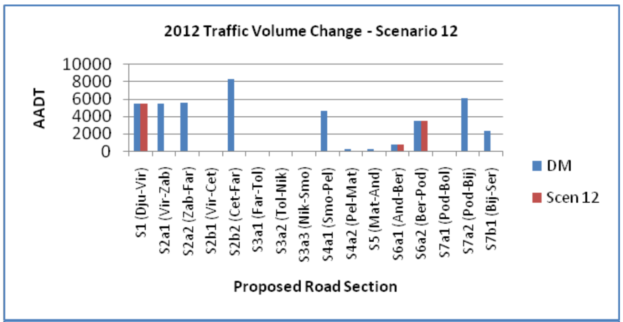

2012 Traffic Volume Change - Scenario 7
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 7
Proposed Road Section

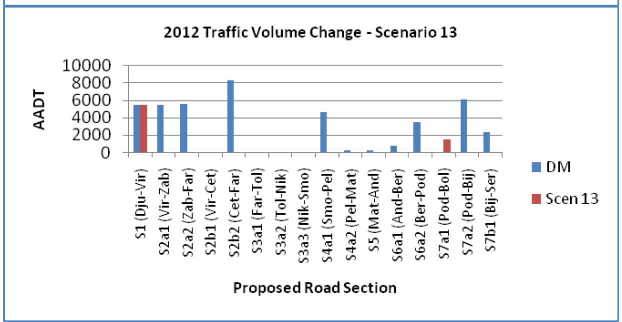

2012 Traffic Volume Change - Scenario 8
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 8
Proposed Road Section

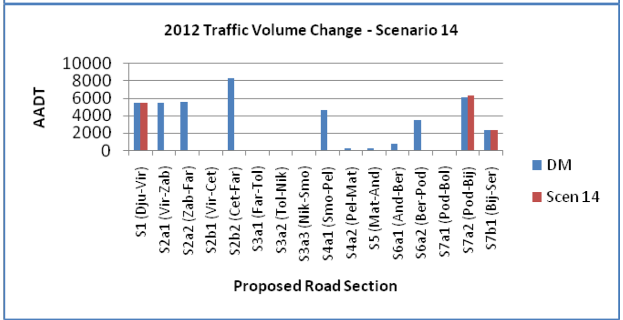

2012 Traffic Volume Change - Scenario 9
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 9
Proposed Road Section

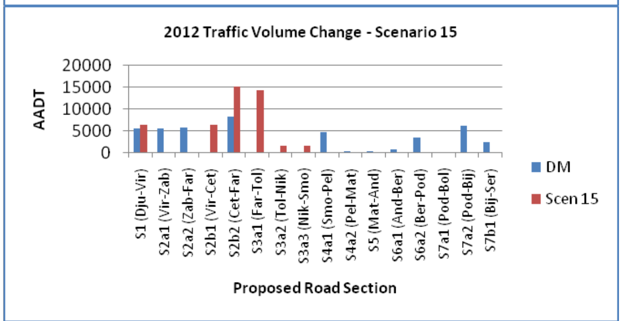

2012 Traffic Volume Change - Scenario 10
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 10
Proposed Road Section

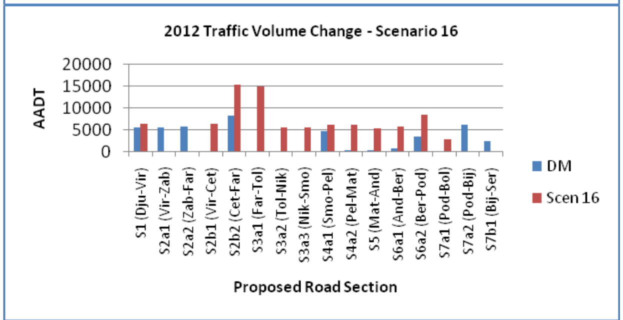

2012 Traffic Volume Change - Scenario 11
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 11

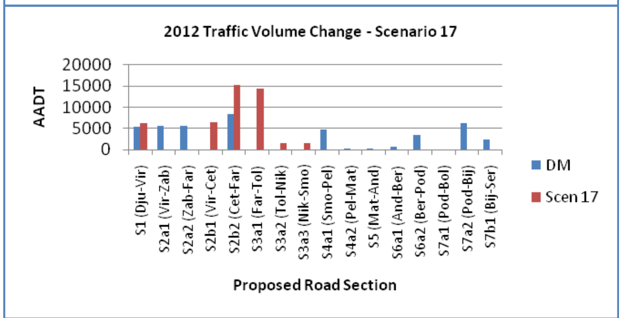

2012 Traffic Volume Change - Scenario 12
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 12

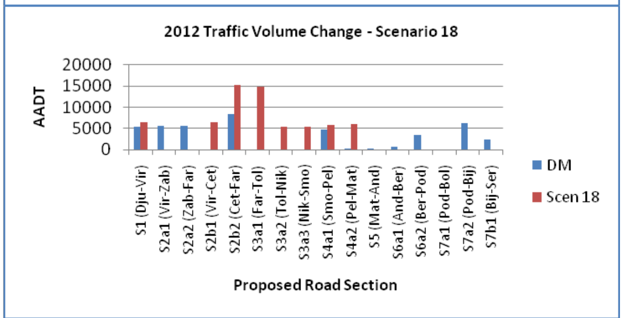

2012 Traffic Volume Change - Scenario 13
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 13

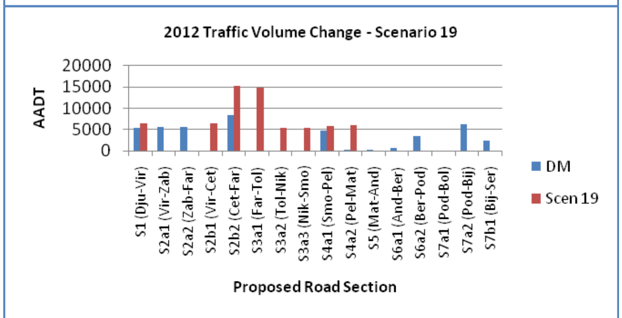

2012 Traffic Volume Change - Scenario 14
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 14

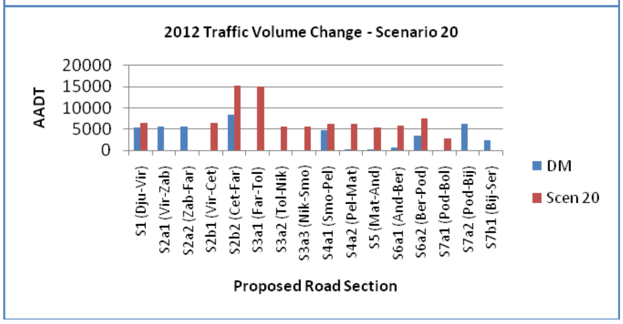

2012 Traffic Volume Change - Scenario 15
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 15


2012 Traffic Volume Change - Scenario 16
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 16

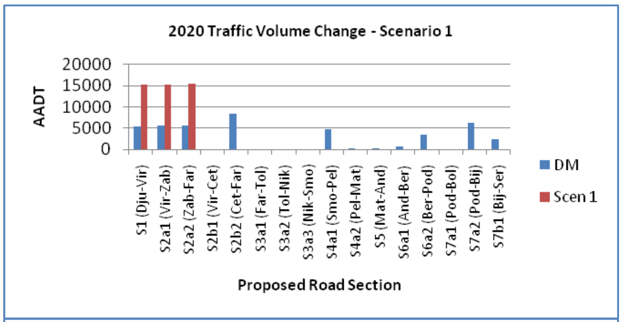

2012 Traffic Volume Change - Scenario 17
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 17

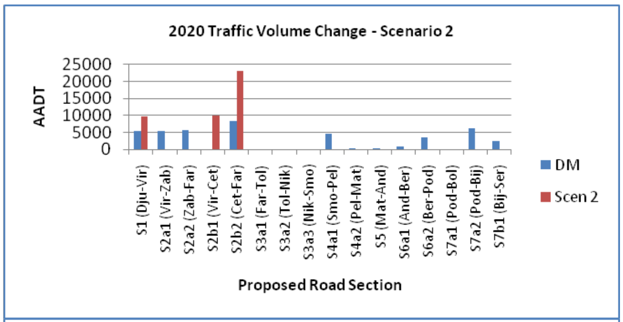

2012 Traffic Volume Change - Scenario 18
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 18

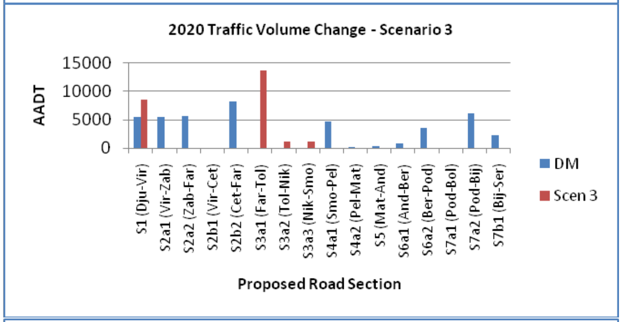

2012 Traffic Volume Change - Scenario 19
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 19

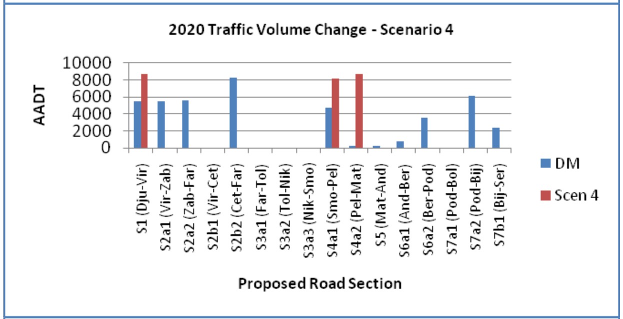

2012 Traffic Volume Change - Scenario 20
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 20

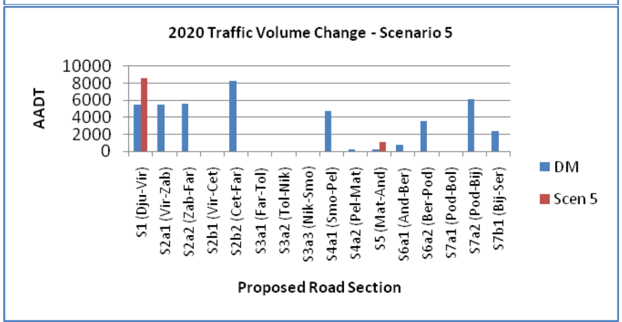
APPENDIX 8 YEAR 2020 TRAFFIC FLOWS

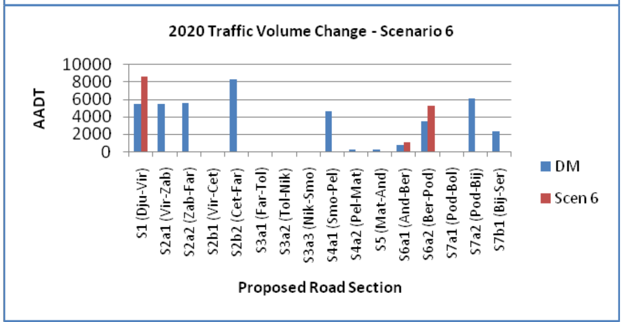

2020 Traffic Volume Change - Scenario 1
AADT
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 1
Proposed Road Section

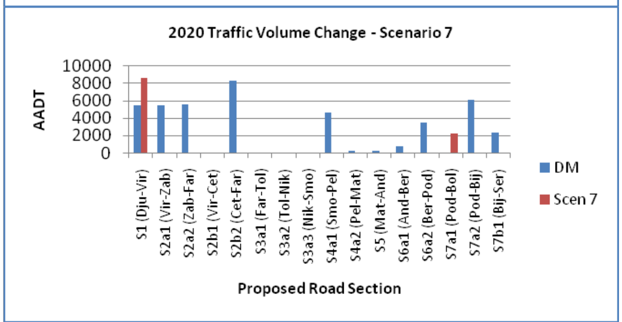

2020 Traffic Volume Change - Scenario 2
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 2
Proposed Road Section

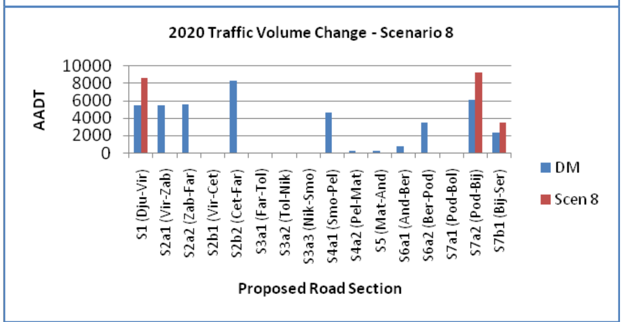

2020 Traffic Volume Change - Scenario 3
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 3
Proposed Road Section

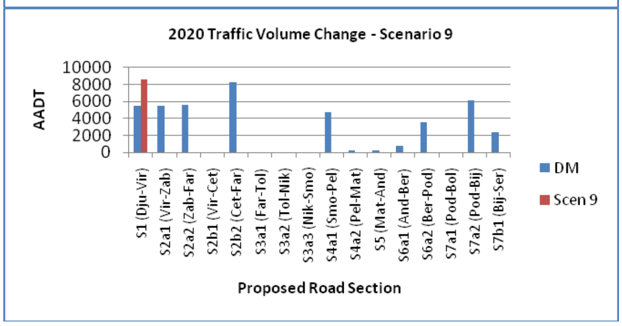

2020 Traffic Volume Change - Scenario 4
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 4
Proposed Road Section

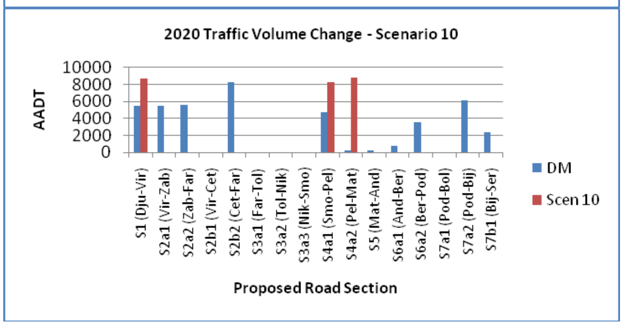

2020 Traffic Volume Change - Scenario 5
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 5
Proposed Road Section

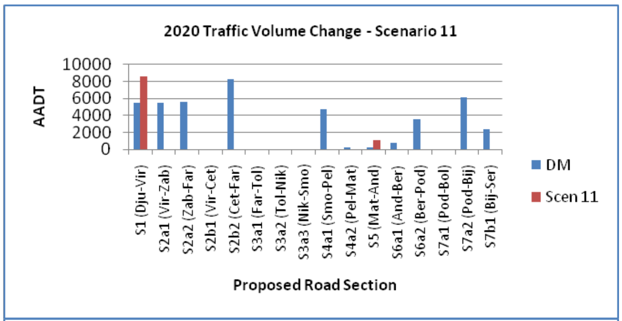

2020 Traffic Volume Change - Scenario 6
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 6
Proposed Road Section

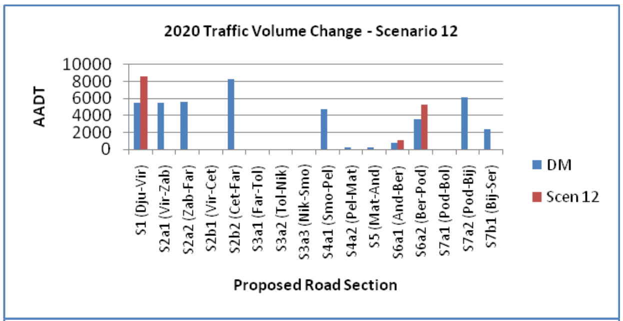

2020 Traffic Volume Change - Scenario 7
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 7
Proposed Road Section

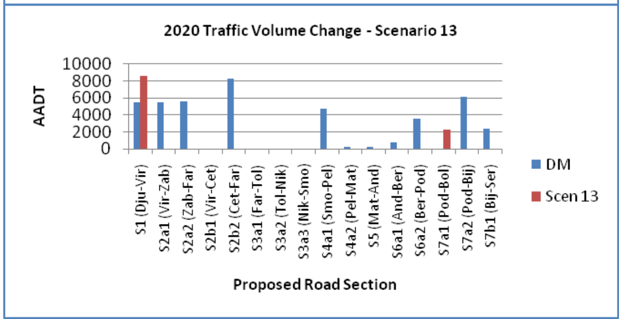

2020 Traffic Volume Change - Scenario 8
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 8
Proposed Road Section

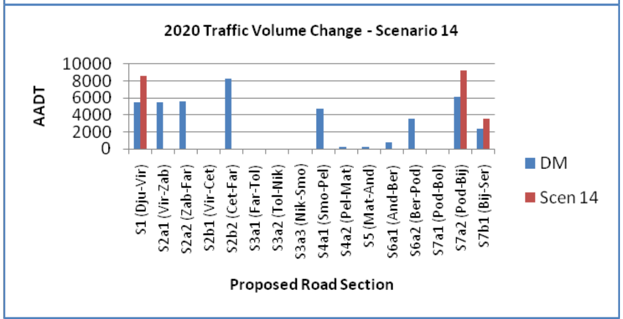

2020 Traffic Volume Change - Scenario 9
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 9
Proposed Road Section

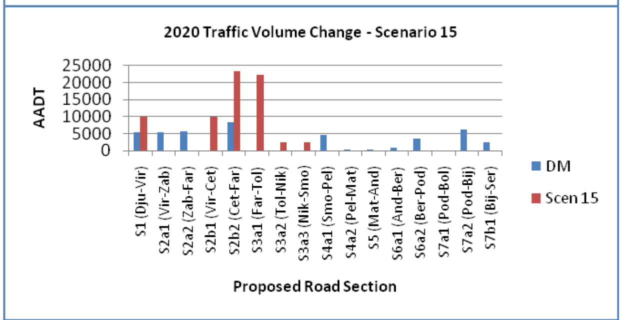

2020 Traffic Volume Change - Scenario 10
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 10
Proposed Road Section

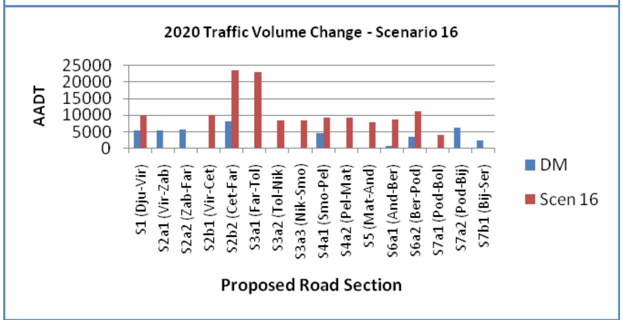

2020 Traffic Volume Change - Scenario 11
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 11

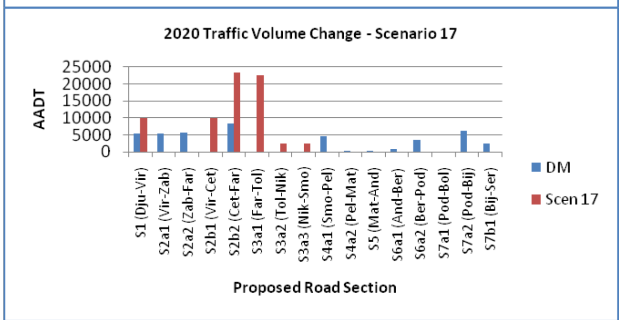

2020 Traffic Volume Change - Scenario 12
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 12

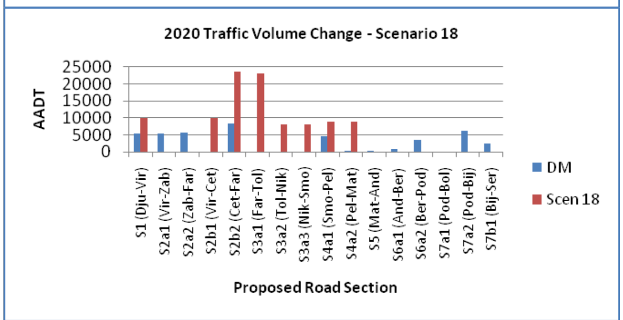

2020 Traffic Volume Change - Scenario 13
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 13

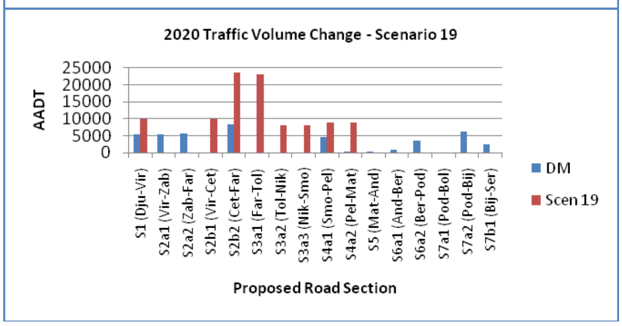

2020 Traffic Volume Change - Scenario 14
AADT
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 14

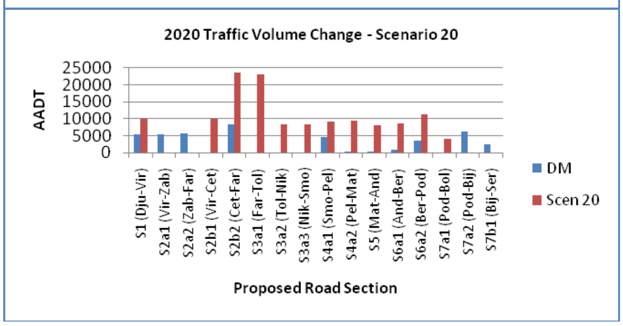

2020 Traffic Volume Change - Scenario 15
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 15


2020 Traffic Volume Change - Scenario 16
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 16

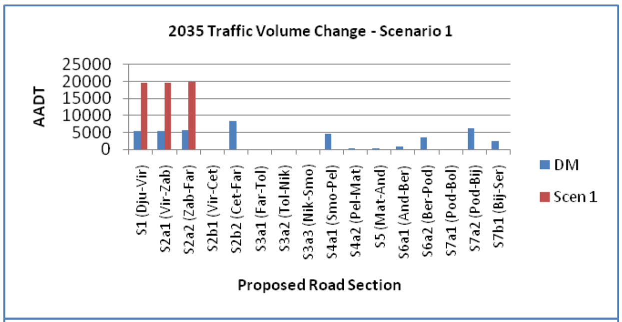

2020 Traffic Volume Change - Scenario 17
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 17

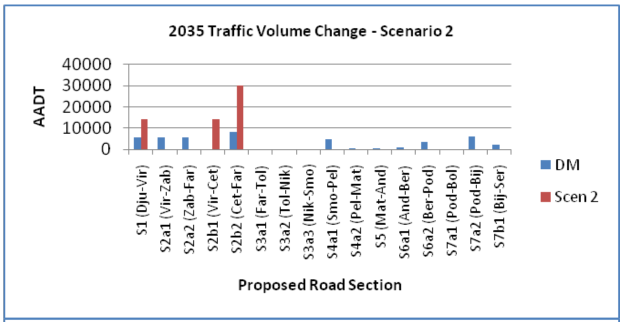

2020 Traffic Volume Change - Scenario 18
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 18

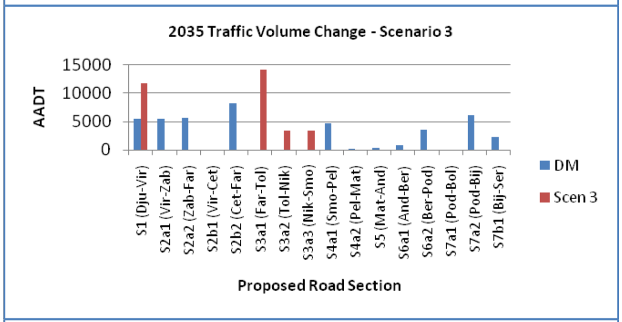

2020 Traffic Volume Change - Scenario 19
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 19

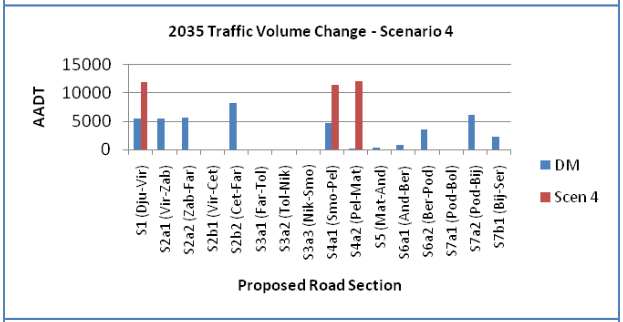

2020 Traffic Volume Change - Scenario 20
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 20

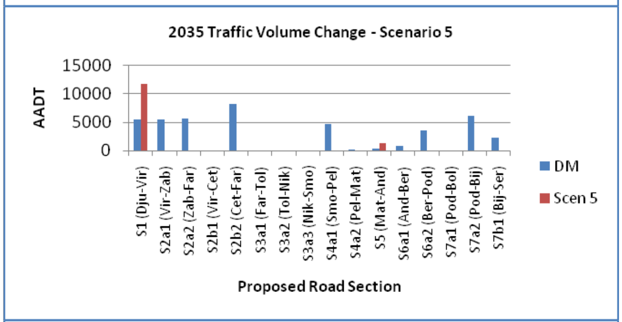
APPENDIX 9 YEAR 2035 TRAFFIC FLOWS

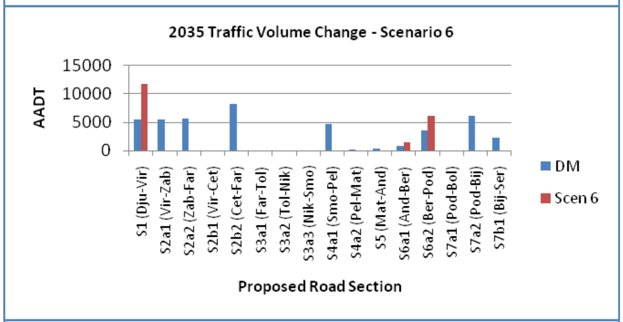

2035 Traffic Volume Change - Scenario 1
AADT
25000
20000
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 1
Proposed Road Section

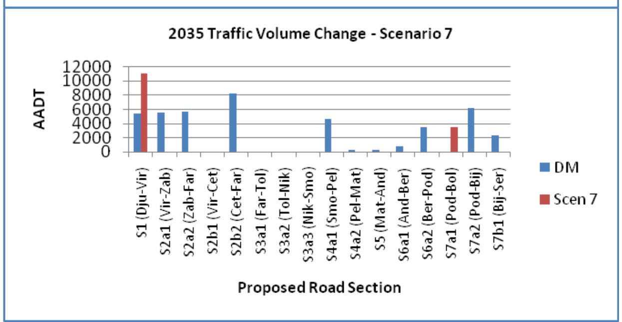

2035 Traffic Volume Change - Scenario 2
AADT
40000
30000
20000
10000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 2
Proposed Road Section

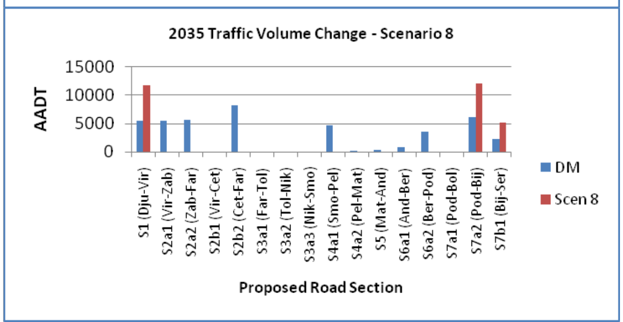

2035 Traffic Volume Change - Scenario 3
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 3
Proposed Road Section

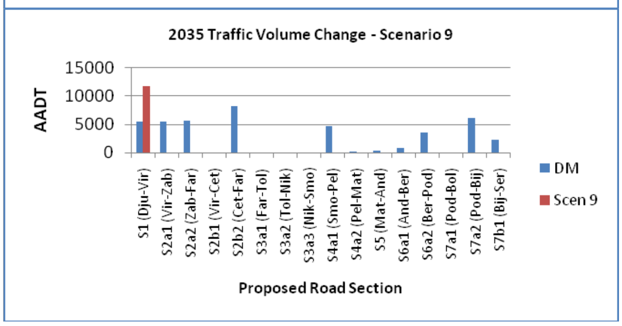

2035 Traffic Volume Change - Scenario 4
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 4
Proposed Road Section

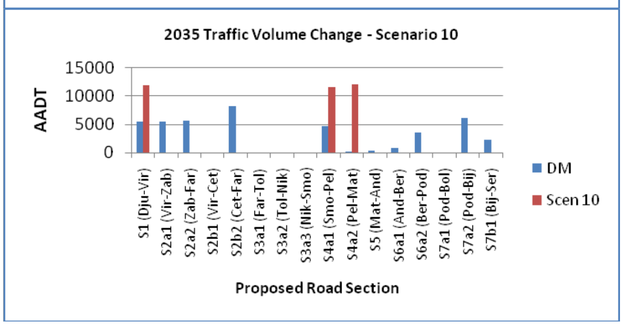

2035 Traffic Volume Change - Scenario 5
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 5
Proposed Road Section

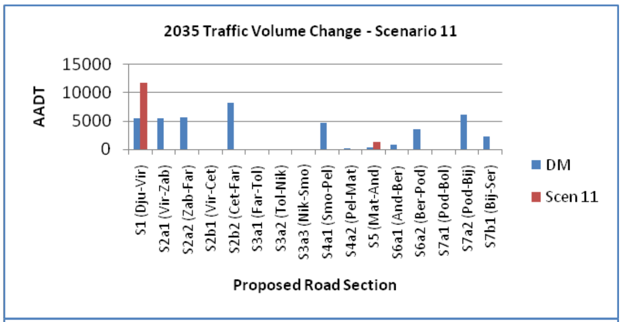

2035 Traffic Volume Change - Scenario 6
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 6
Proposed Road Section

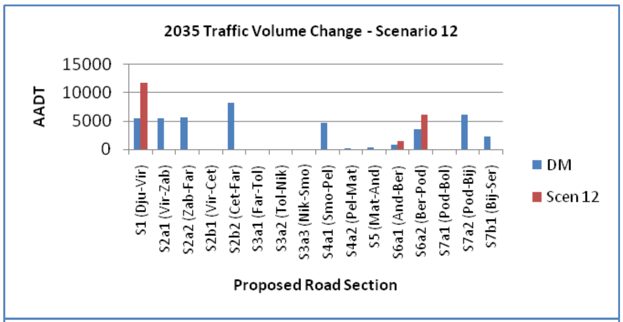

2035 Traffic Volume Change - Scenario 7
AADT
12000
10000
8000
6000
4000
2000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 7
Proposed Road Section

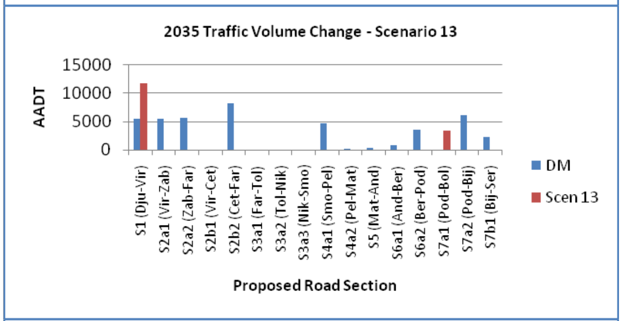

2035 Traffic Volume Change - Scenario 8
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 8
Proposed Road Section

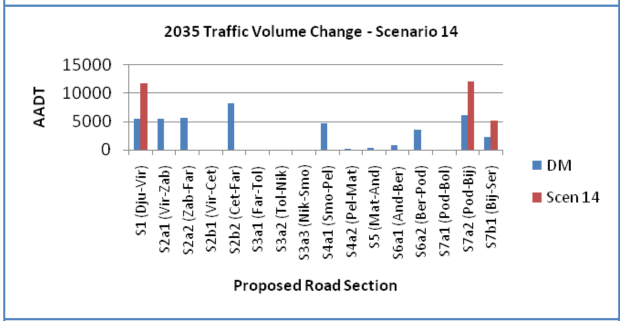

2035 Traffic Volume Change - Scenario 9
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 9
Proposed Road Section

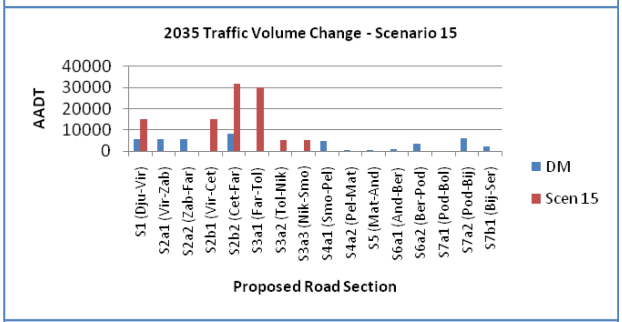

2035 Traffic Volume Change - Scenario 10
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
DM
Scen 10
Proposed Road Section

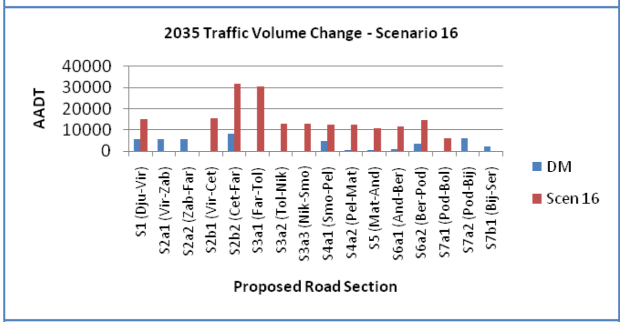

2035 Traffic Volume Change - Scenario 11
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 11

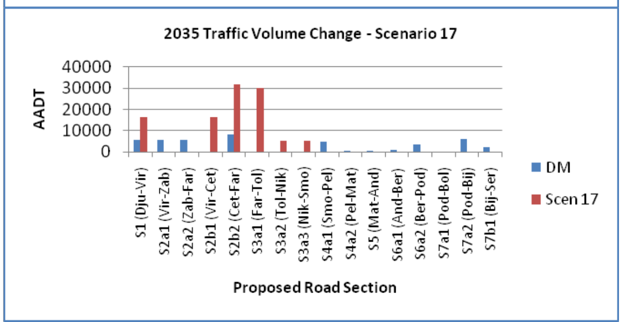

2035 Traffic Volume Change - Scenario 12
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 12

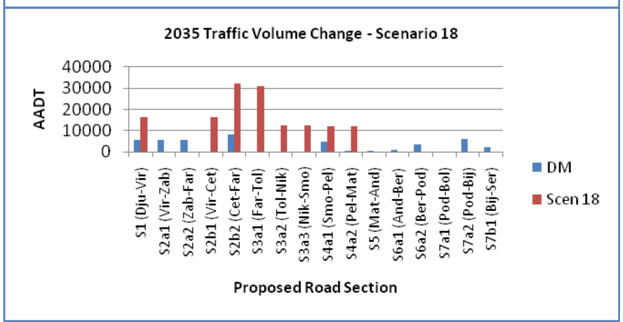

2035 Traffic Volume Change - Scenario 13
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 13

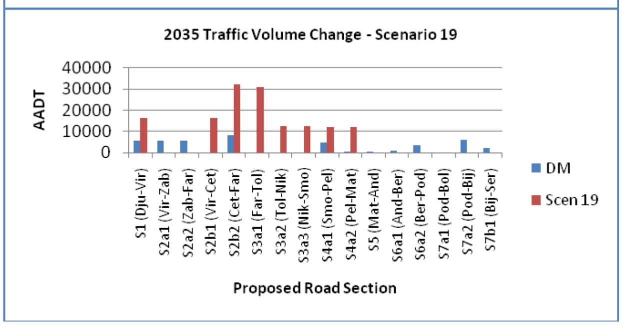

2035 Traffic Volume Change - Scenario 14
AADT
15000
10000
5000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 14

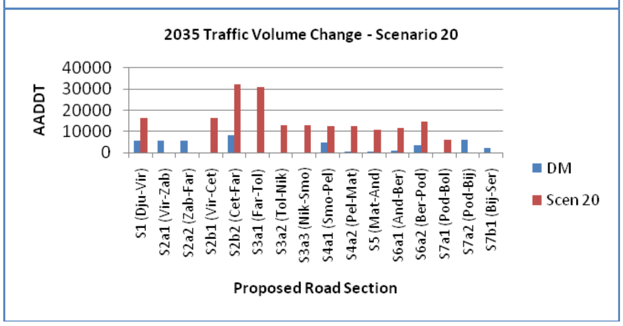

2035 Traffic Volume Change - Scenario 15
AADT
40000
30000
20000
10000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 15


2035 Traffic Volume Change - Scenario 16
AADT
40000
30000
20000
10000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 16


2035 Traffic Volume Change - Scenario 17
AADT
40000
30000
20000
10000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 17

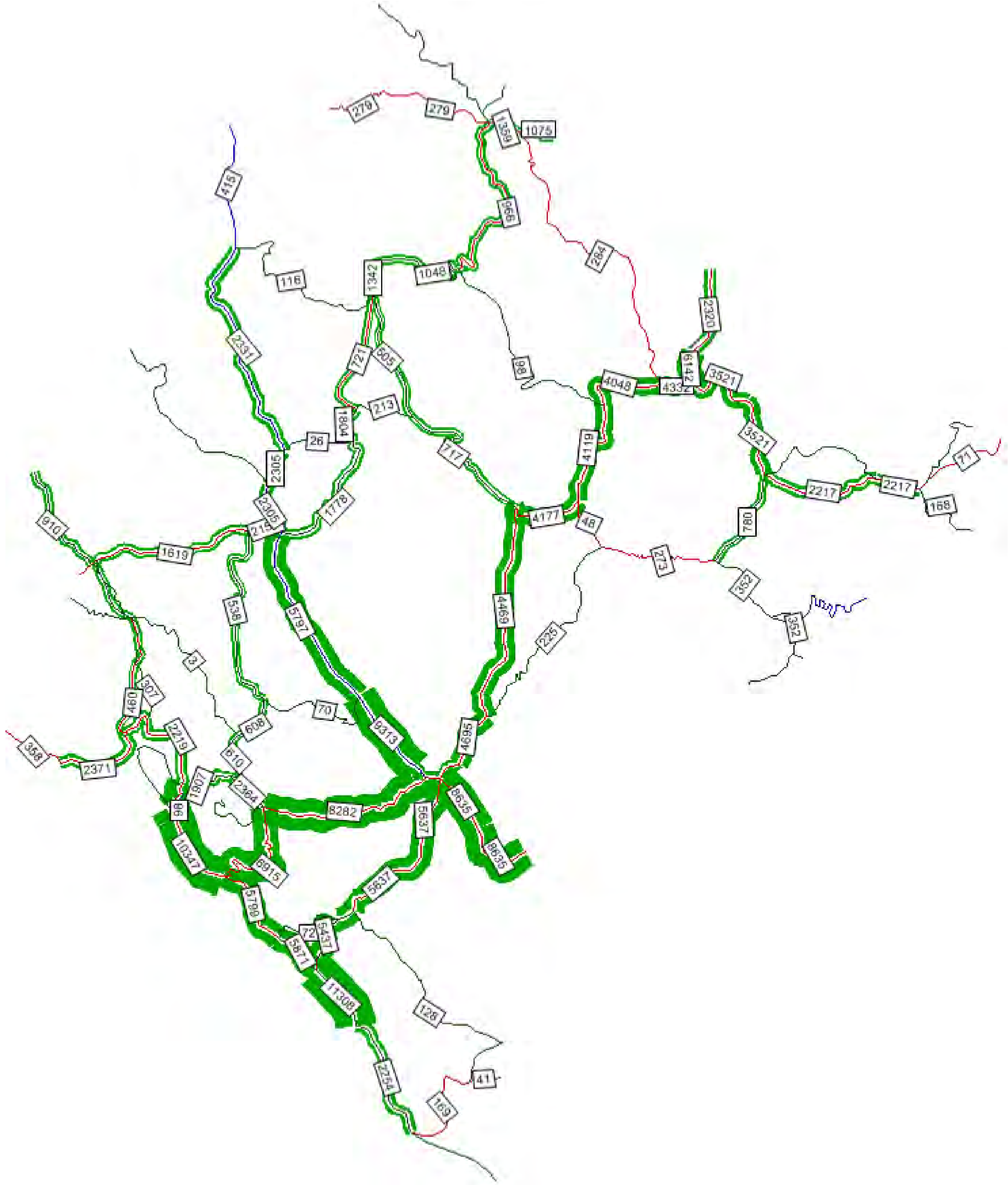

2035 Traffic Volume Change - Scenario 18
AADT
40000
30000
20000
10000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 18


2035 Traffic Volume Change - Scenario 19
AADT
40000
30000
20000
10000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 19

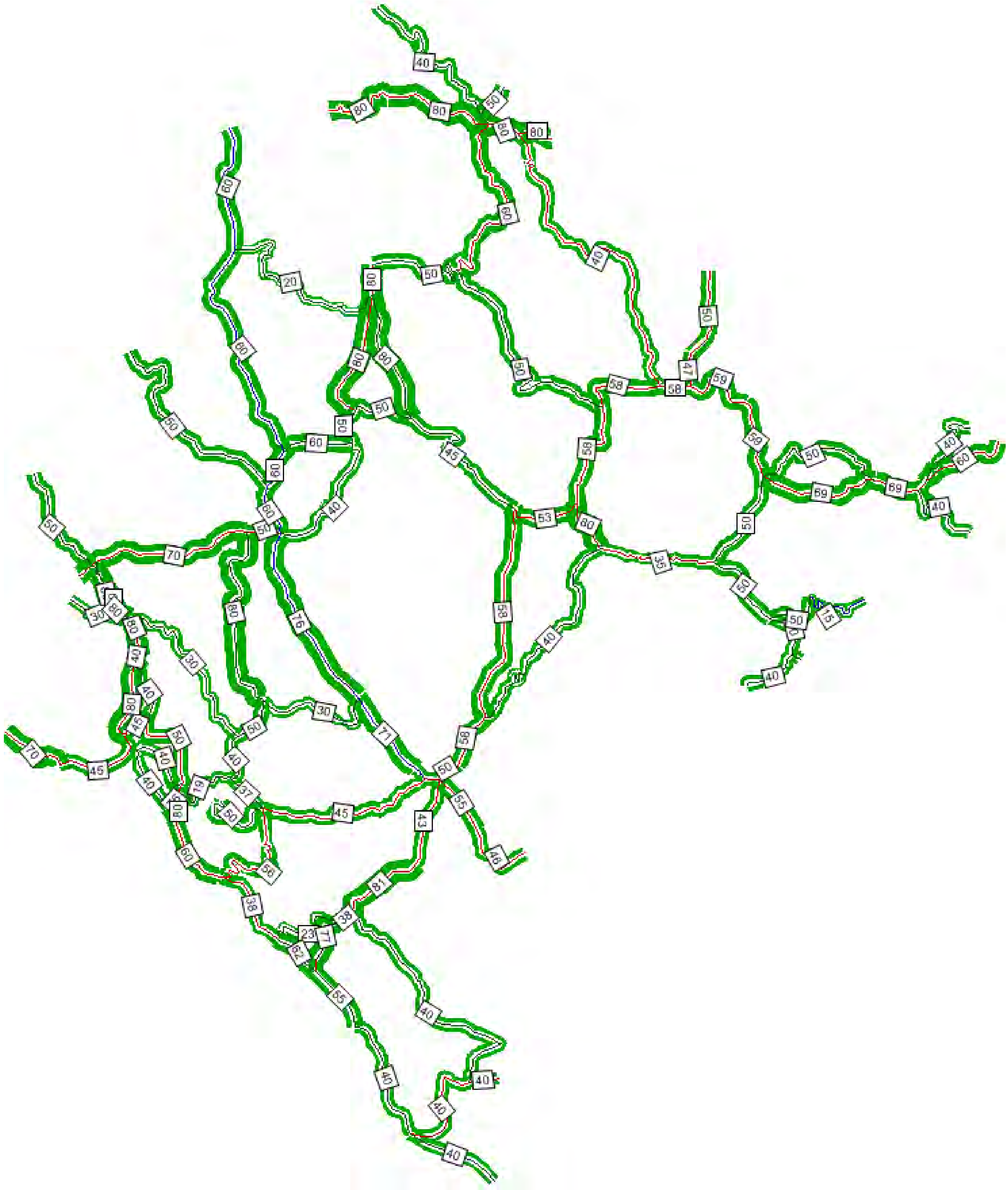

2035 Traffic Volume Change - Scenario 20
AADDT
40000
30000
20000
10000
0
S1 (Dju-Vir)
S2a1 (Vir-Zab)
S2a2 (Zab-Far)
S2b1 (Vir-Cet)
S2b2 (Cet-Far)
S3a1 (Far-Tol)
S3a2 (Tol-Nik)
S3a3 (Nik-Smo)
S4a1 (Smo-Pel)
S4a2 (Pel-Mat)
S5 (Mat-And)
S6a1 (And-Ber)
S6a2 (Ber-Pod)
S7a1 (Pod-Bol)
S7a2 (Pod-Bij)
S7b1 (Bij-Ser)
Proposed Road Section
DM
Scen 20

APPENDIX 10 YEAR 2012 PLOTS

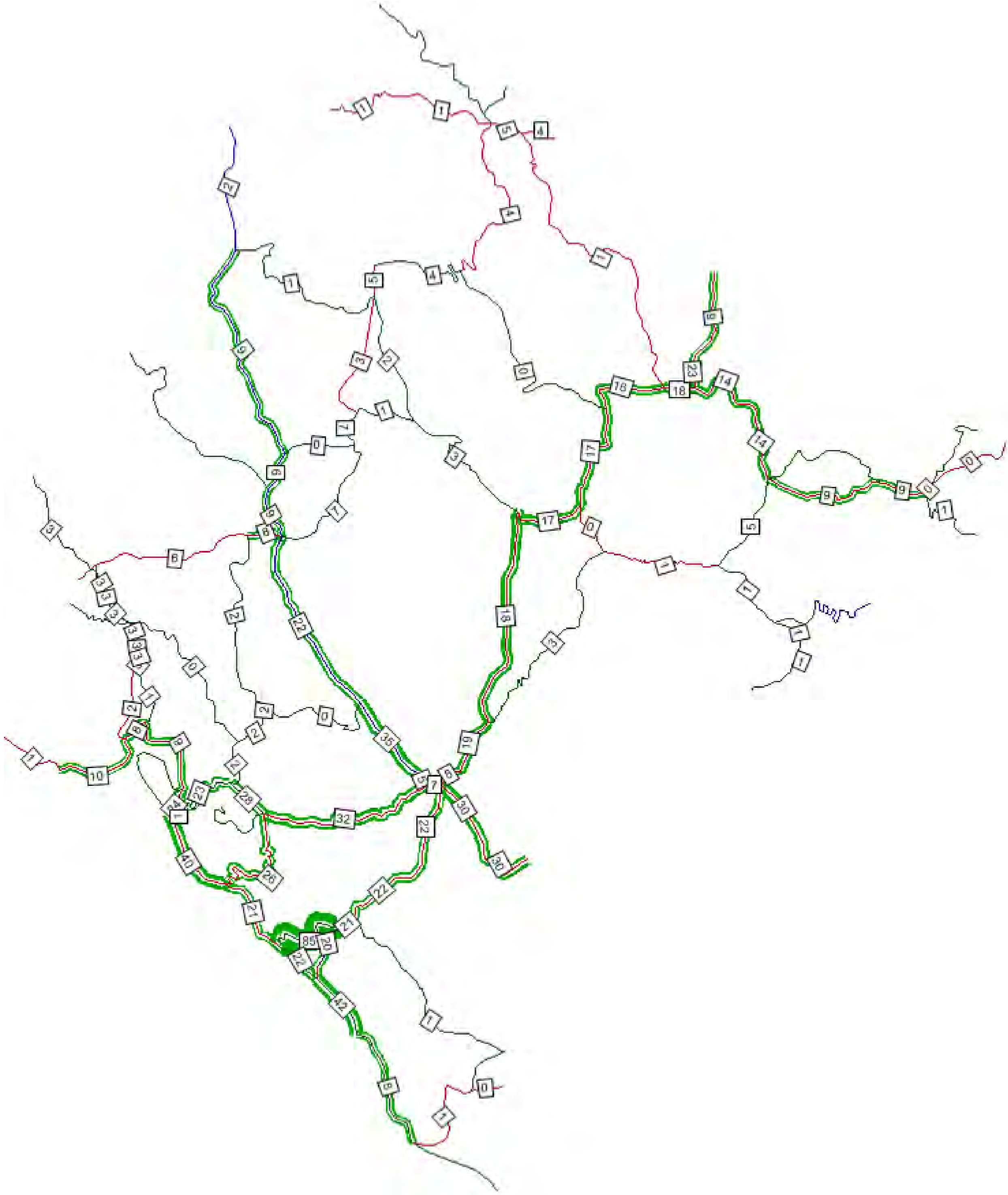
Year 2012 DM AADT Flow



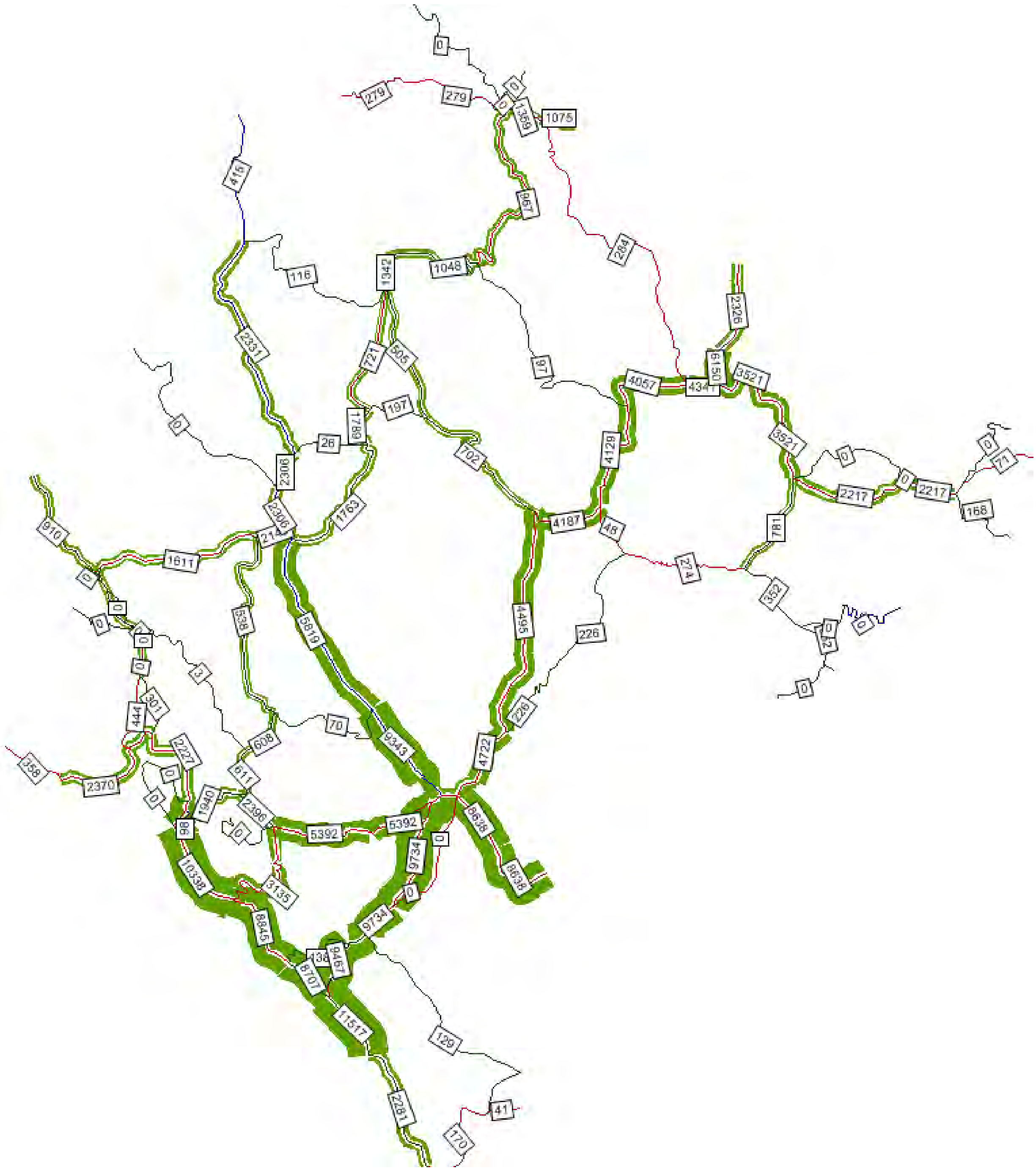
Year 2012 DM Speed (km/h)



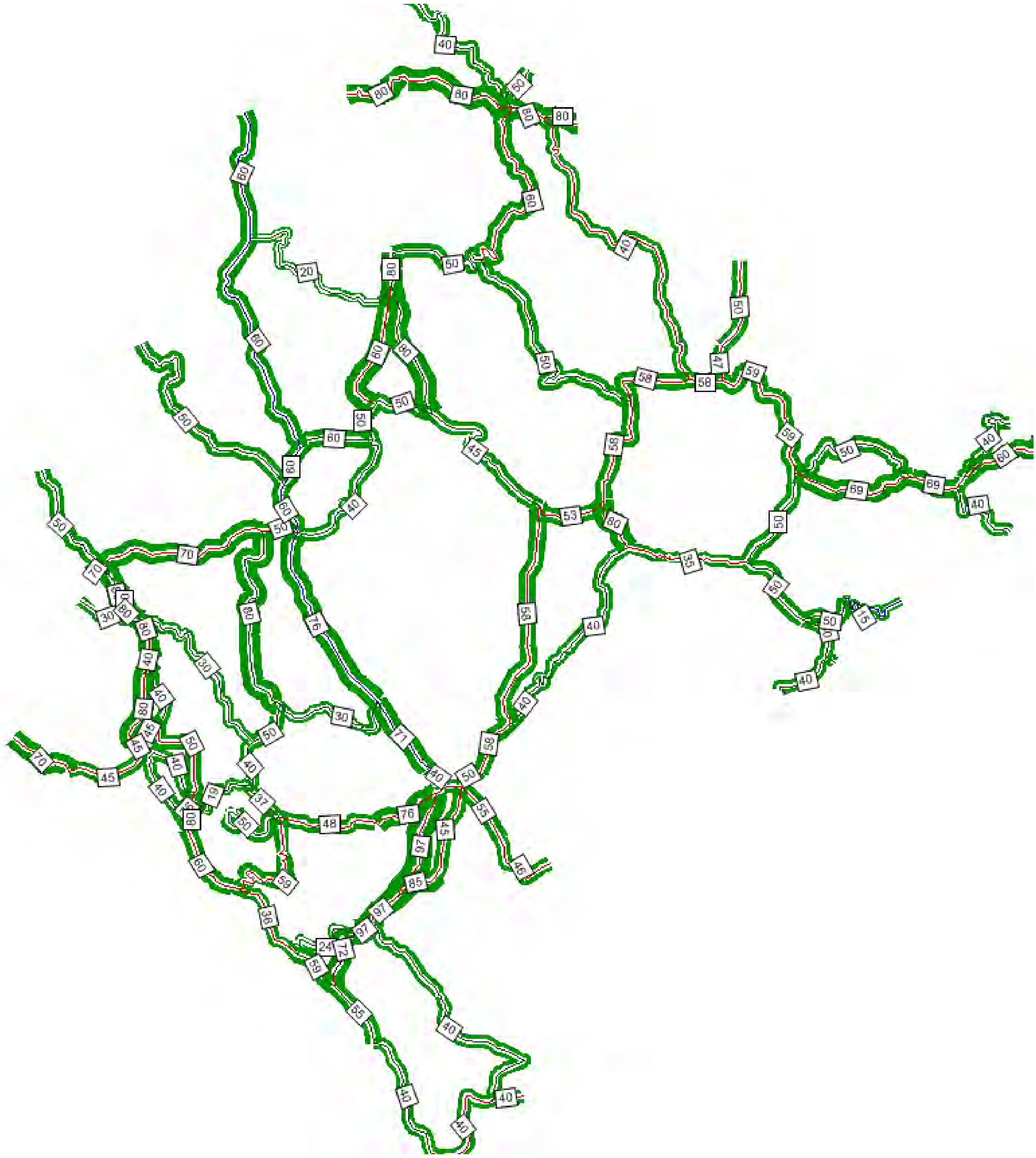
Year 2012 DM Volume/Capacity Ratio



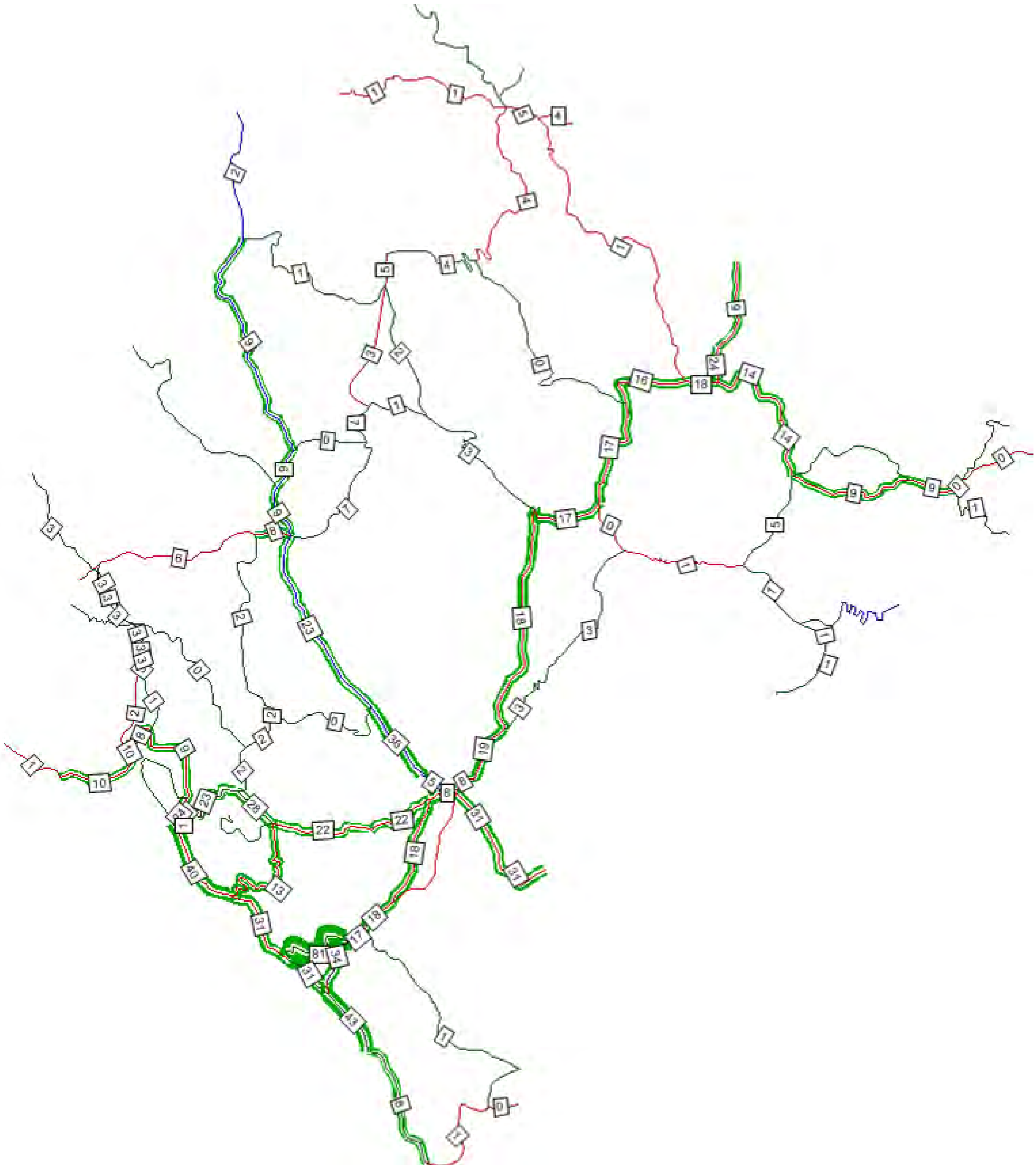
Year 2012 Scenario 1 AADT Flow



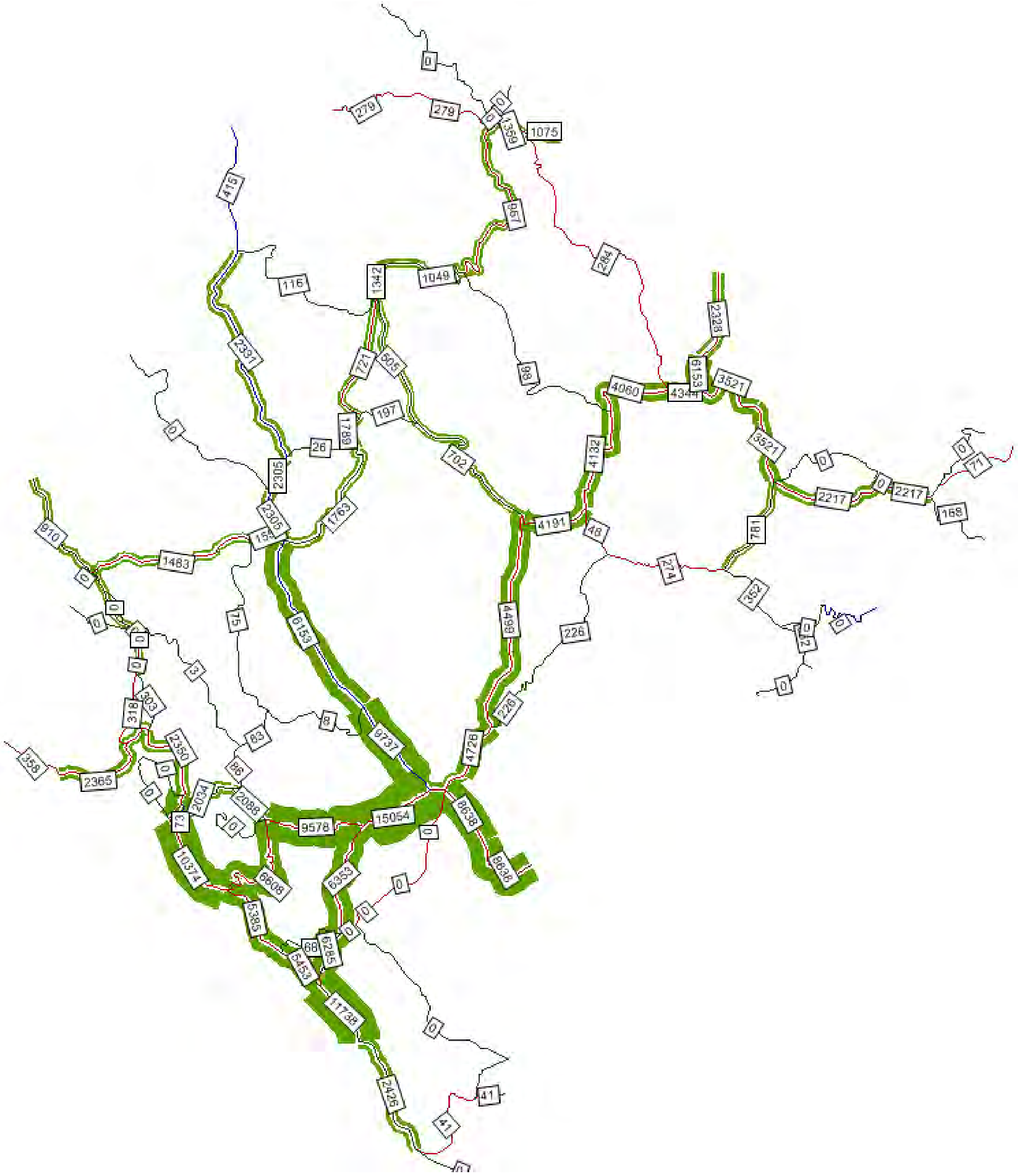
Year 2012 Scenario 1 Speed (km/h)



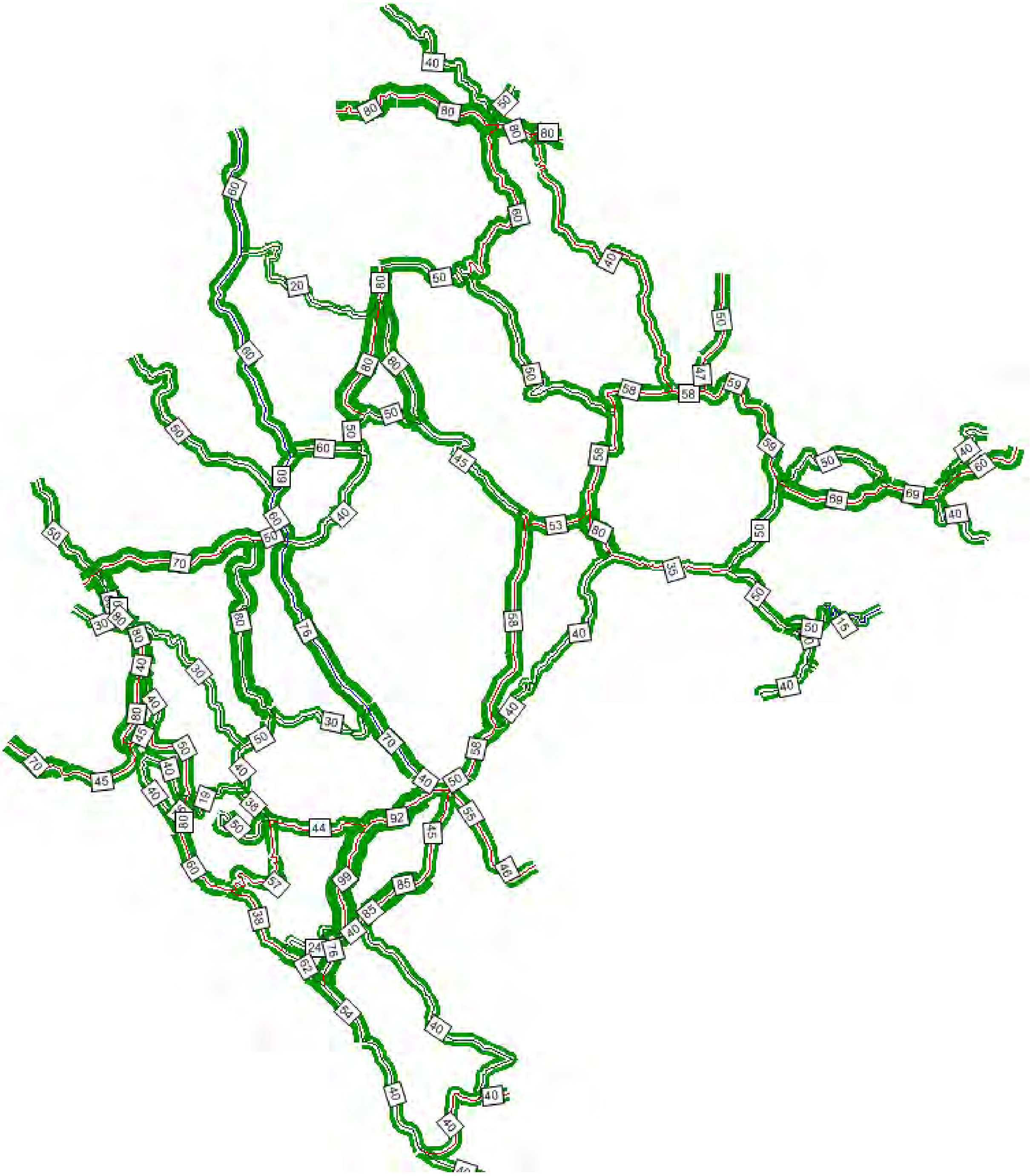
Year 2012 Scenario 1 Volume/Capacity Ratio



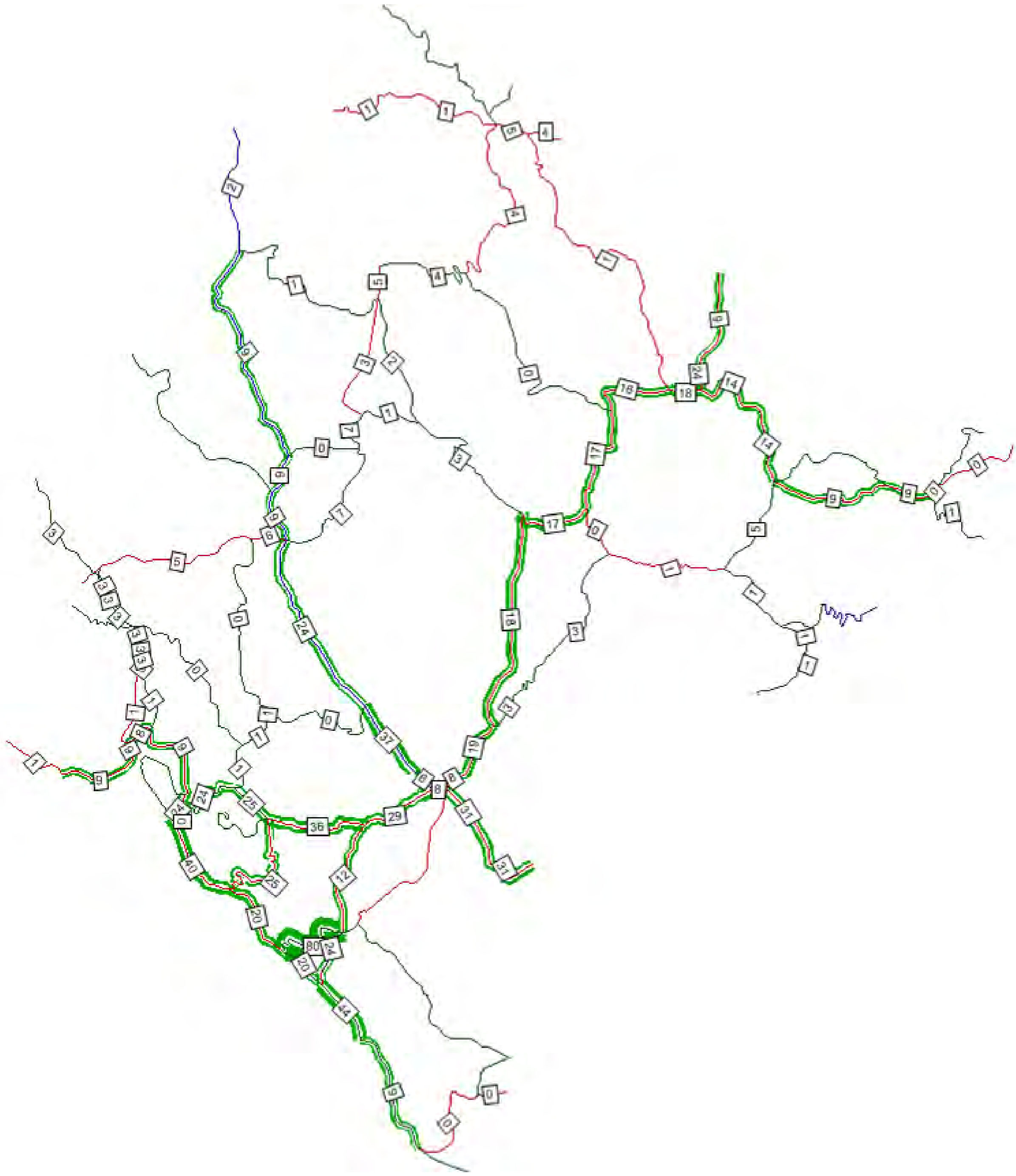
Year 2012 Scenario 2 AADT Flow



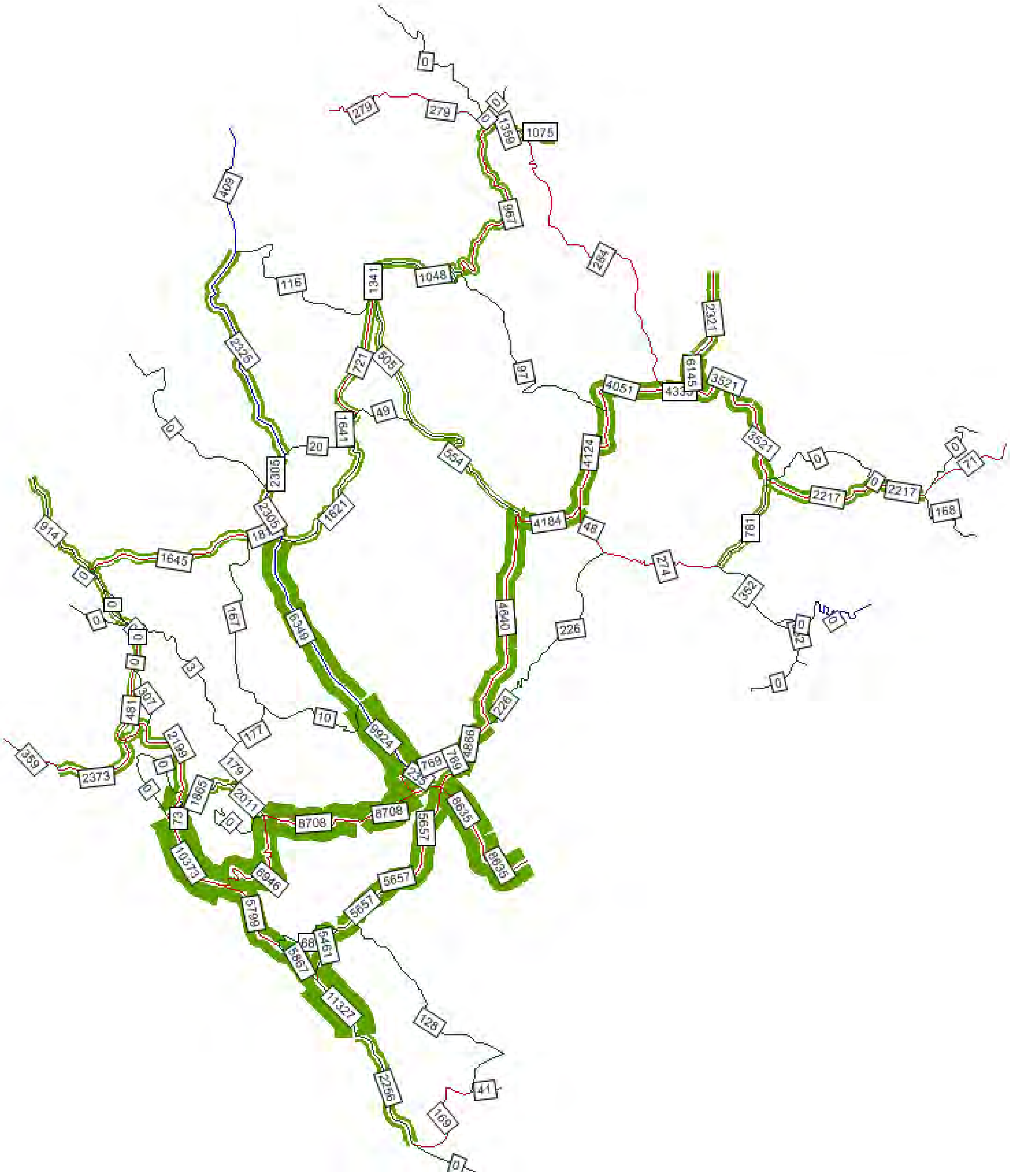
Year 2012 Scenario 2 Speed (km/h)



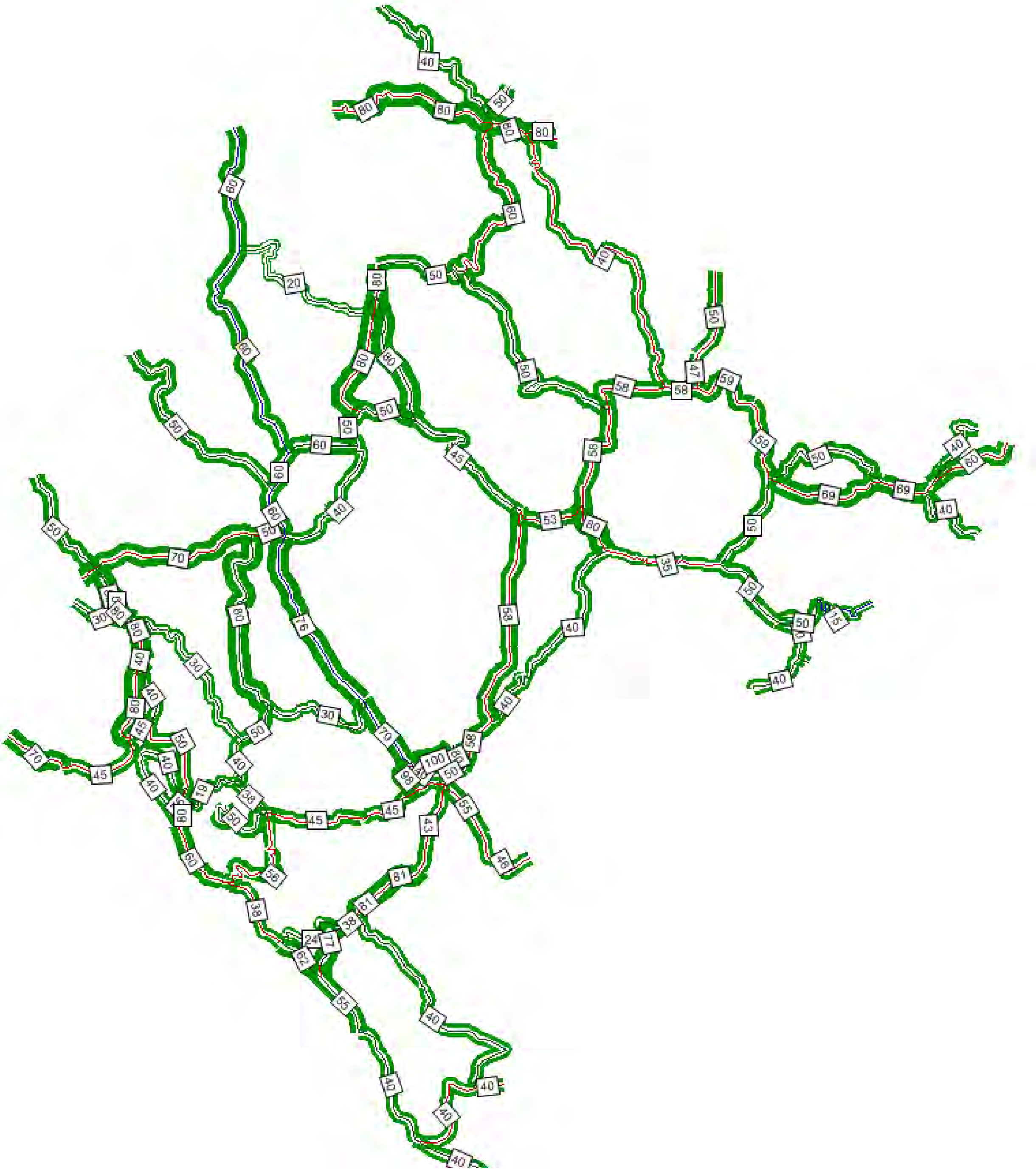
Year 2012 Scenario 2 Volume/Capacity Ratio



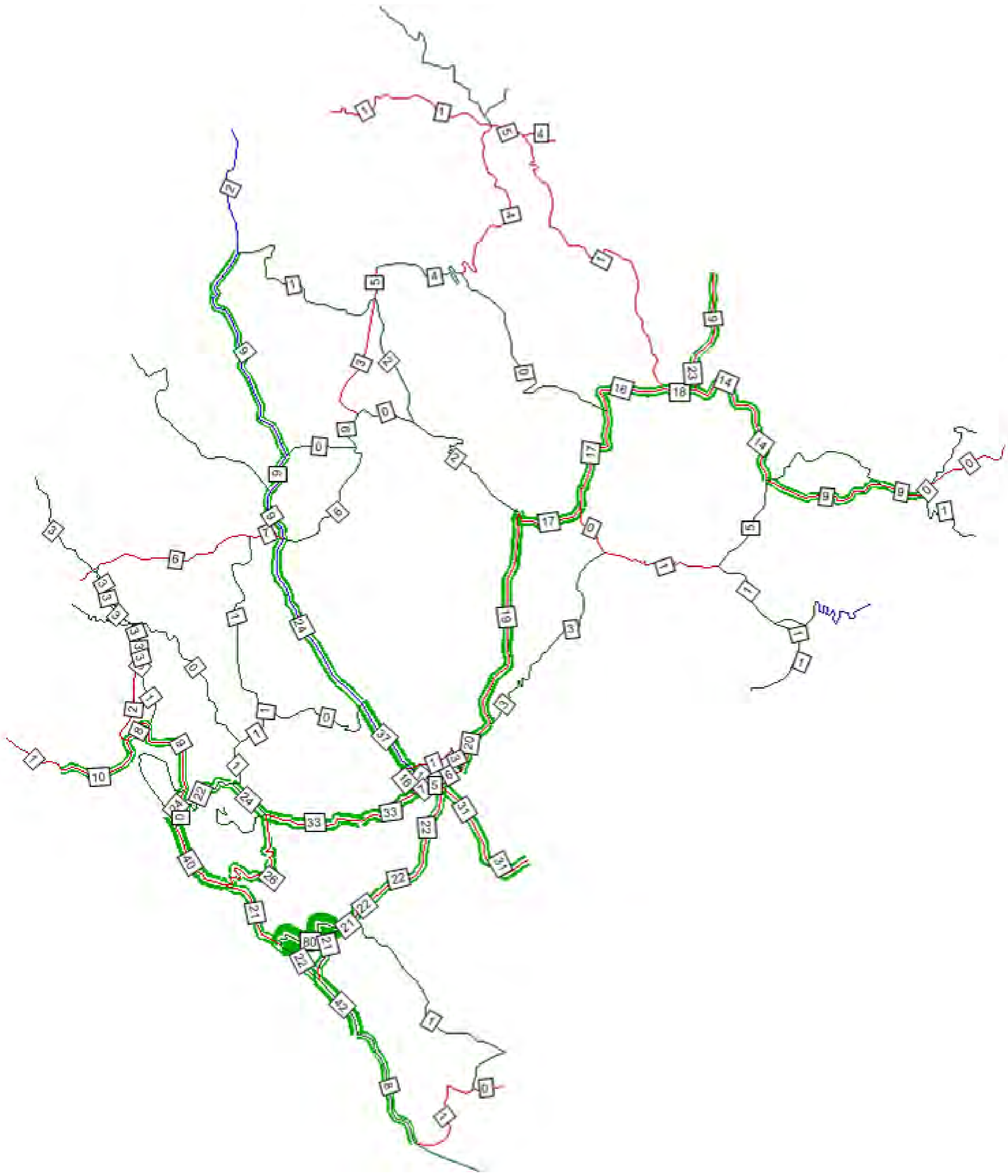
Year 2012 Scenario 3 AADT Flow



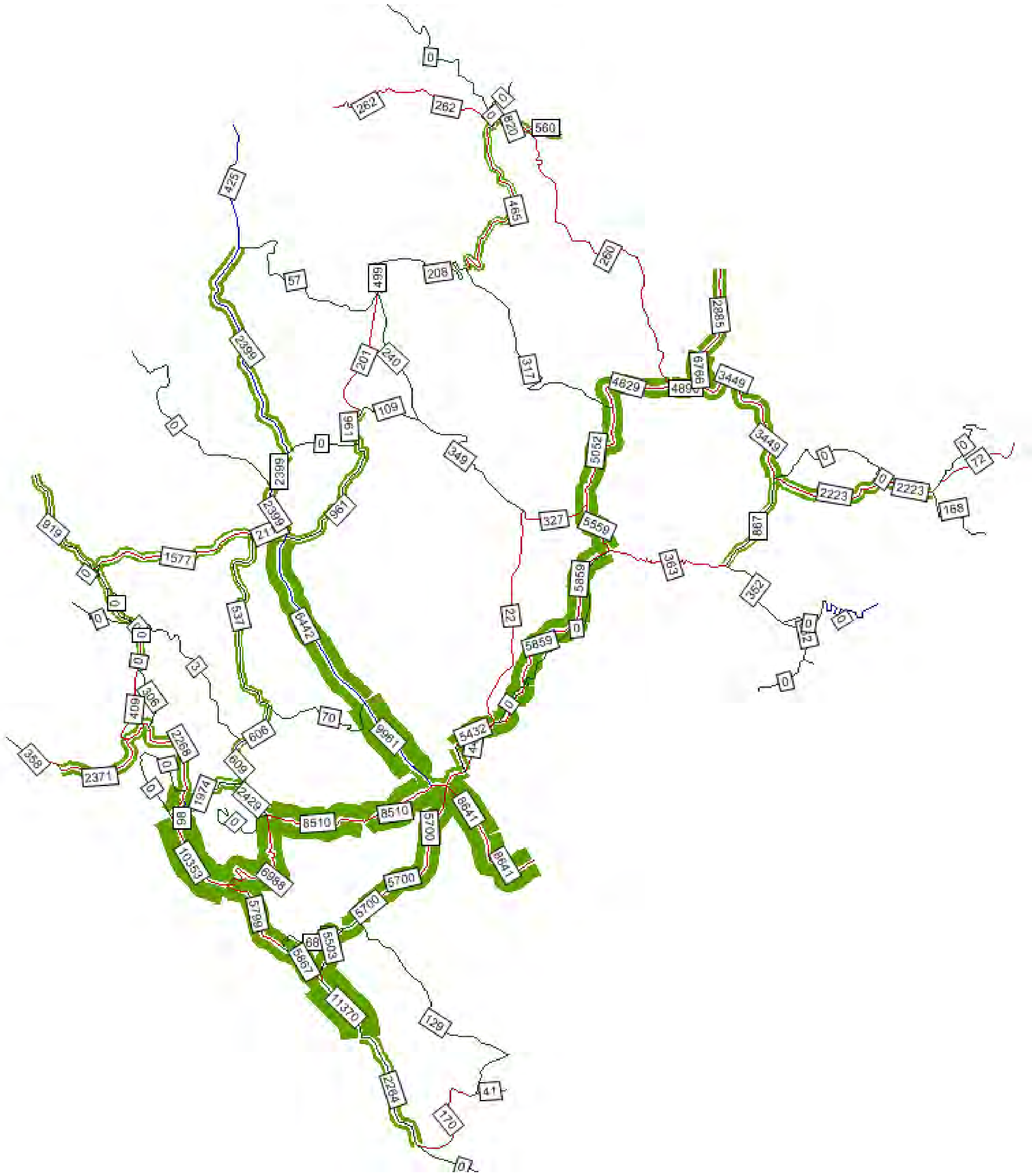
Year 2012 Scenario 3 Speed (km/h)



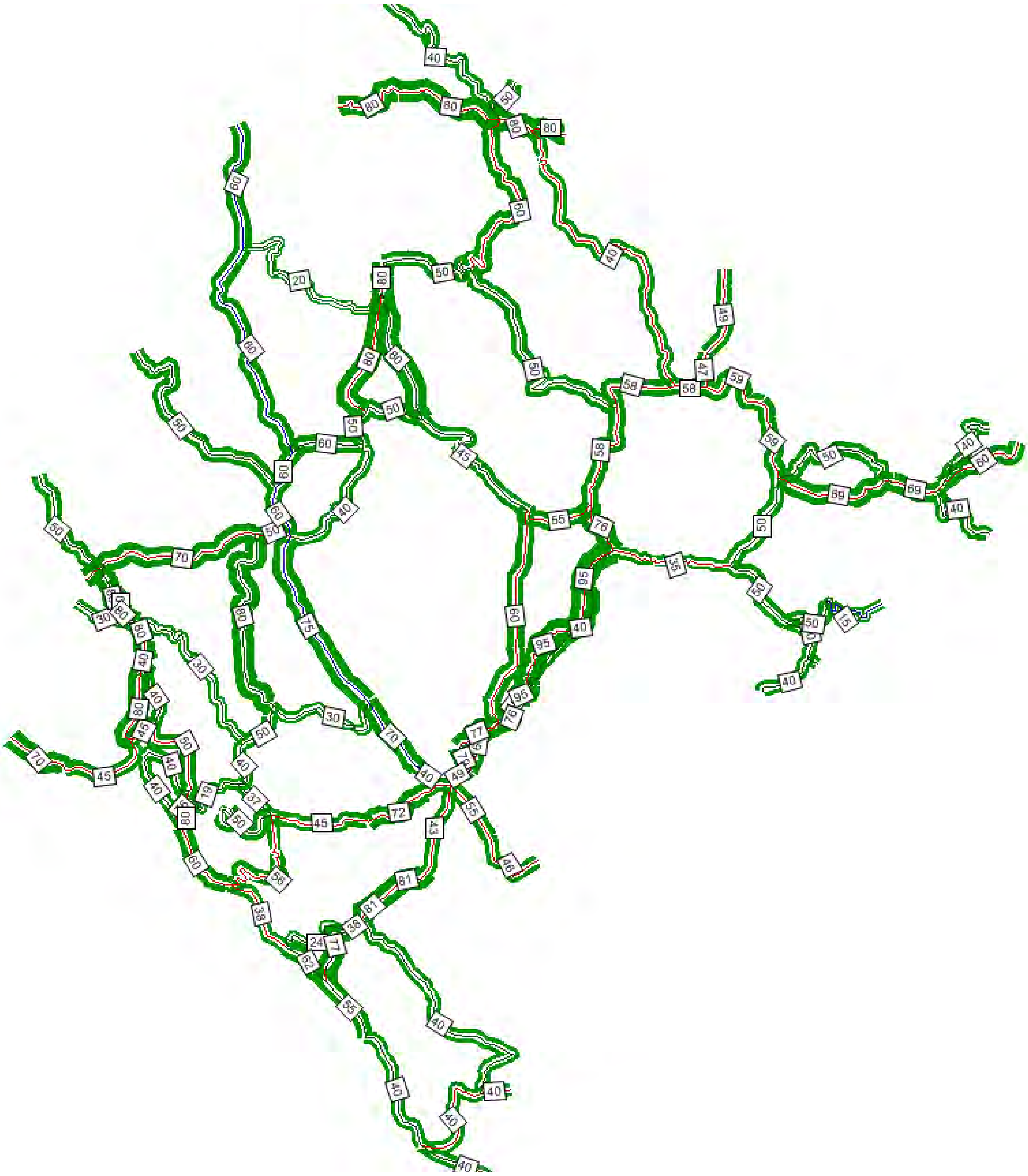
Year 2012 Scenario 3 Volume/Capacity Ratio



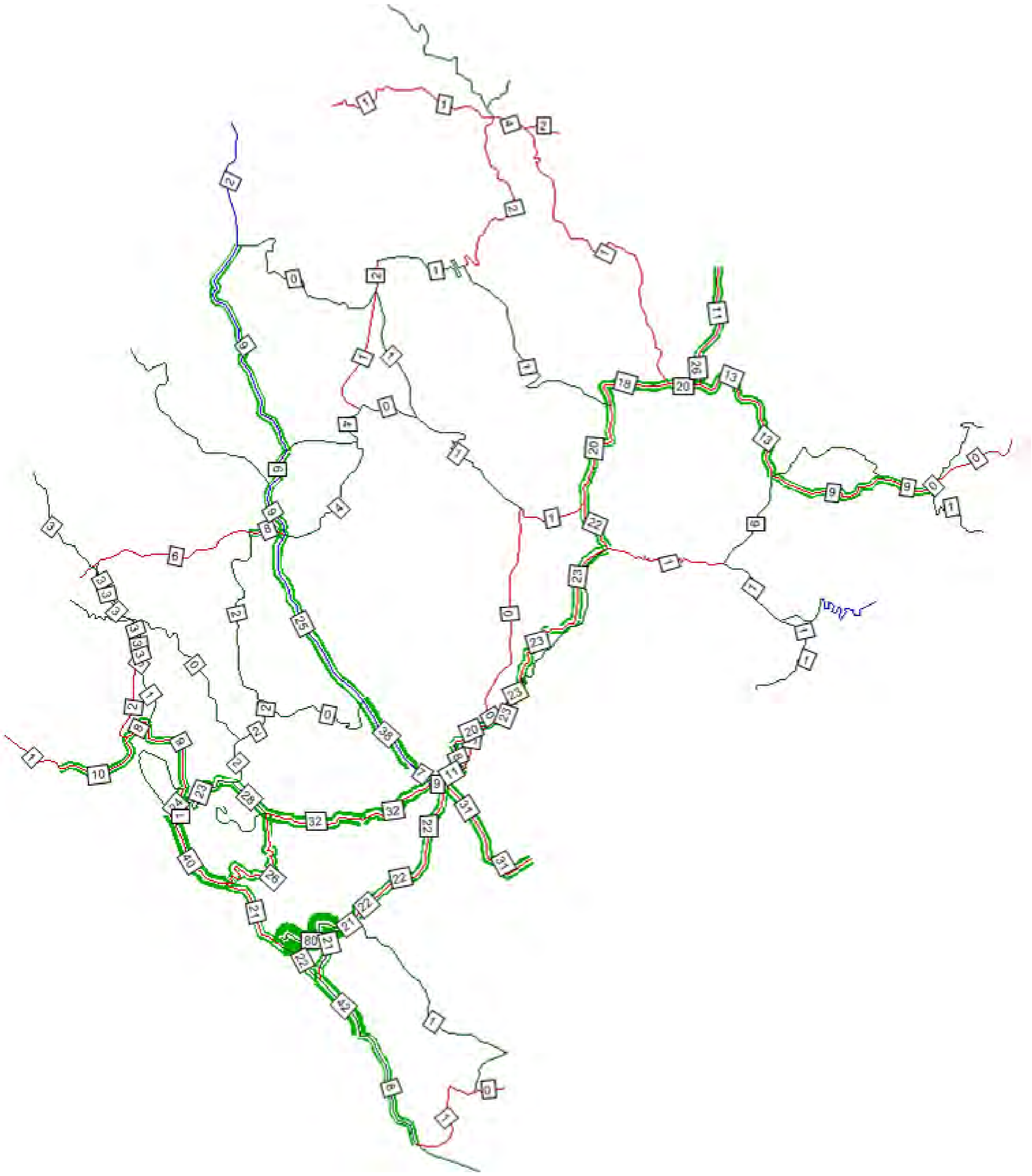
Year 2012 Scenario 4 AADT Flow



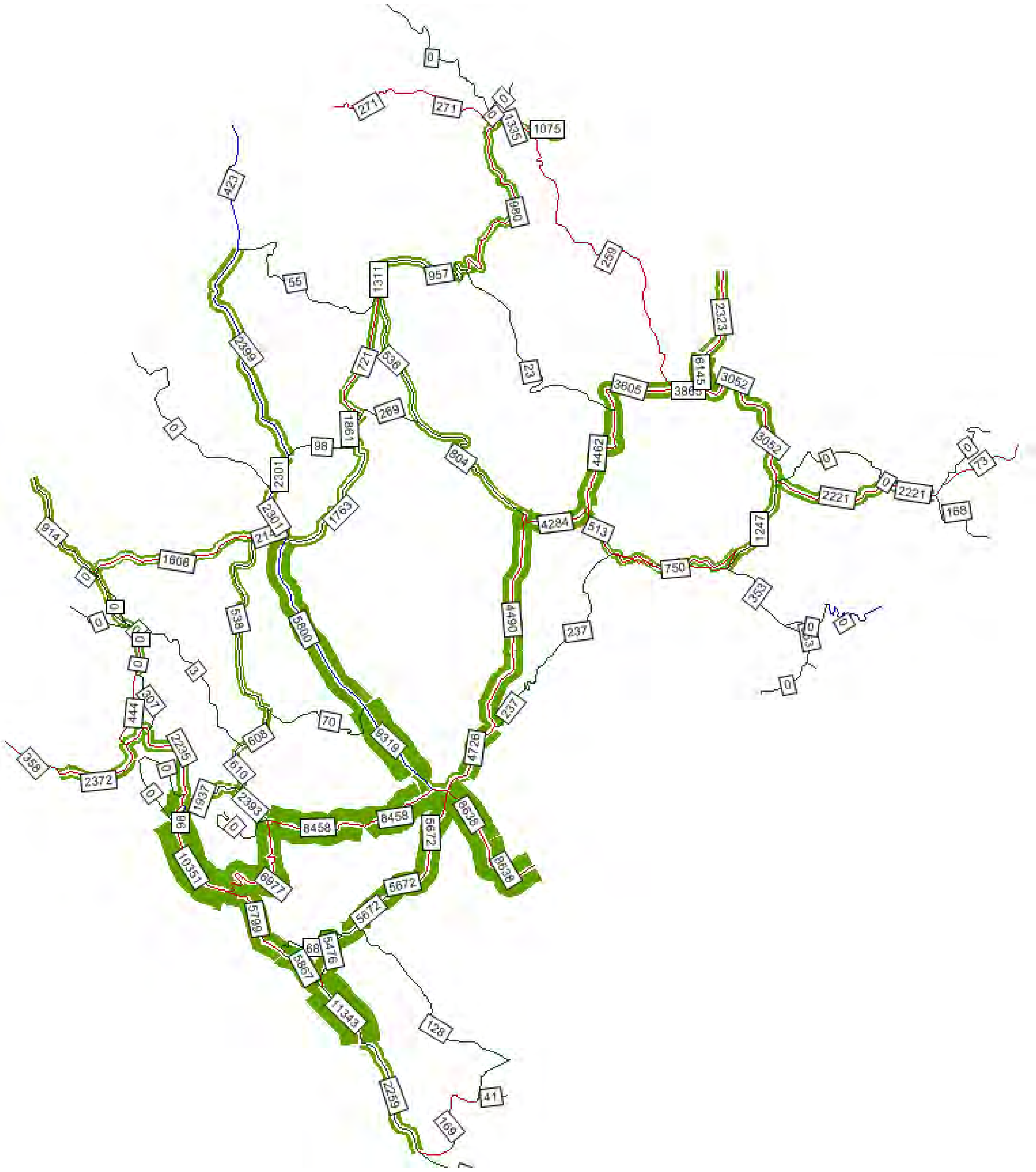
Year 2012 Scenario 4 Speed (km/h)



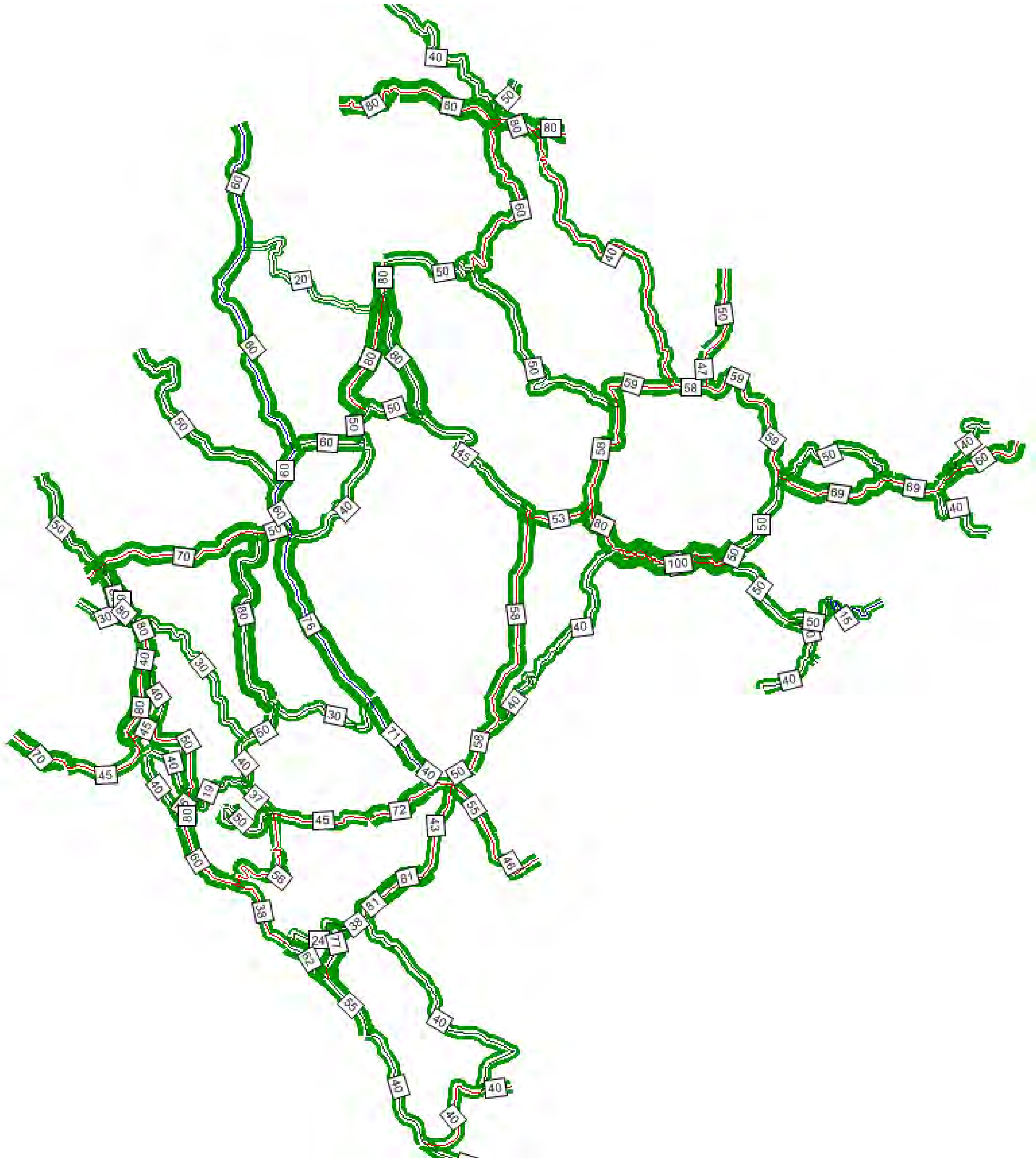
Year 2012 Scenario 4 Volume/Capacity Ratio



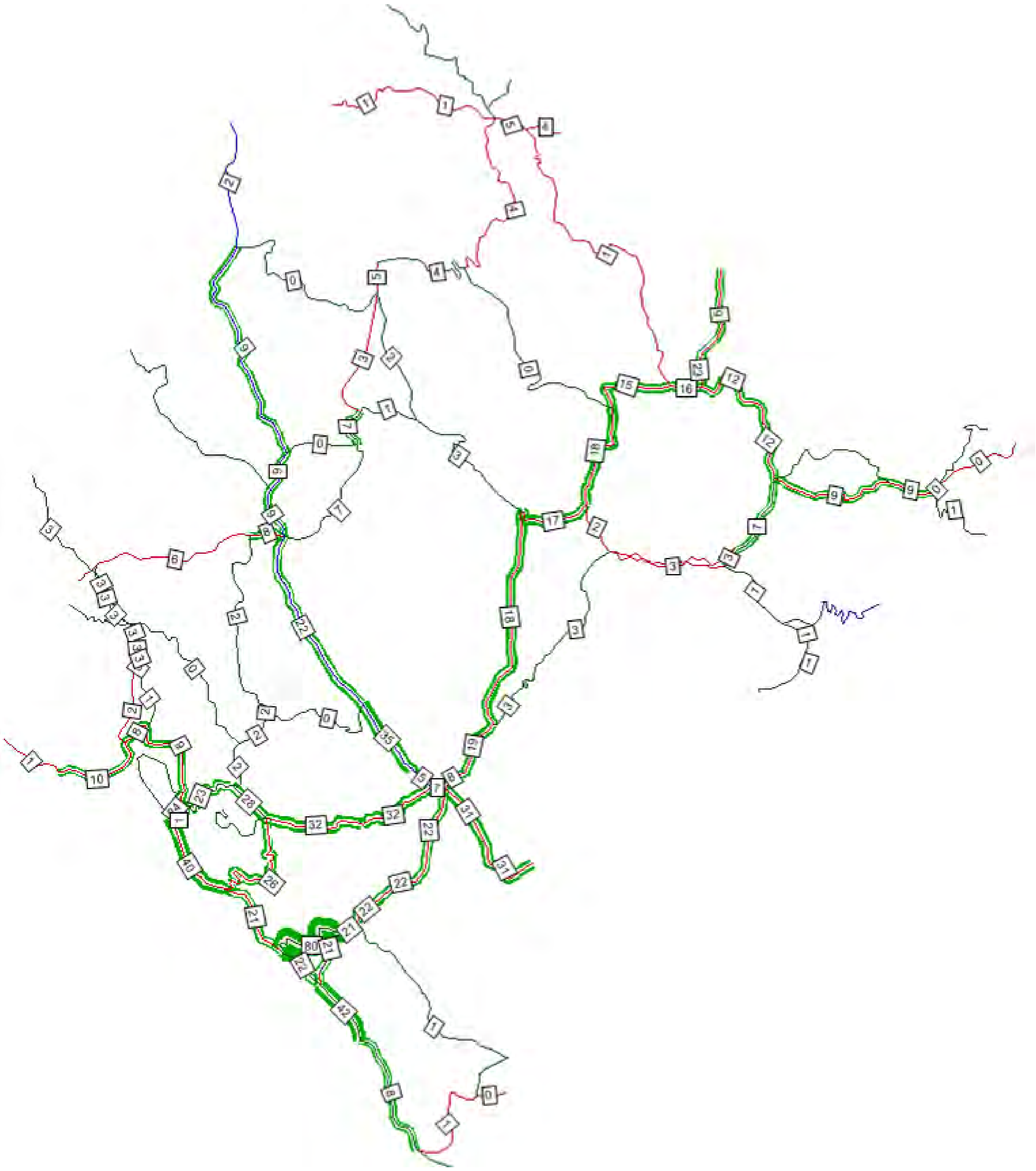
Year 2012 Scenario 5 AADT Flow



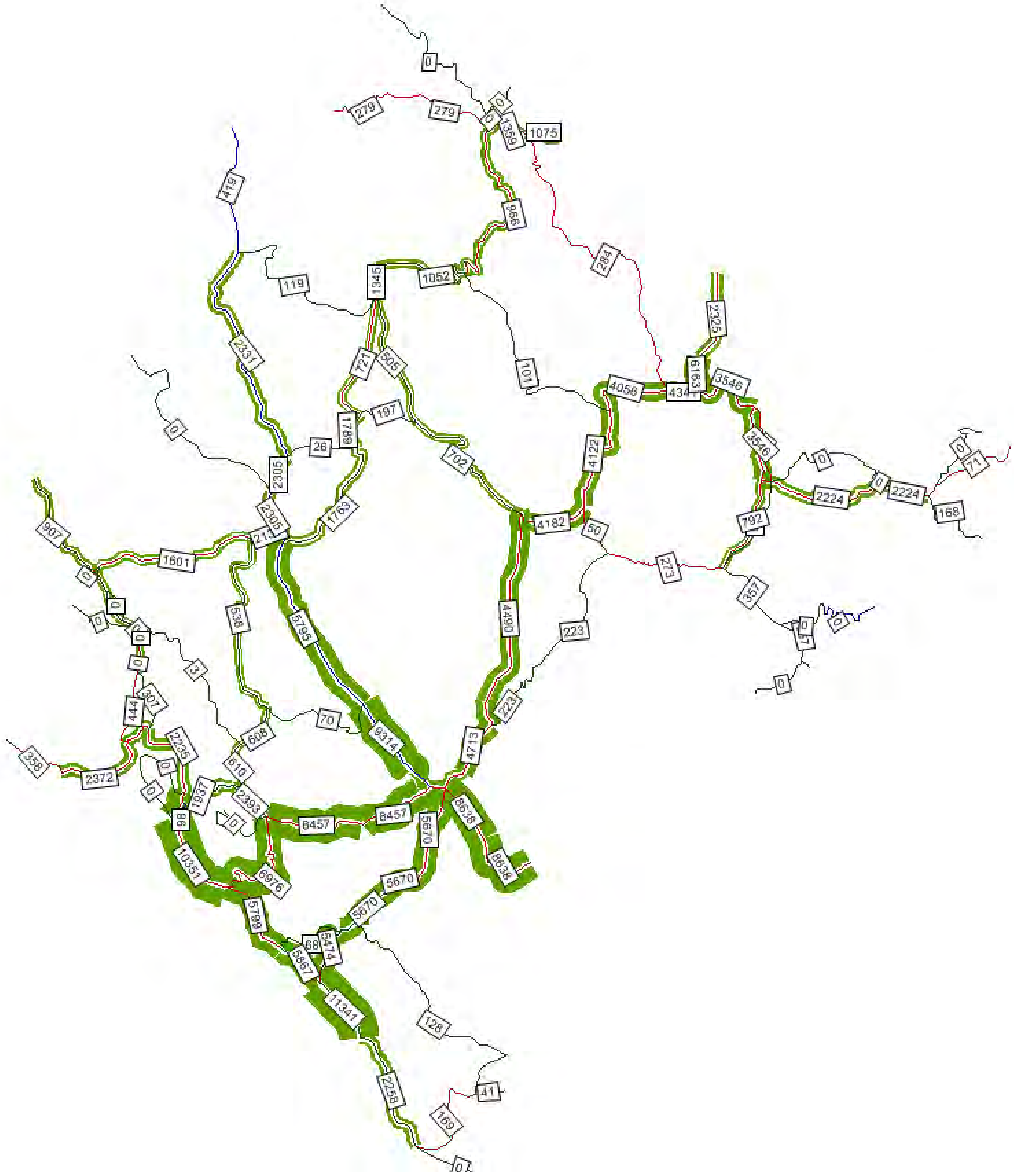
Year 2012 Scenario 5 Speed (km/h)



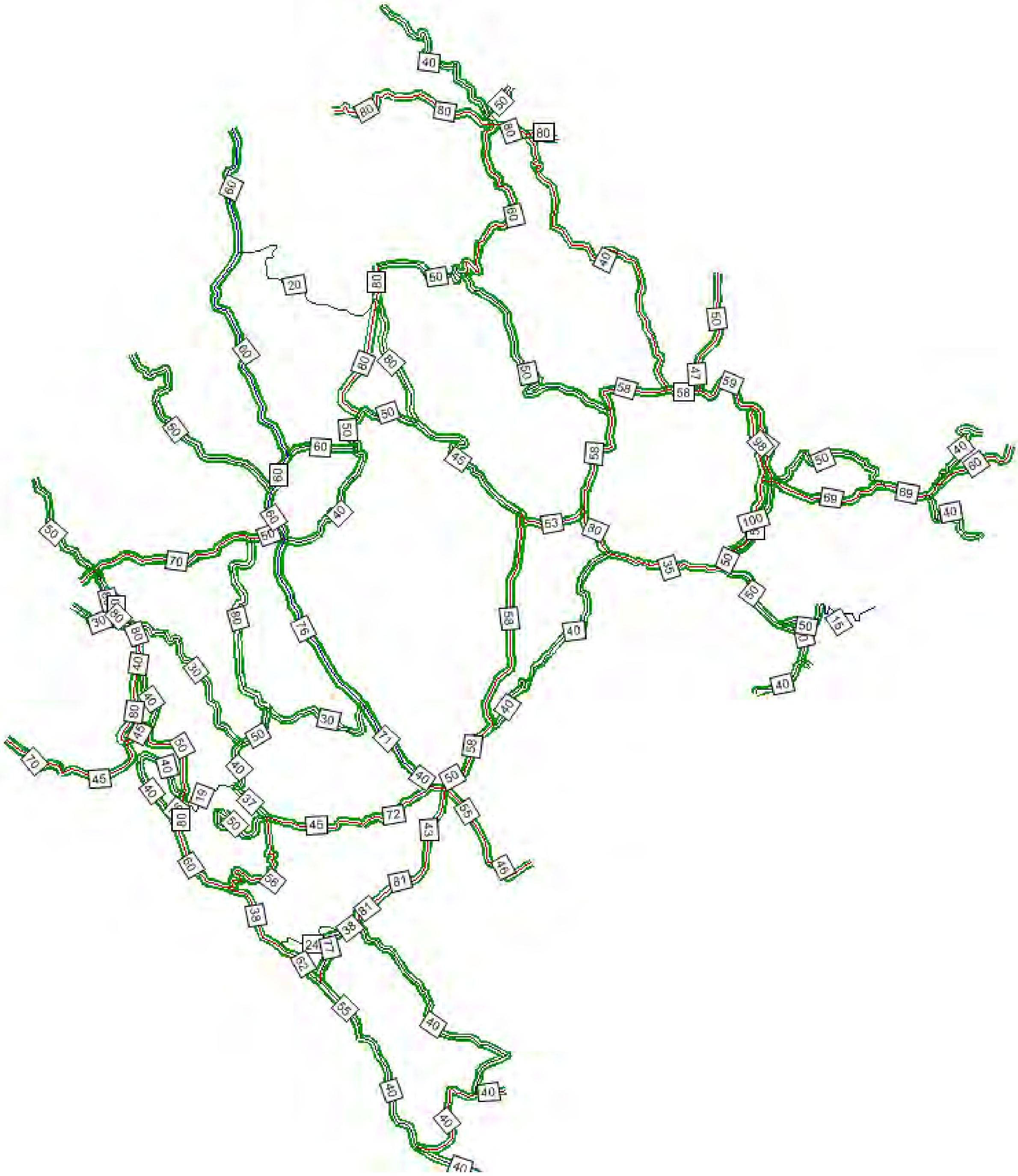
Year 2012 Scenario 5 Volume/Capacity Ratio



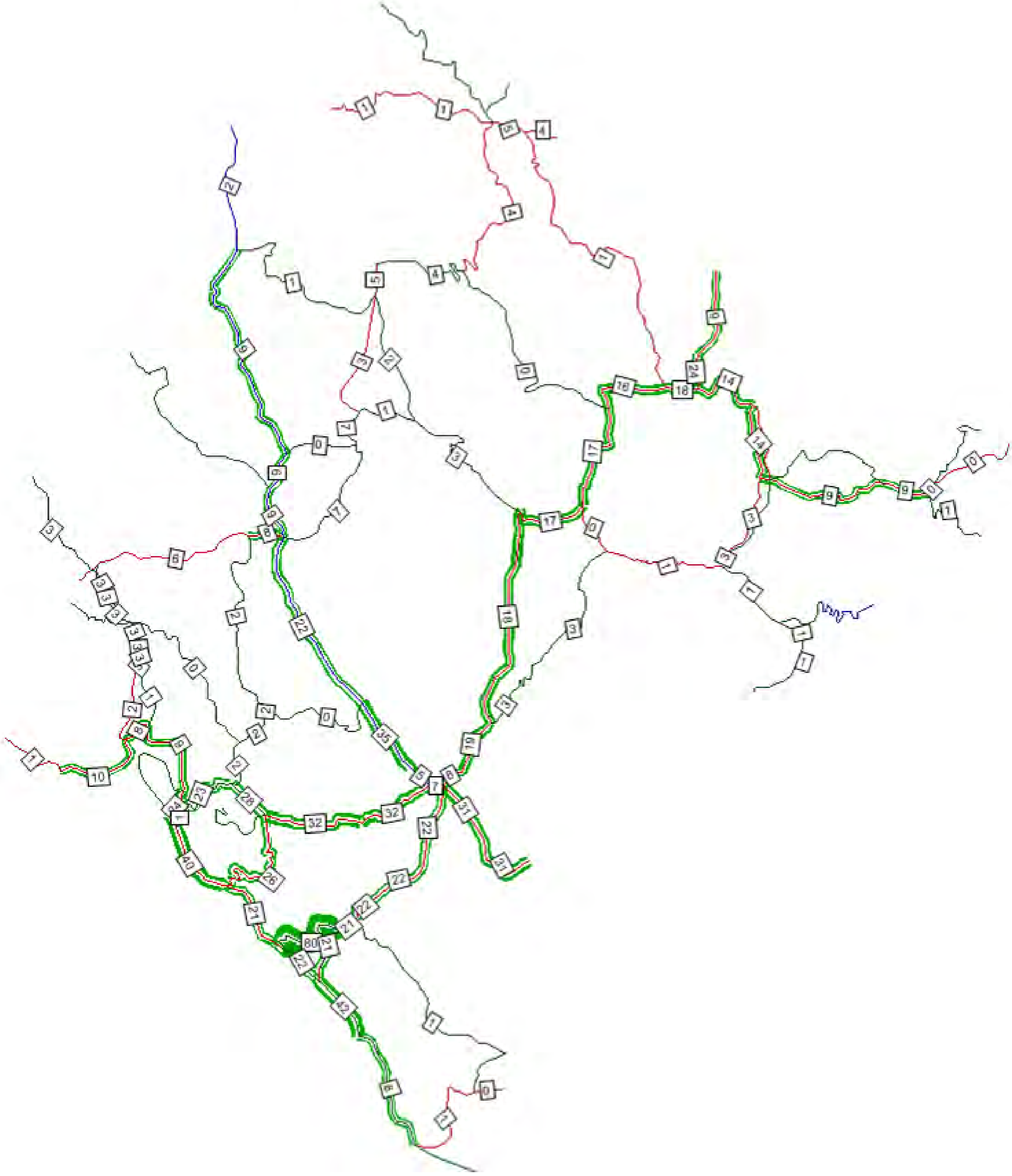
Year 2012 Scenario 6 AADT Flow



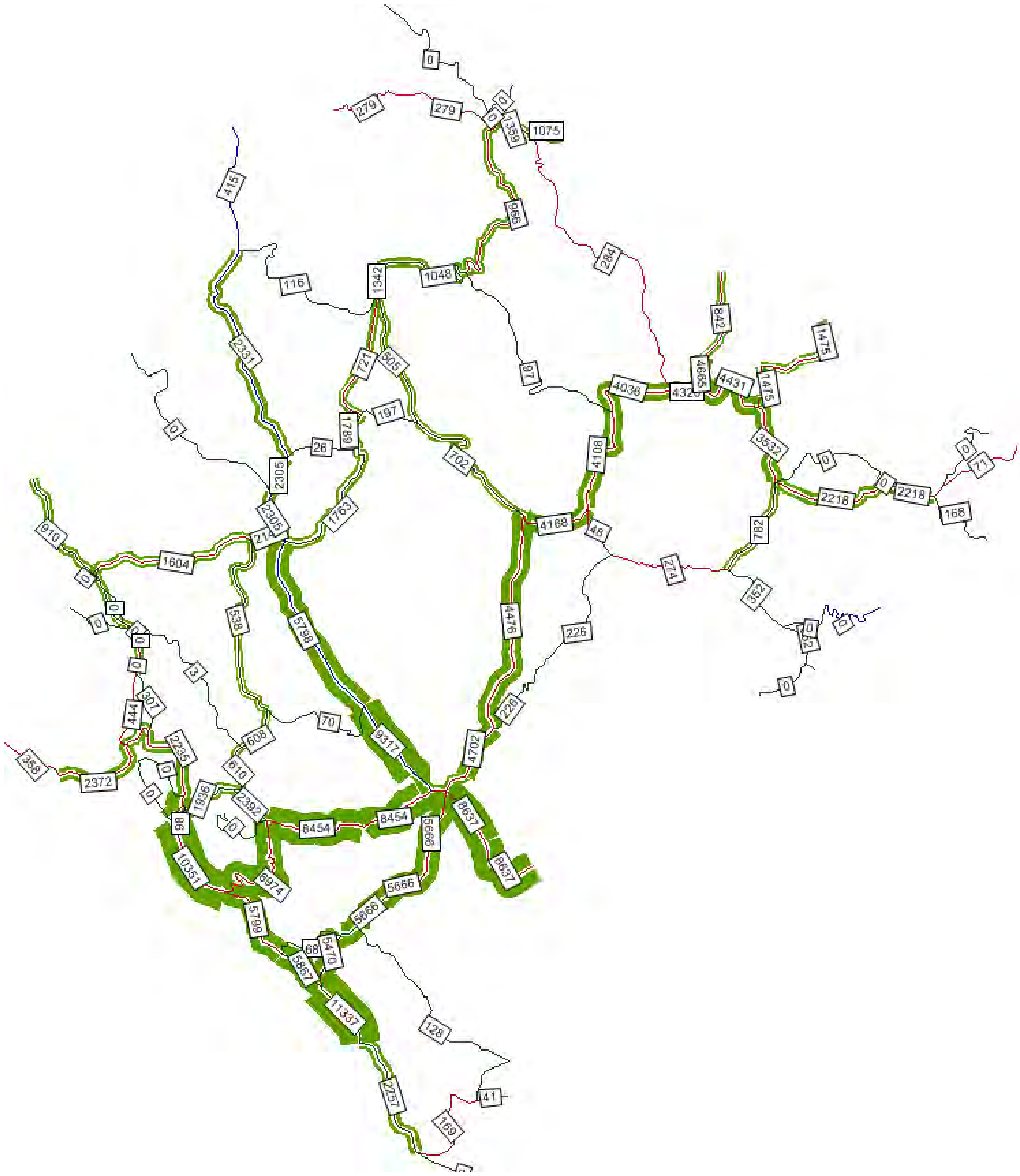
Year 2012 Scenario 6 Speed (km/h)



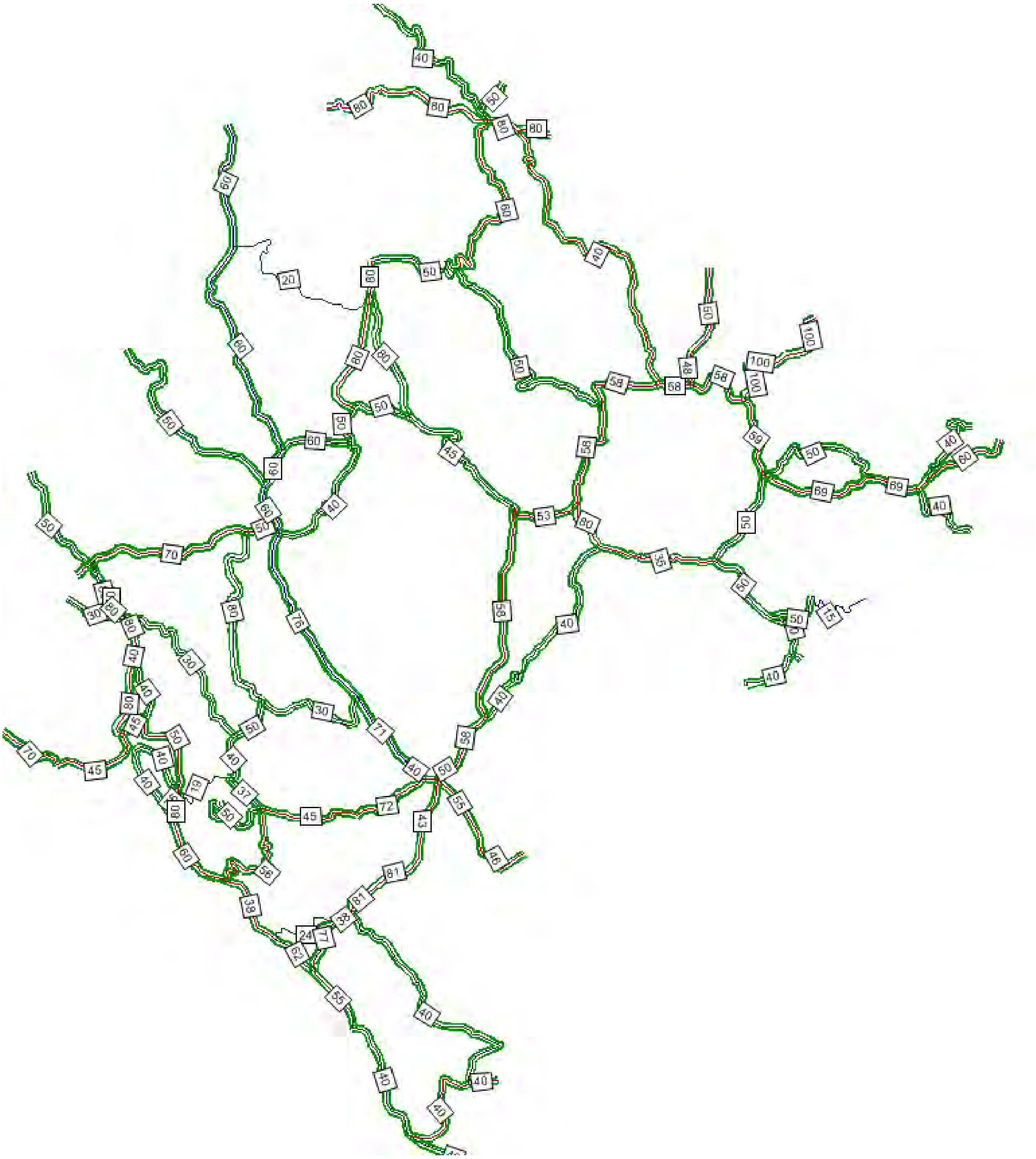
Year 2012 Scenario 6 Volume/Capacity Ratio



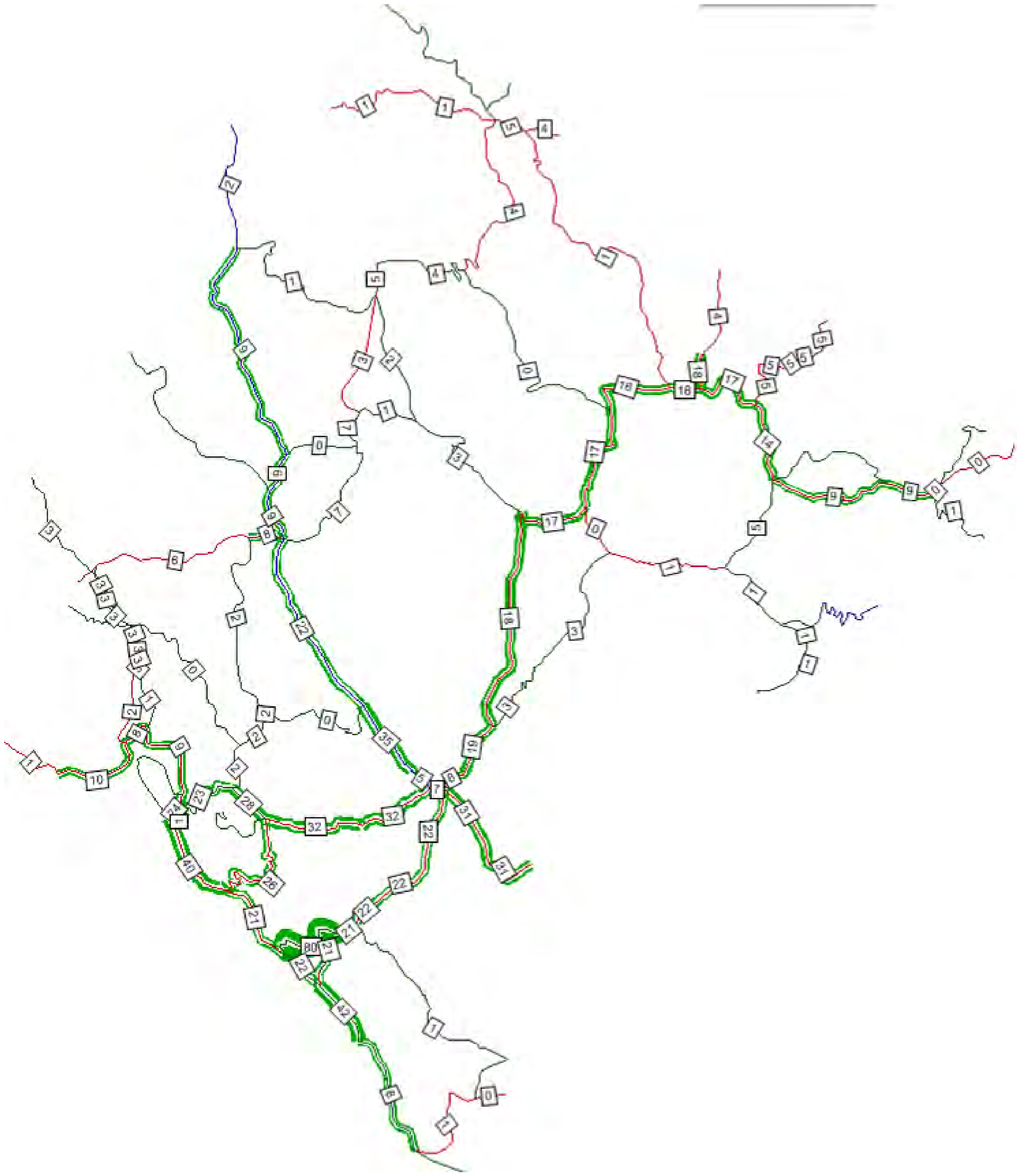
Year 2012 Scenario 7 AADT Flow



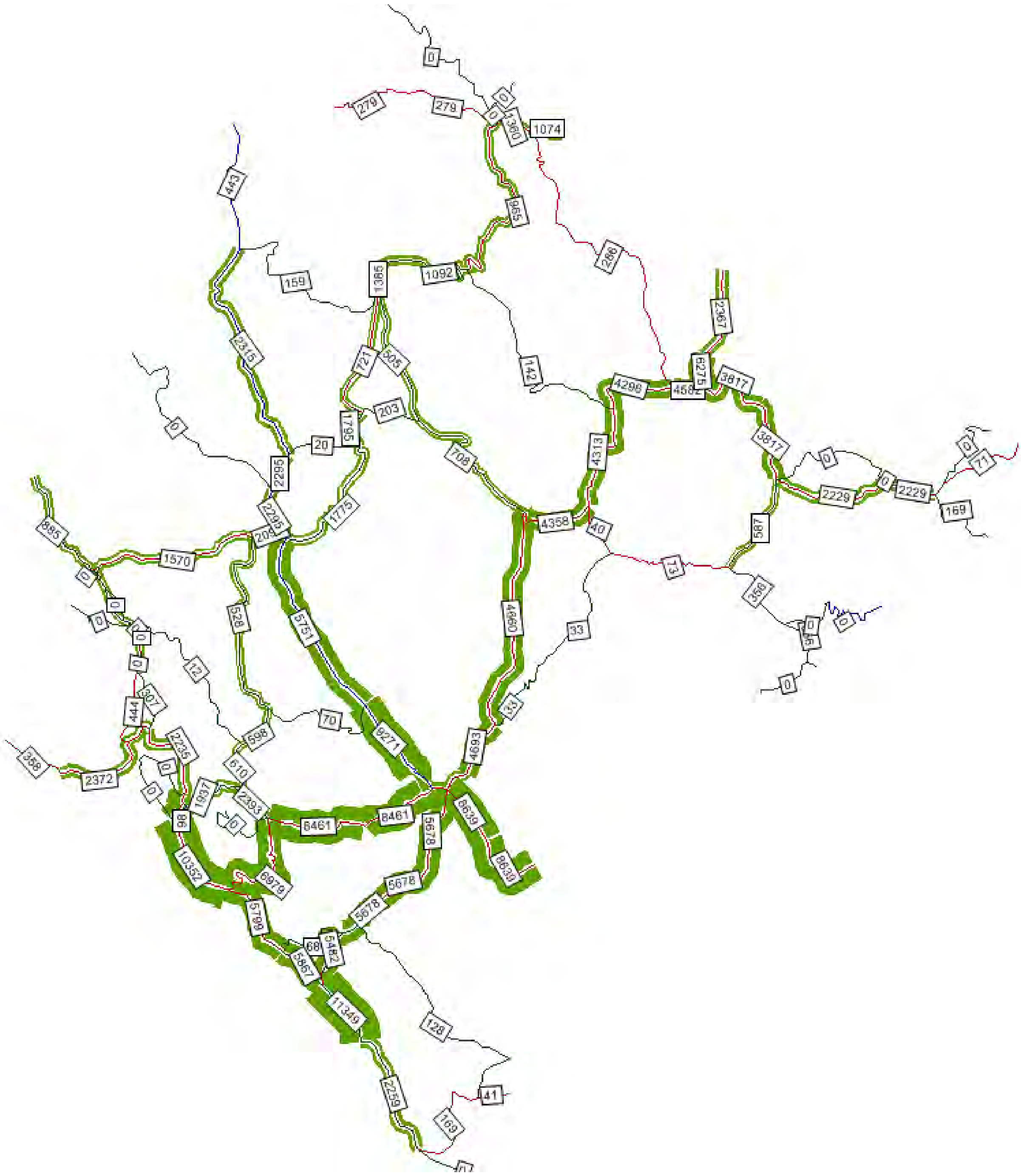
Year 2012 Scenario 7 Speed (km/h)



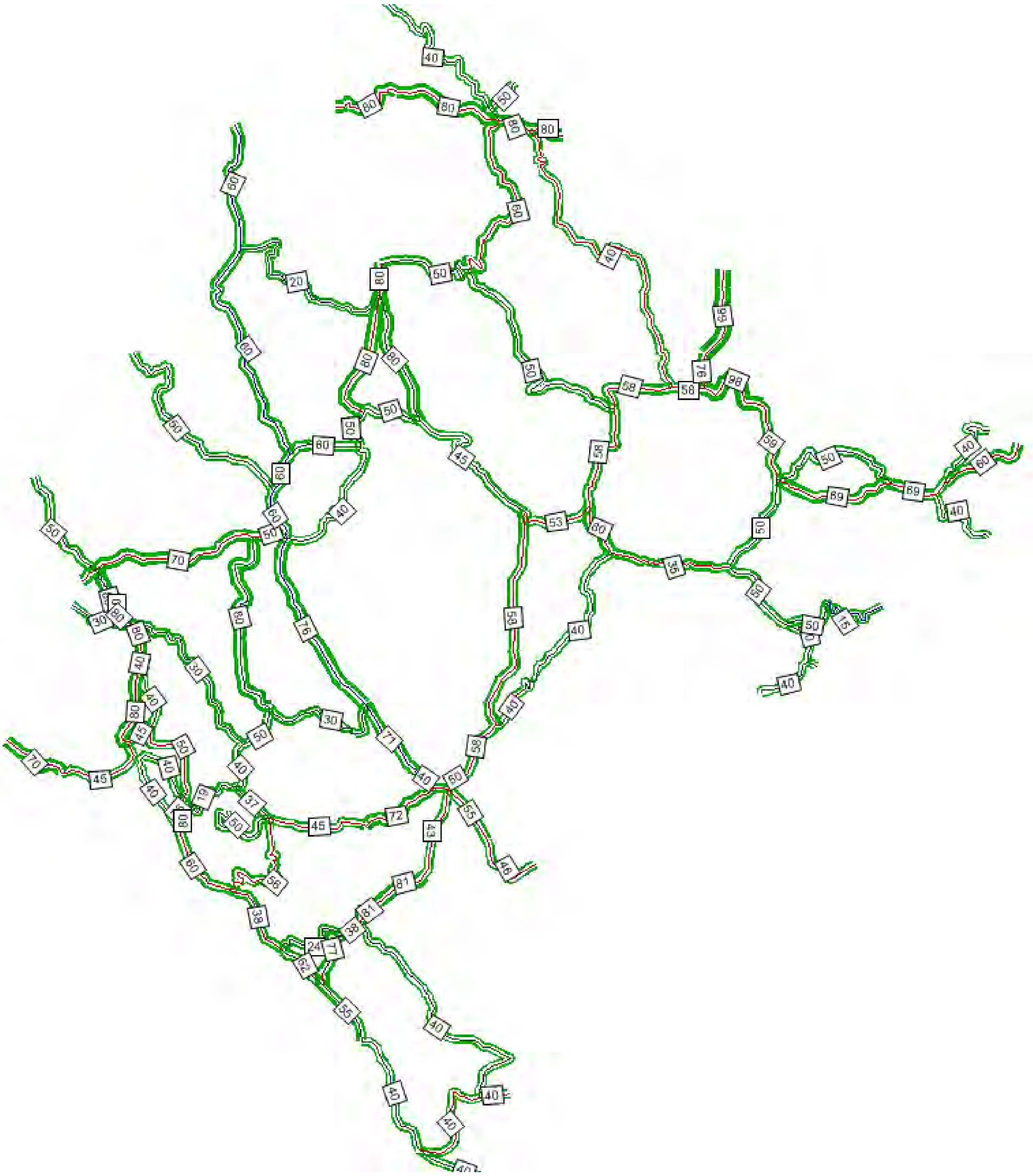
Year 2012 Scenario 7 Volume/Capacity Ratio



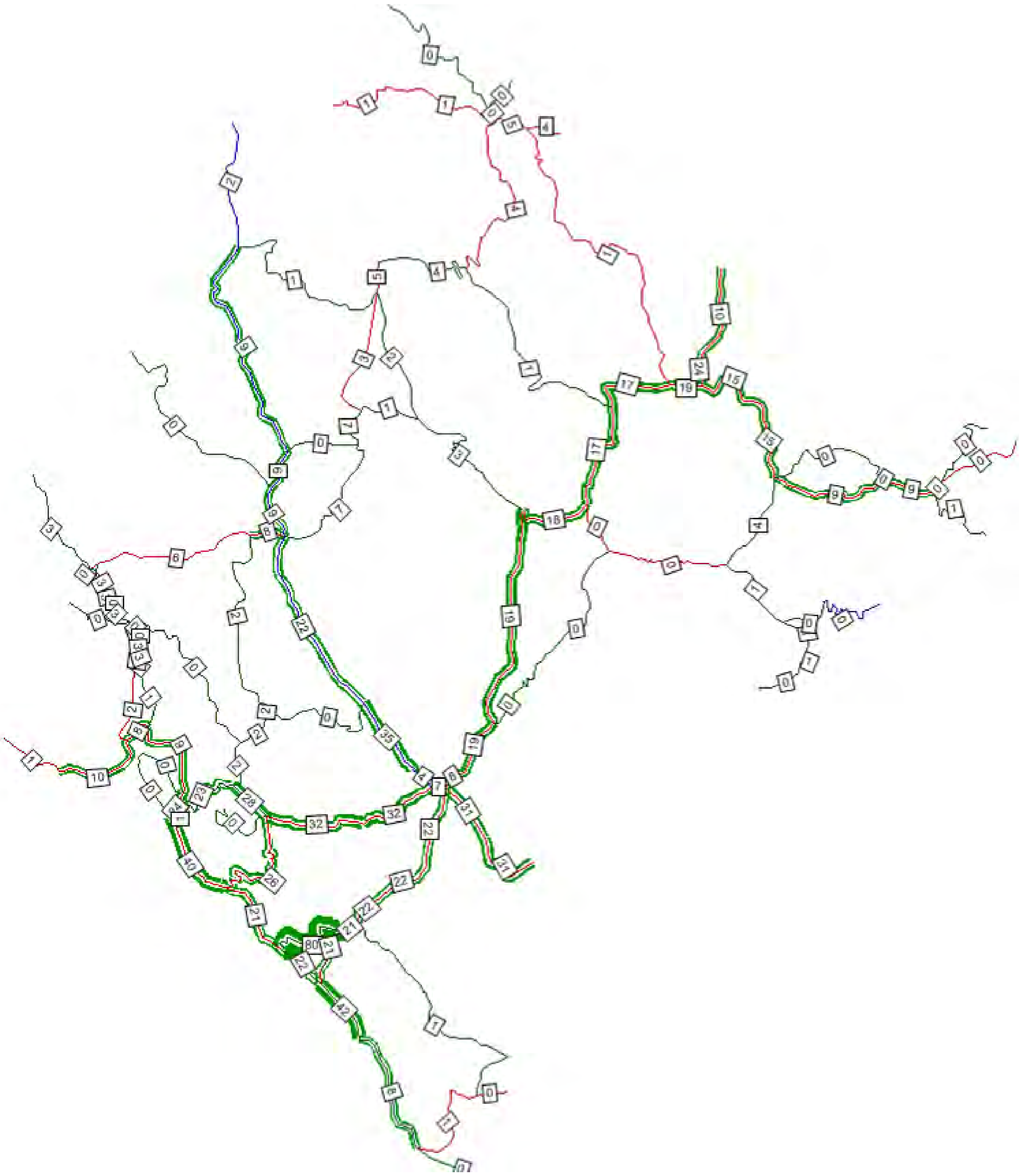
Year 2012 Scenario 8 AADT Flow



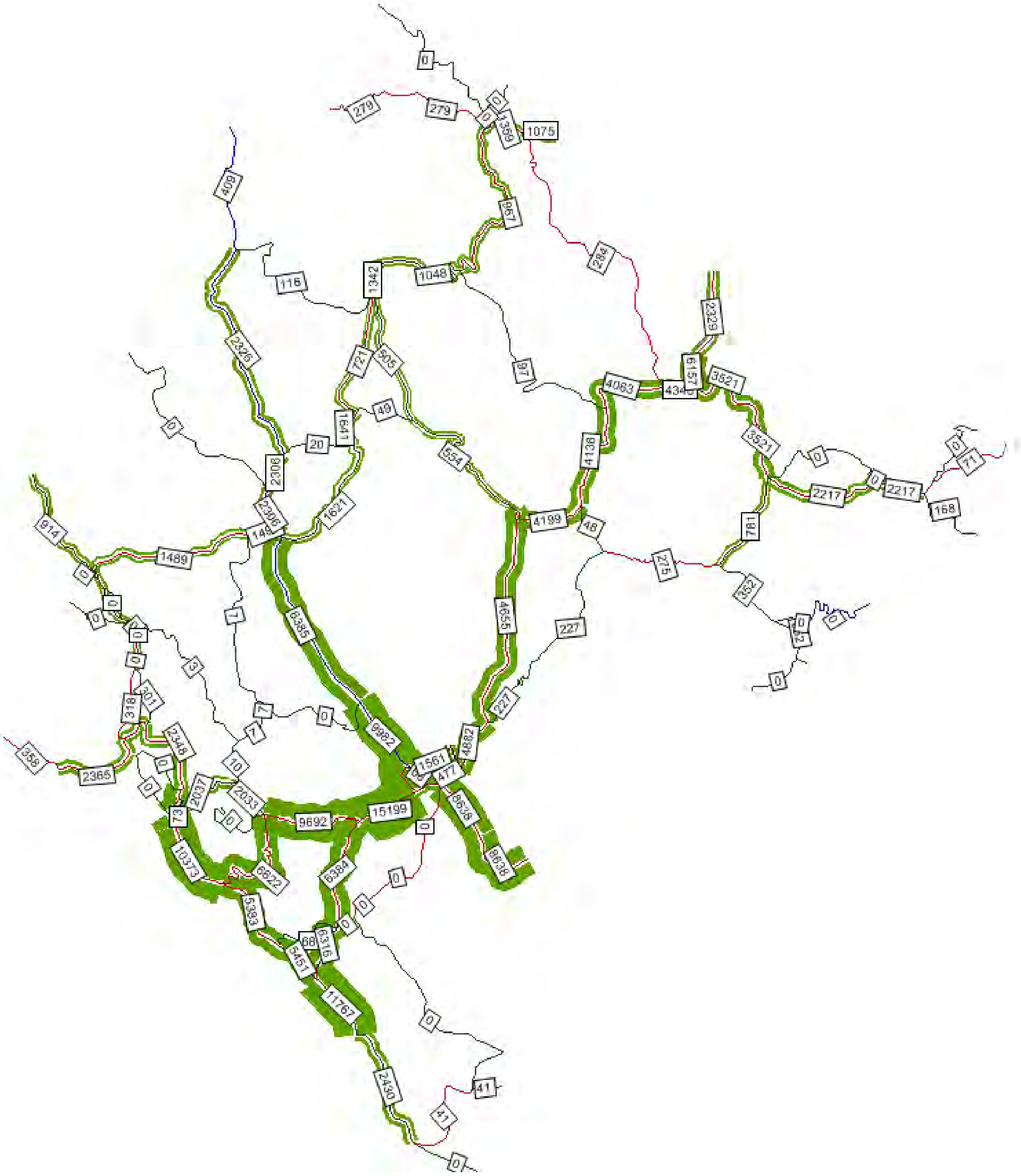
Year 2012 Scenario 8 Speed (km/h)



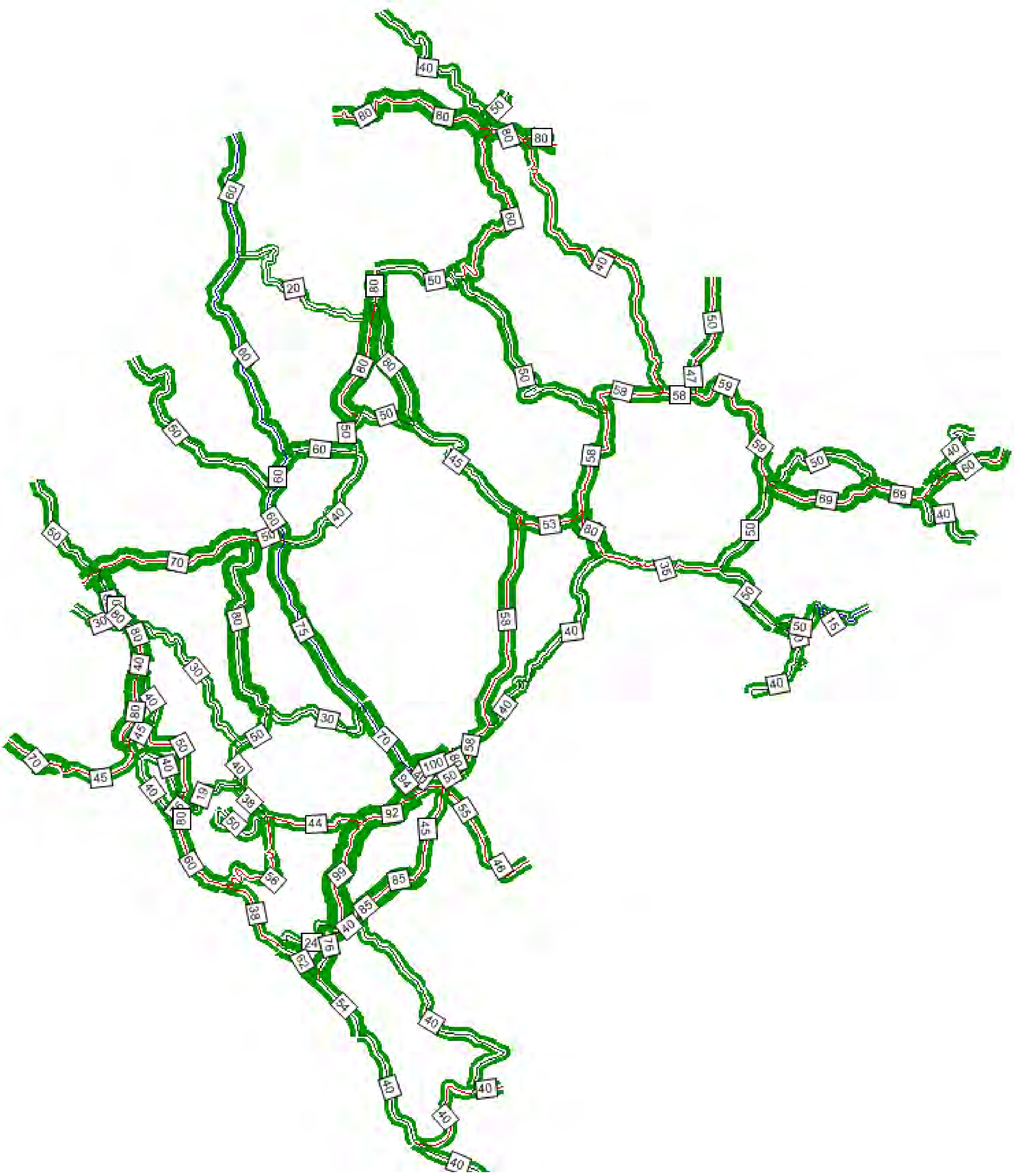
Year 2012 Scenario 8 Volume/Capacity Ratio



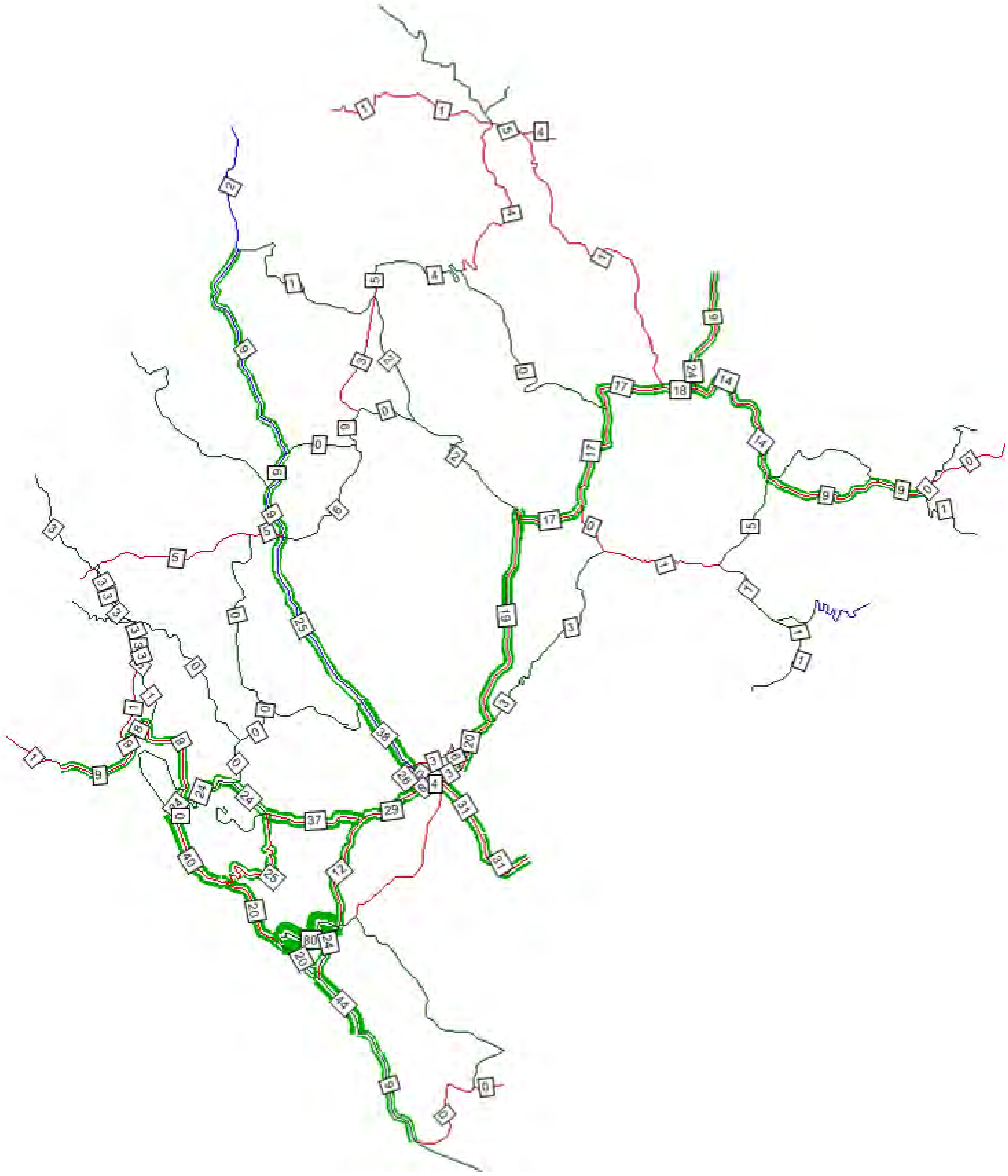
Year 2012 Scenario 15 AADT Flow



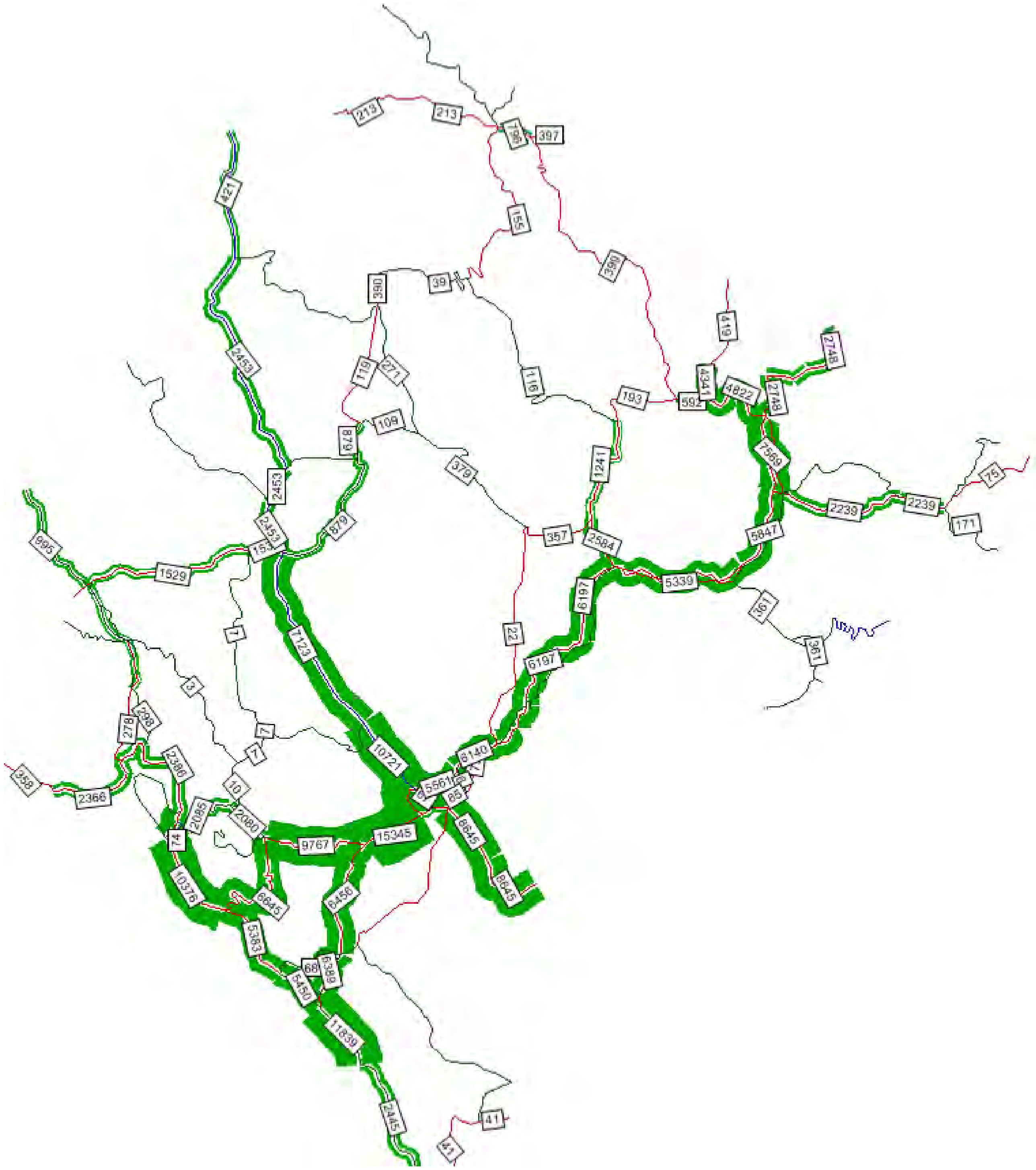
Year 2012 Scenario 15 Speed (km/h)



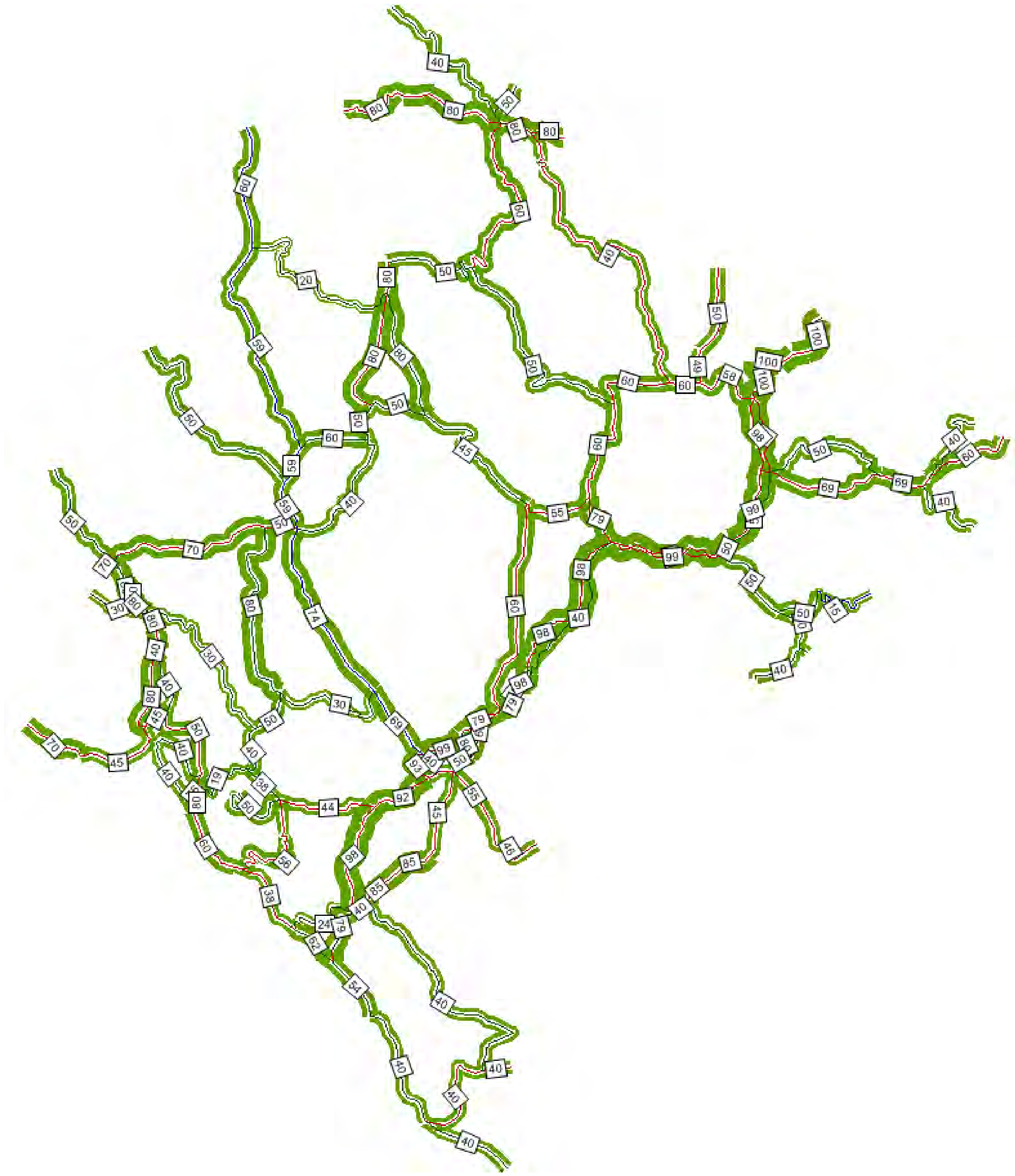
Year 2012 Scenario 15 Volume/Capacity Ratio



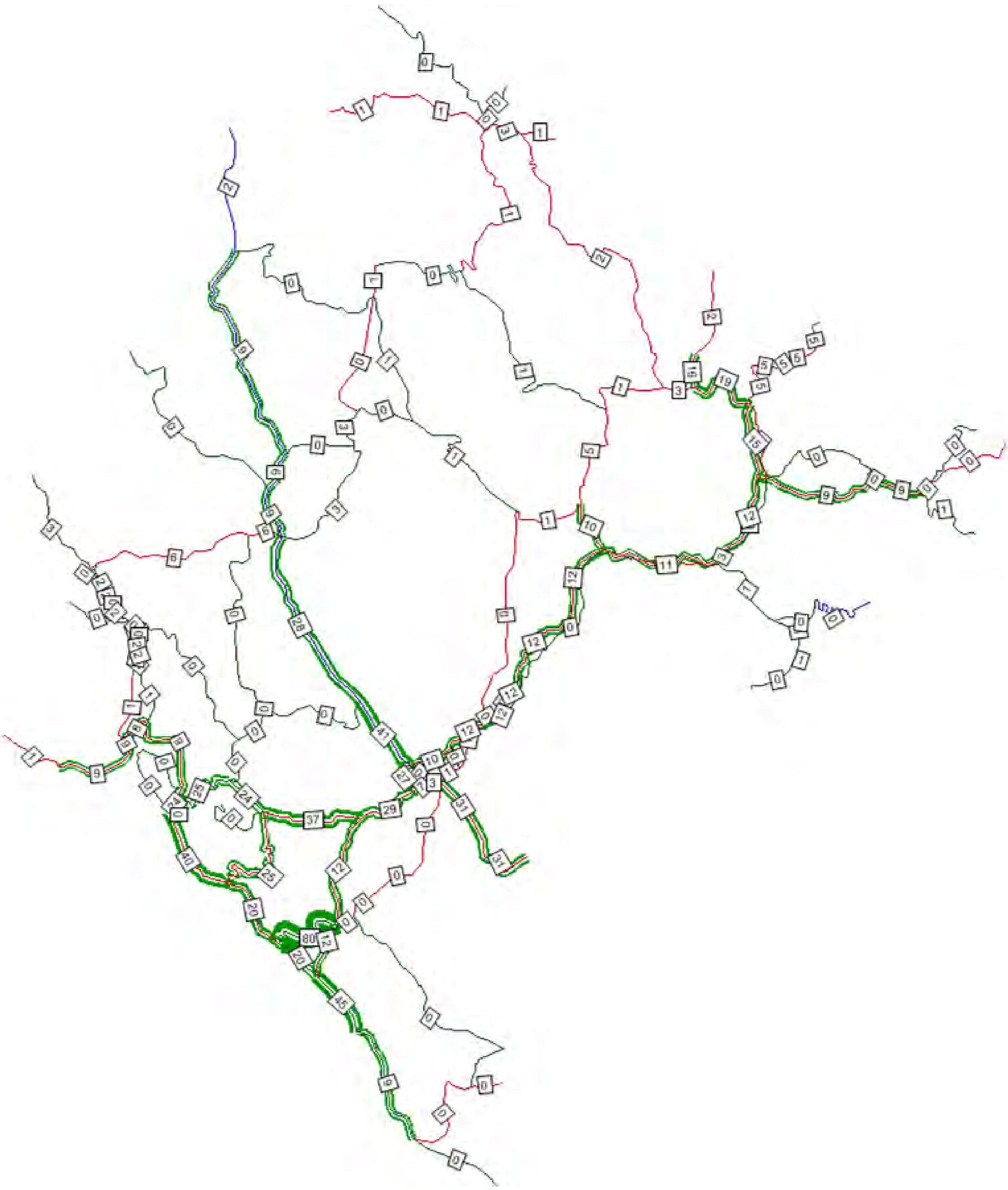
Year 2012 Scenario 20 AADT Flow



Year 2012 Scenario 20 Speed (km/h)

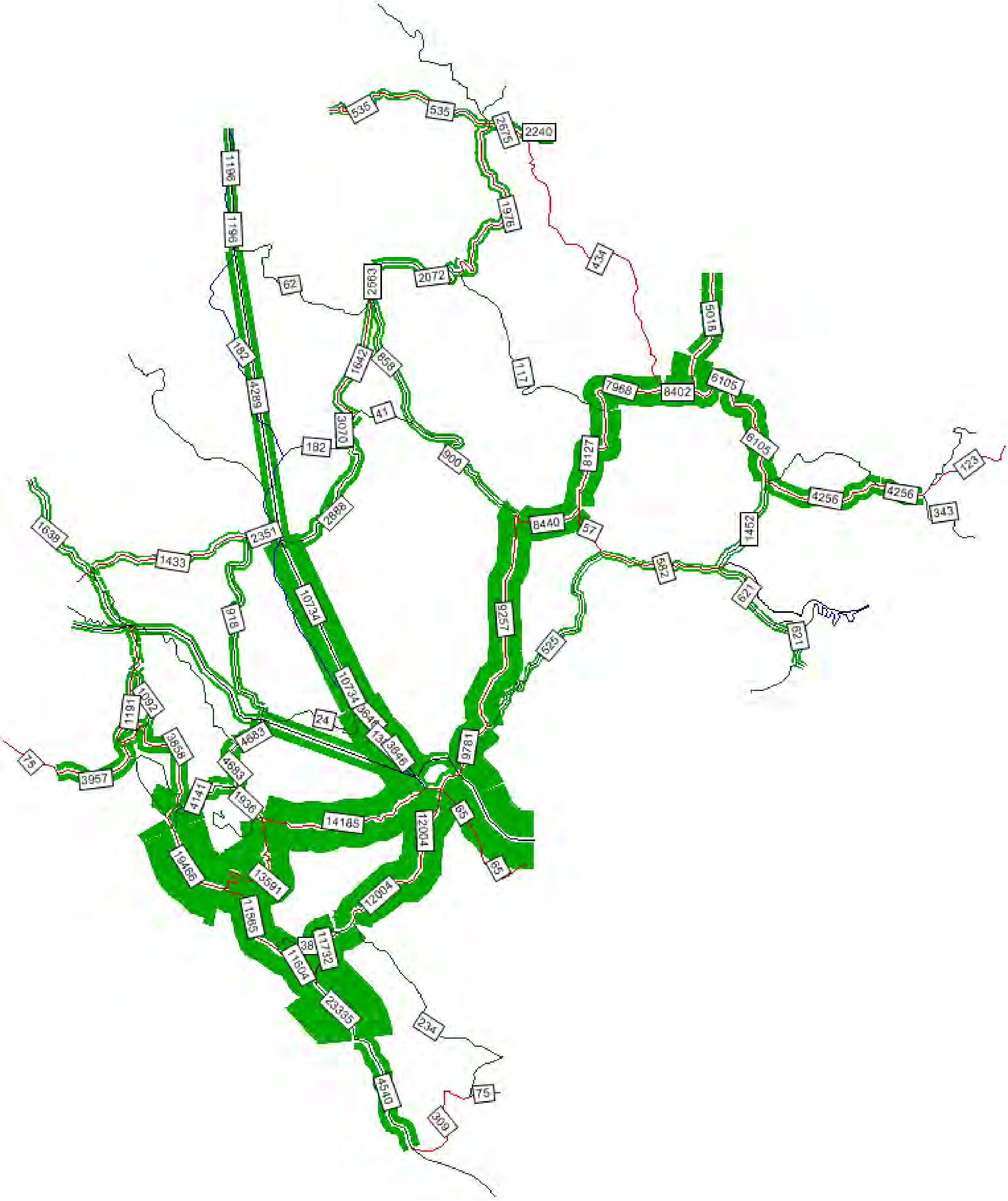


Year 2012 Scenario 20 Volume/Capacity Ratio

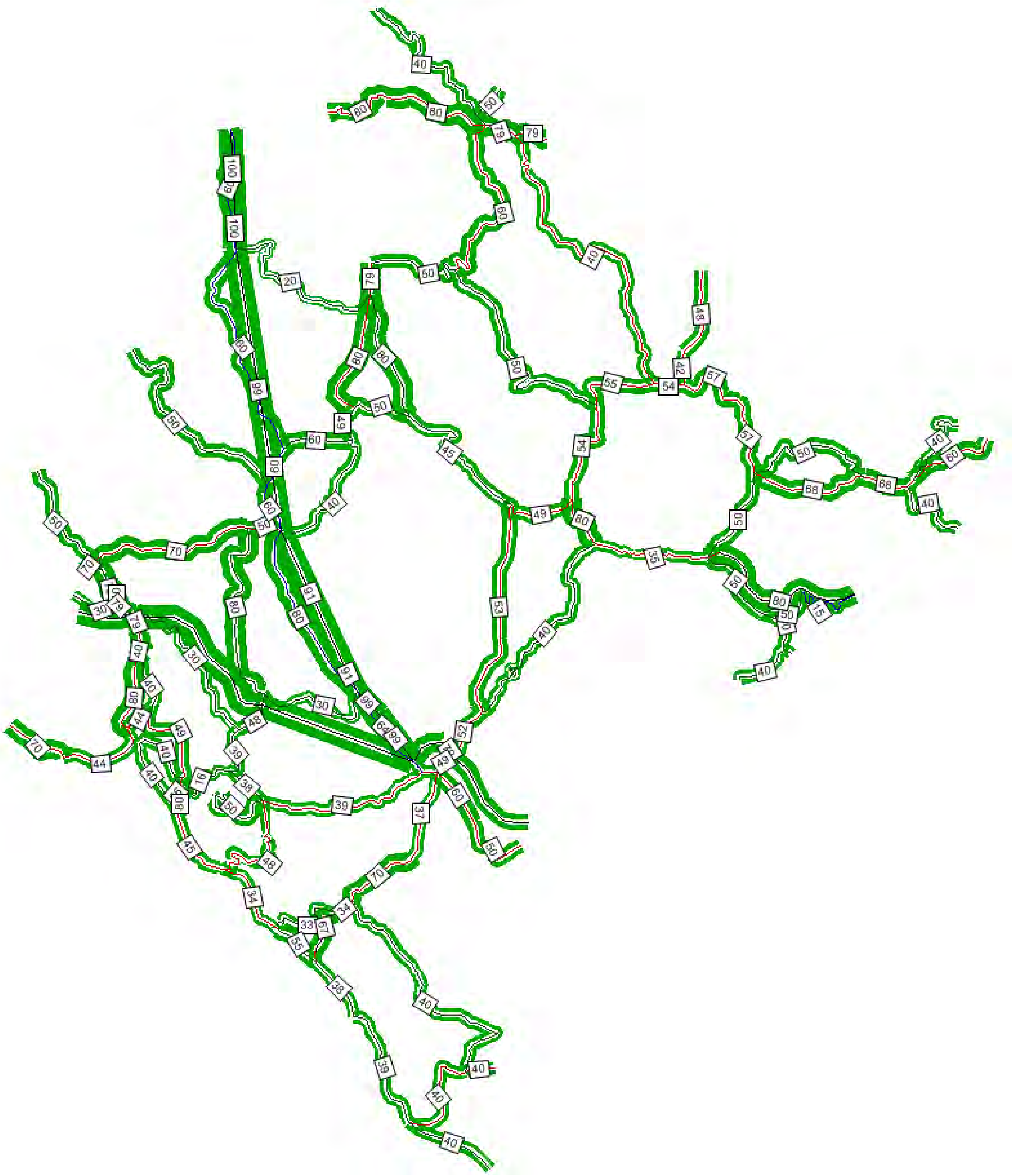


APPENDIX 11 YEAR 2035 PLOTS

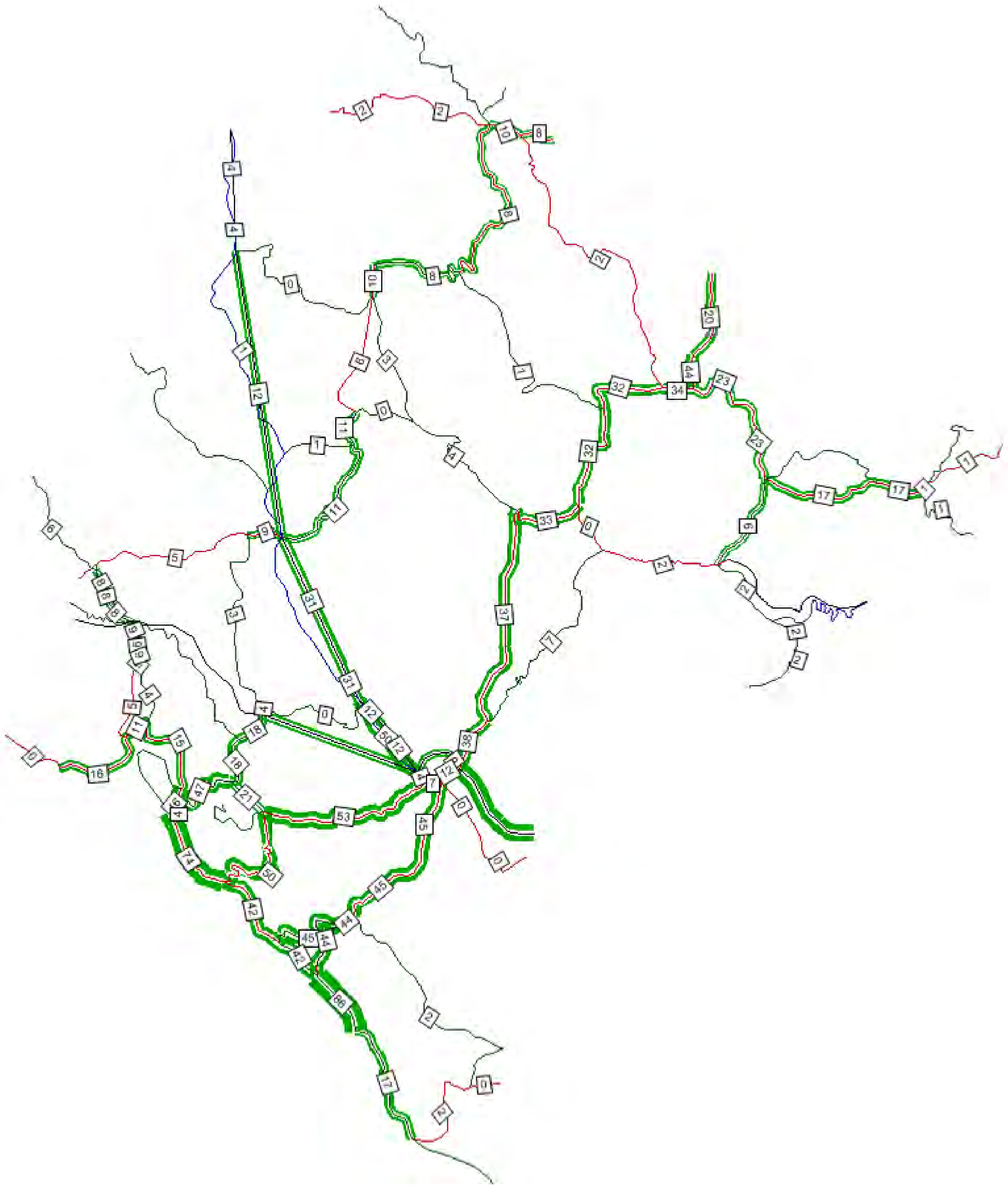
Year 2035 DM AADT Flow



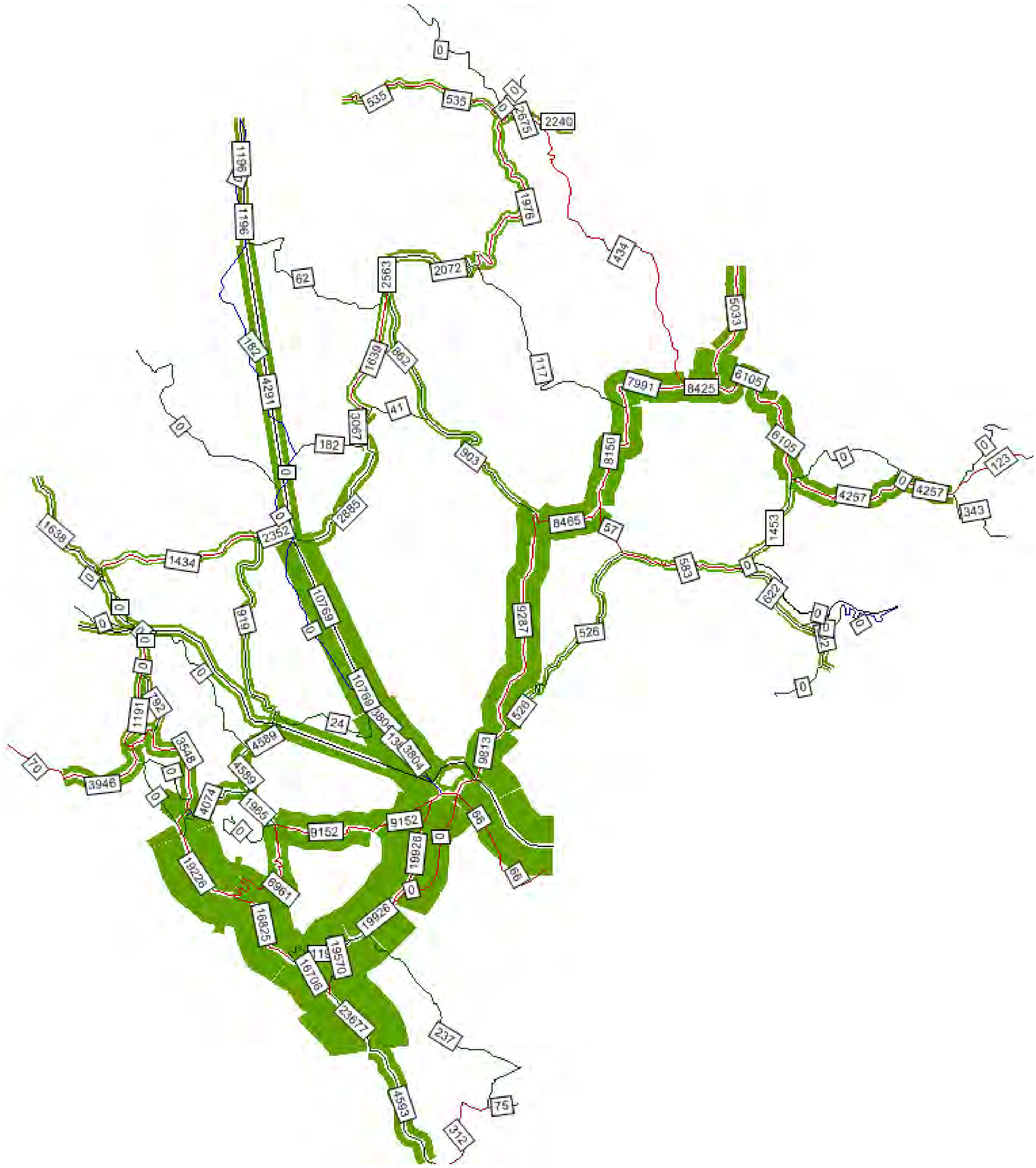
Year 2035 DM Speed (km/h)



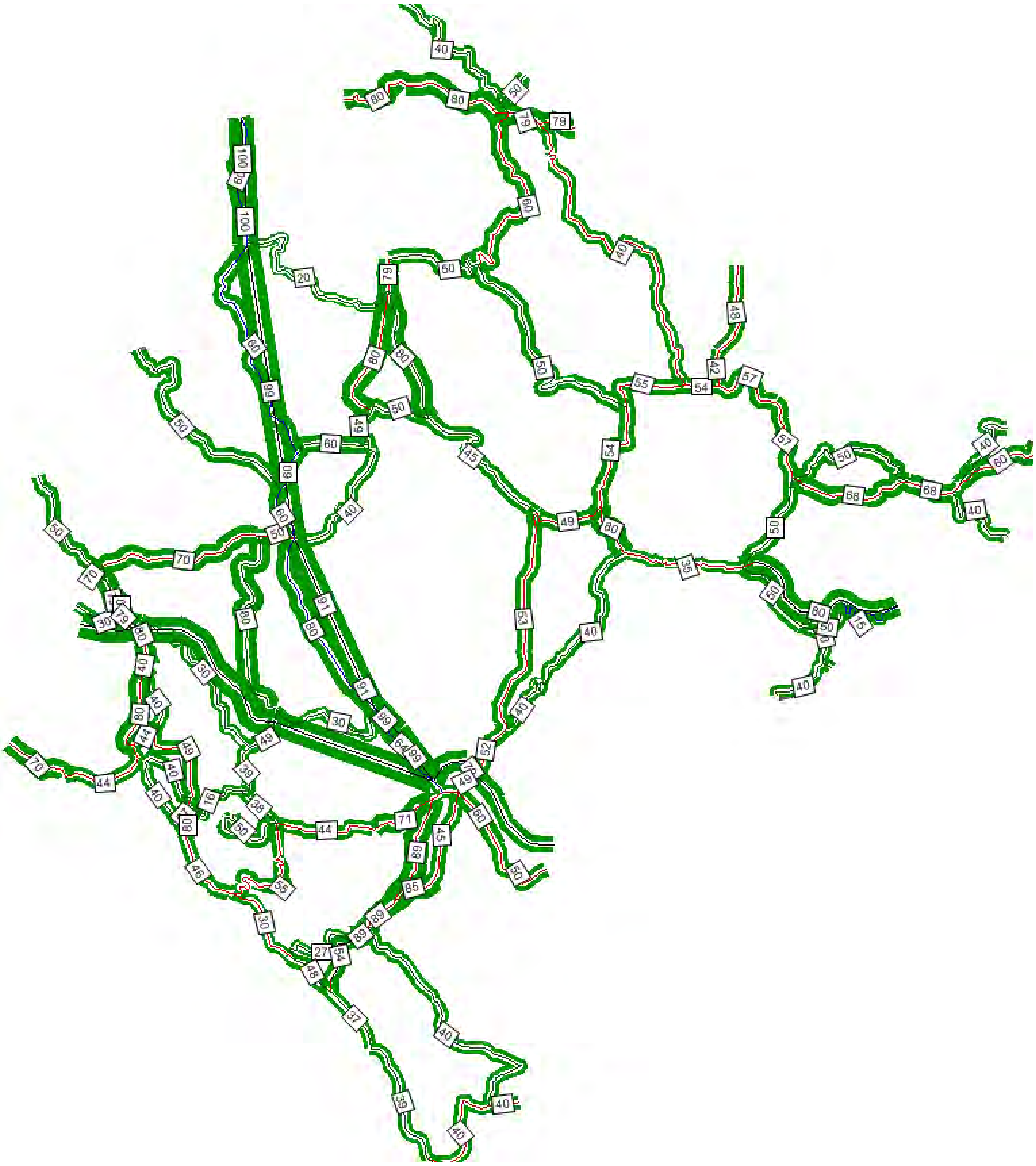
Year 2035 DM Volume/Capacity Ratio



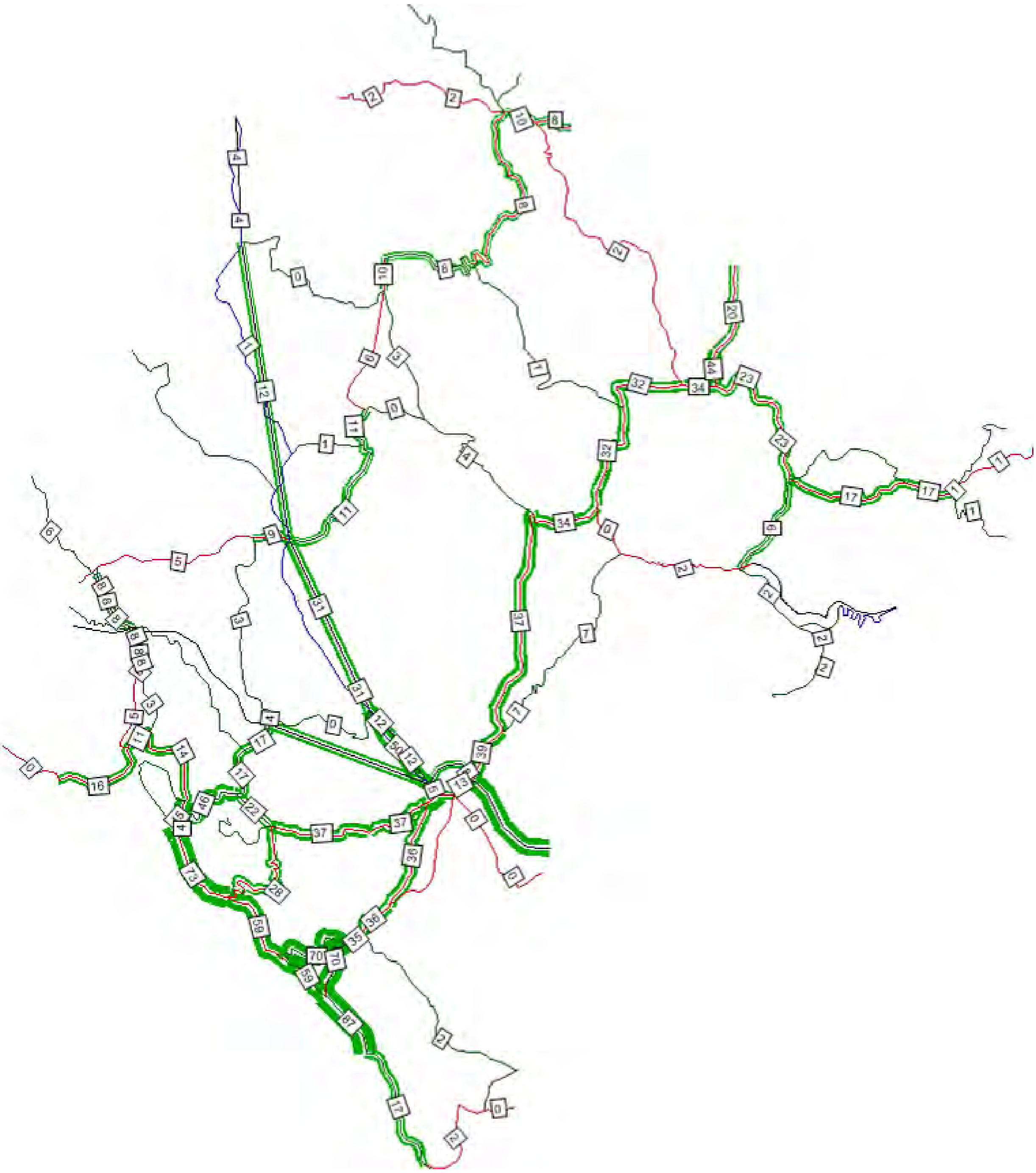
Year 2035 Scenario 1 AADT Flow



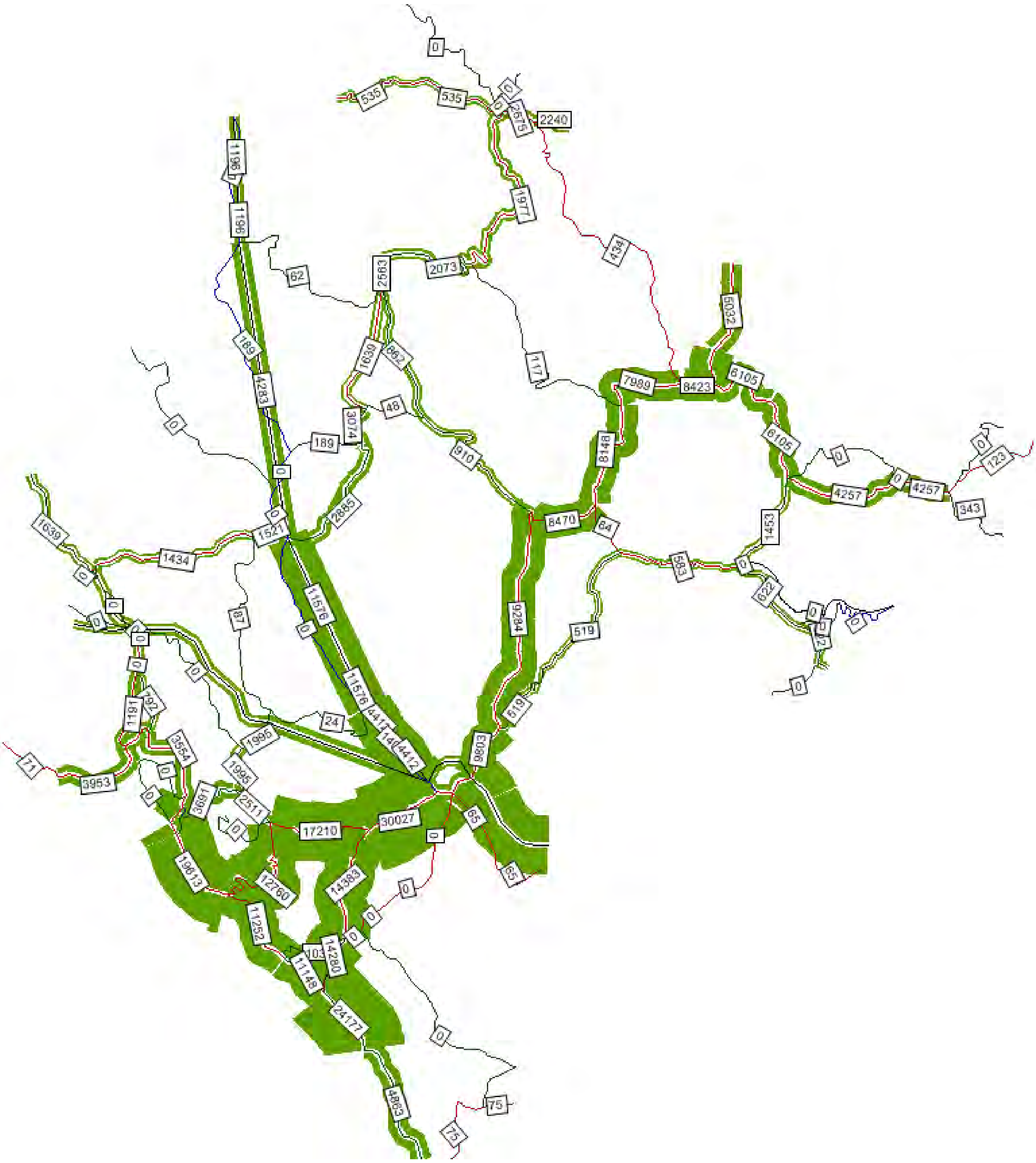
Year 2035 Scenario 1 Speed (km/h)



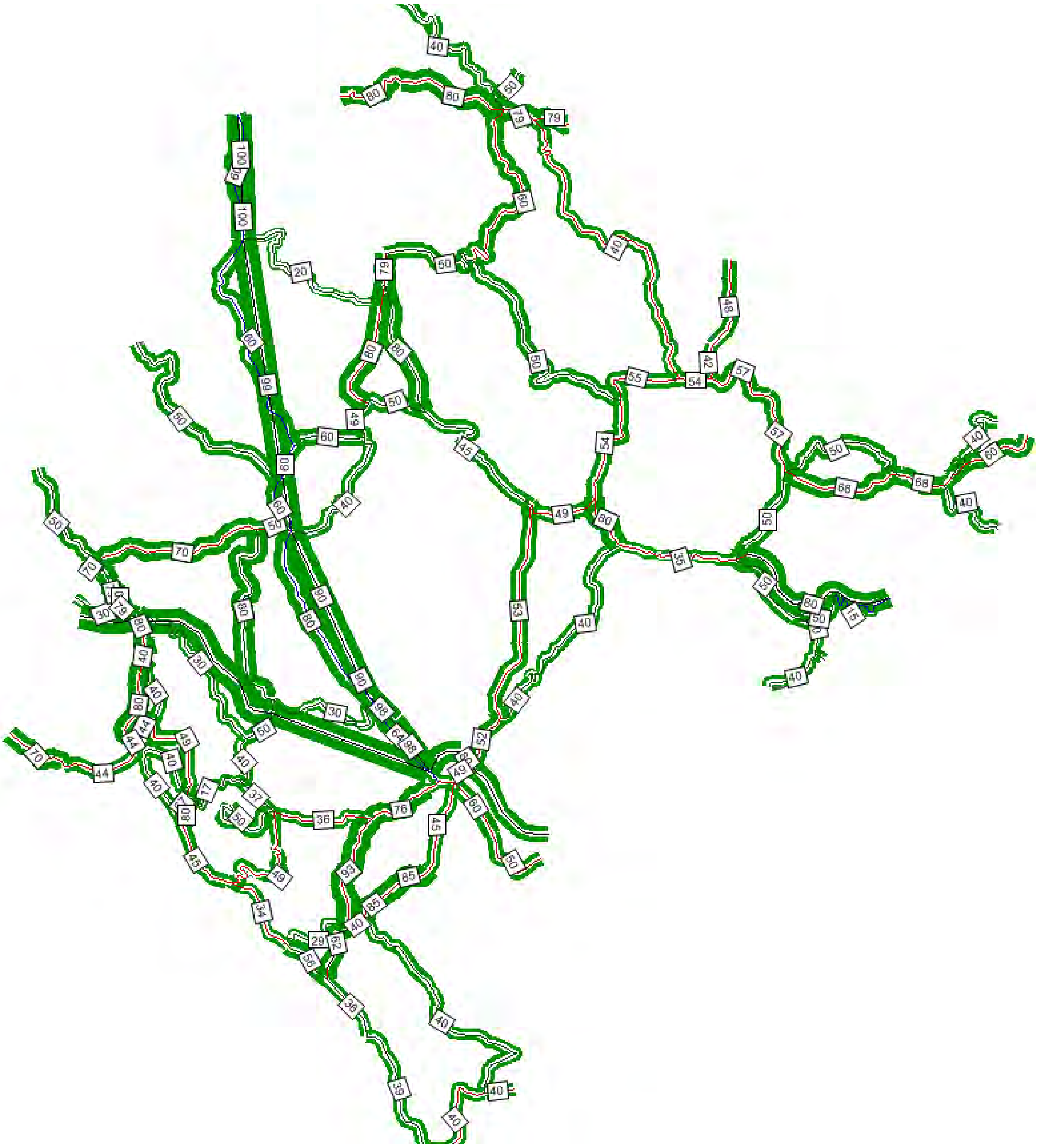
Year 2035 Scenario 1 Volume/Capacity Ratio



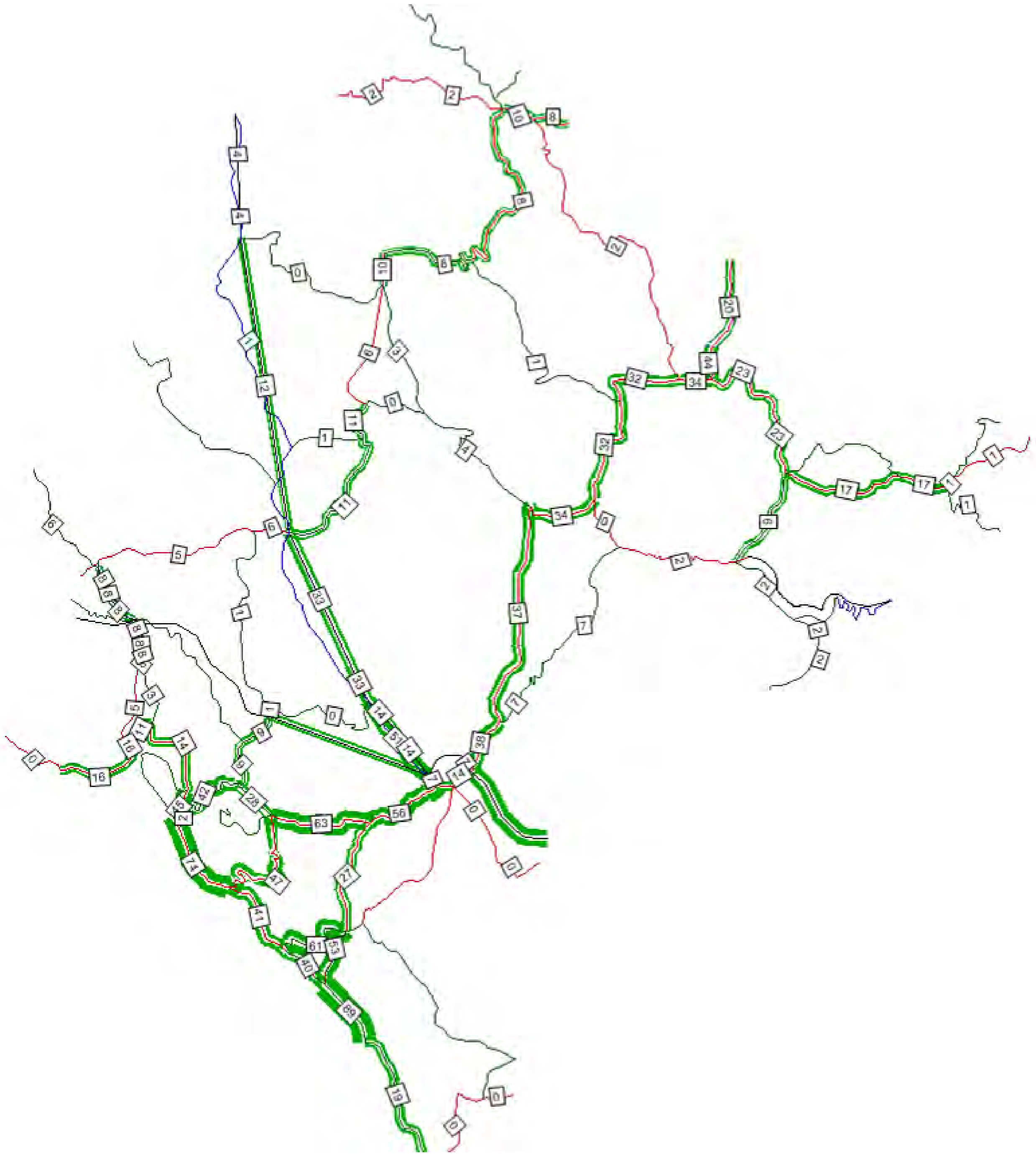
Year 2035 Scenario 2 AADT Flow



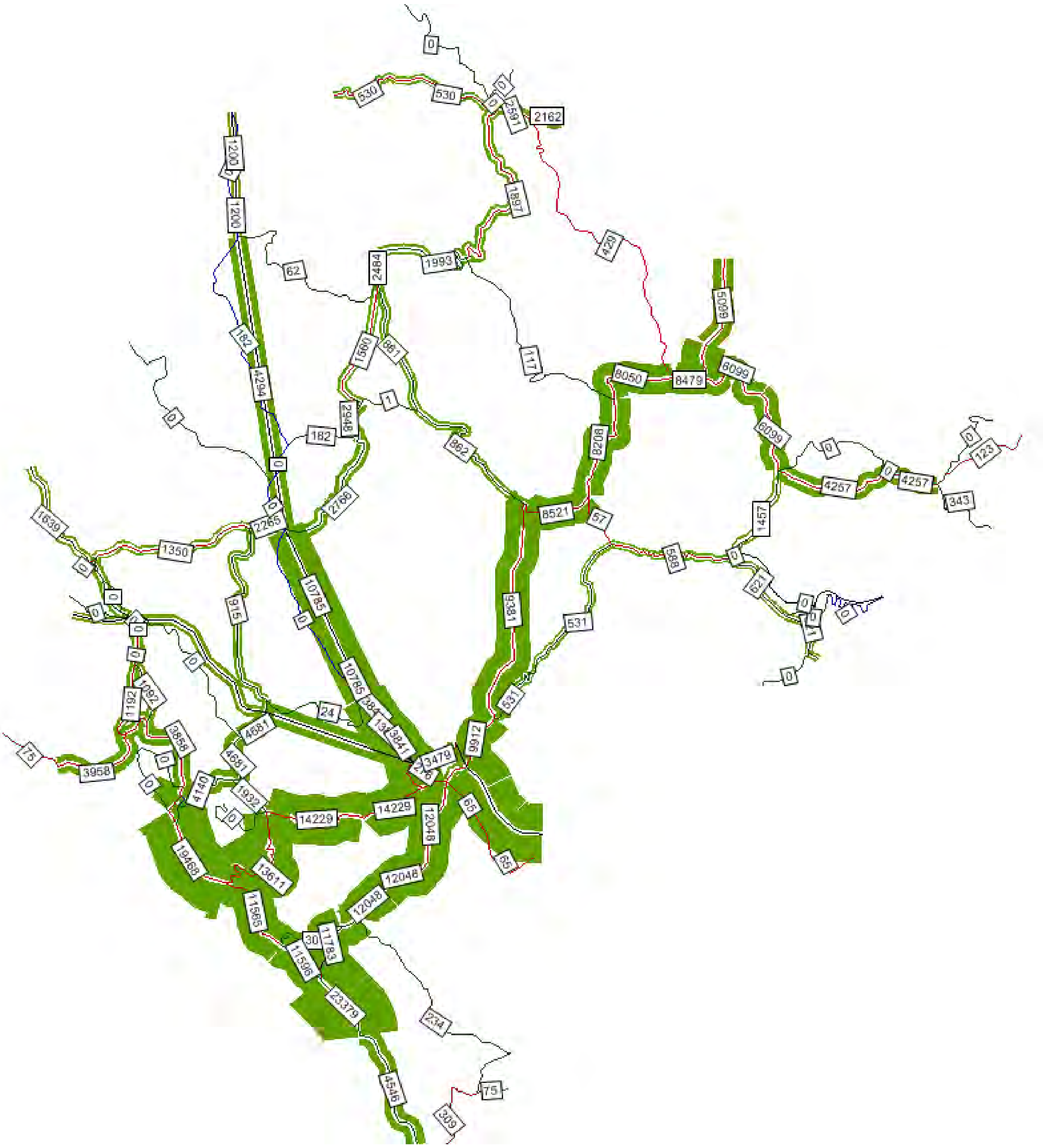
Year 2035 Scenario 2 Speed (km/h)



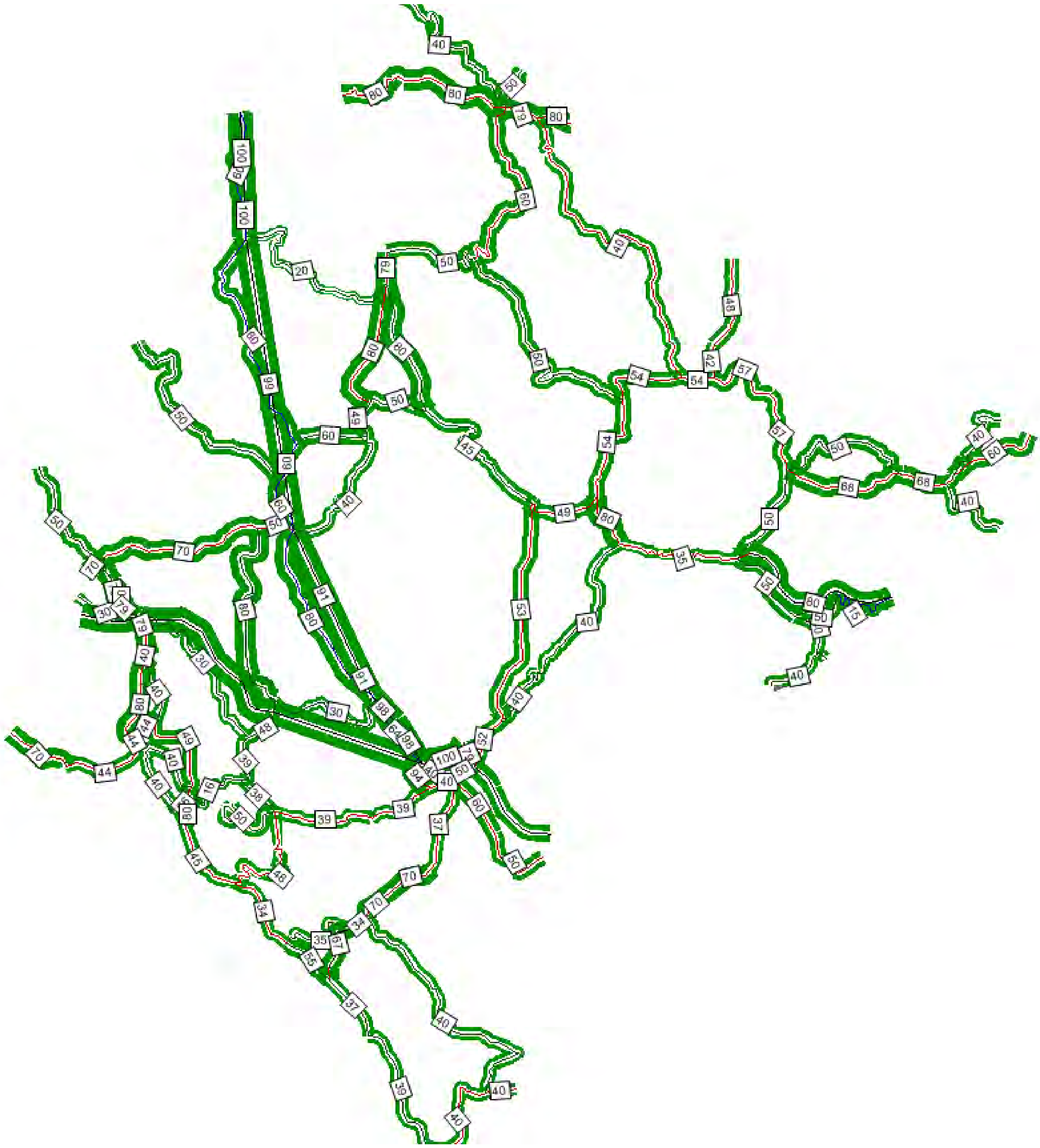
Year 2035 Scenario 2 Volume/Capacity Ratio



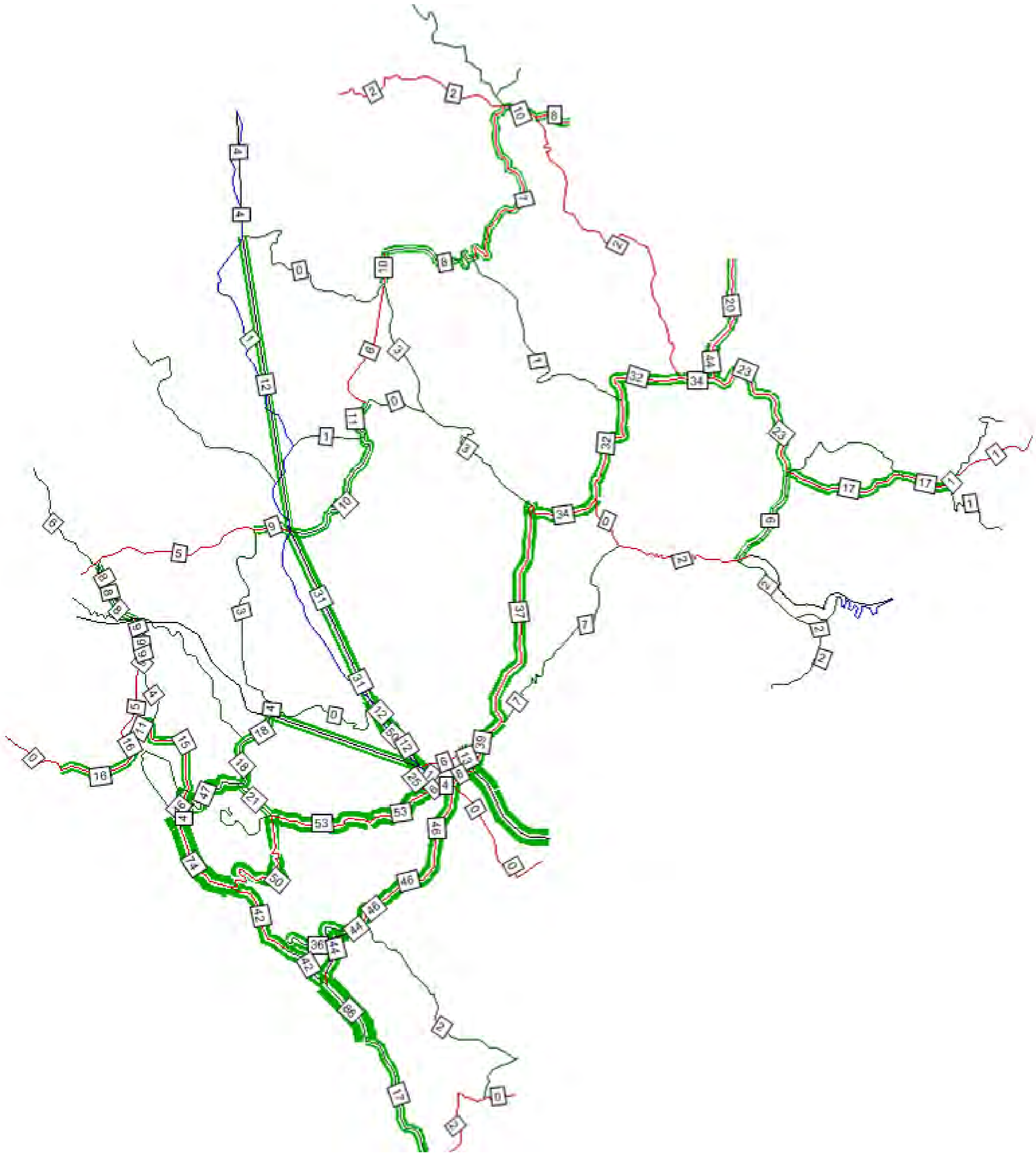
Year 2035 Scenario 3 AADT Flow



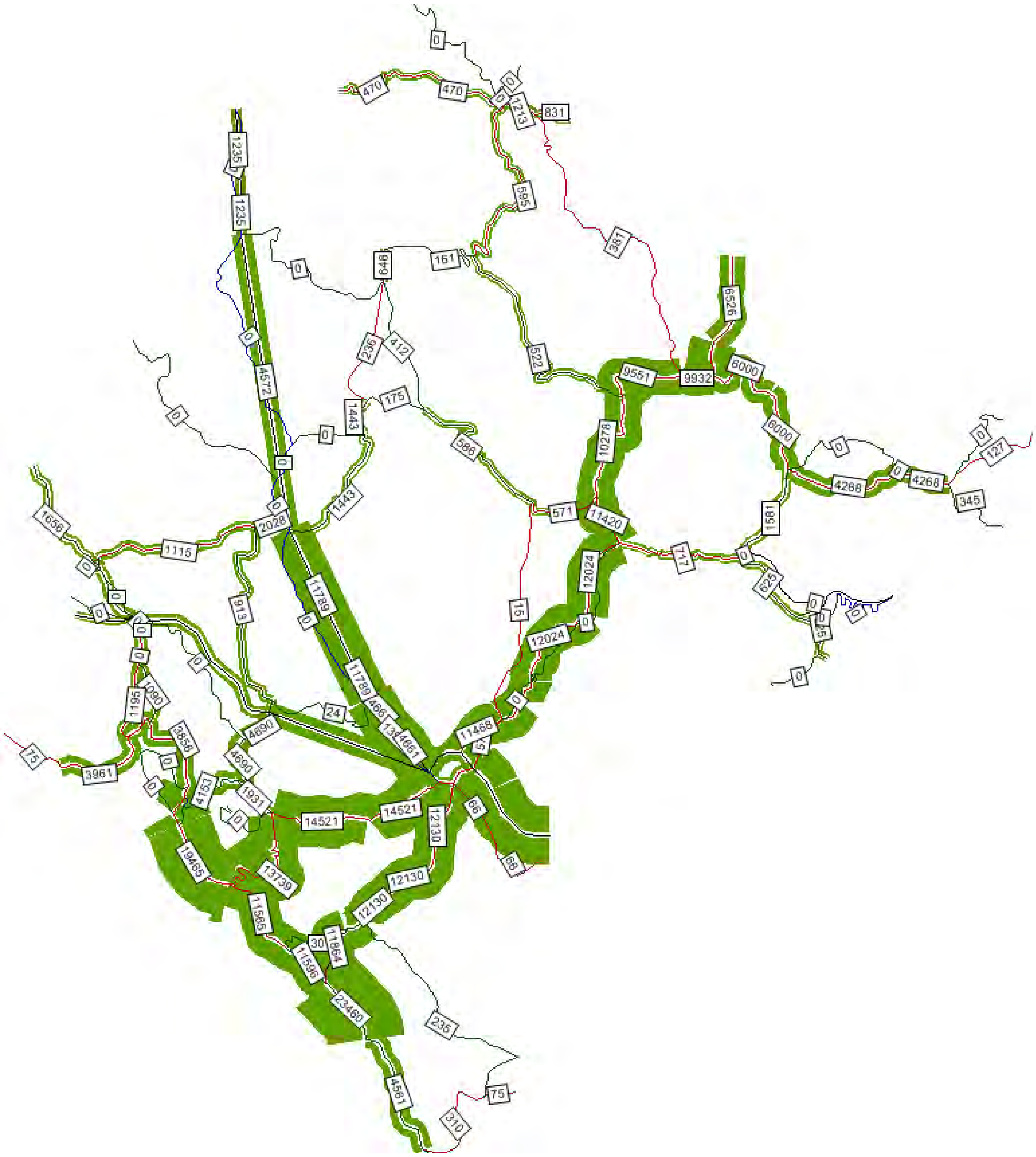
Year 2035 Scenario 3 Speed (km/h)



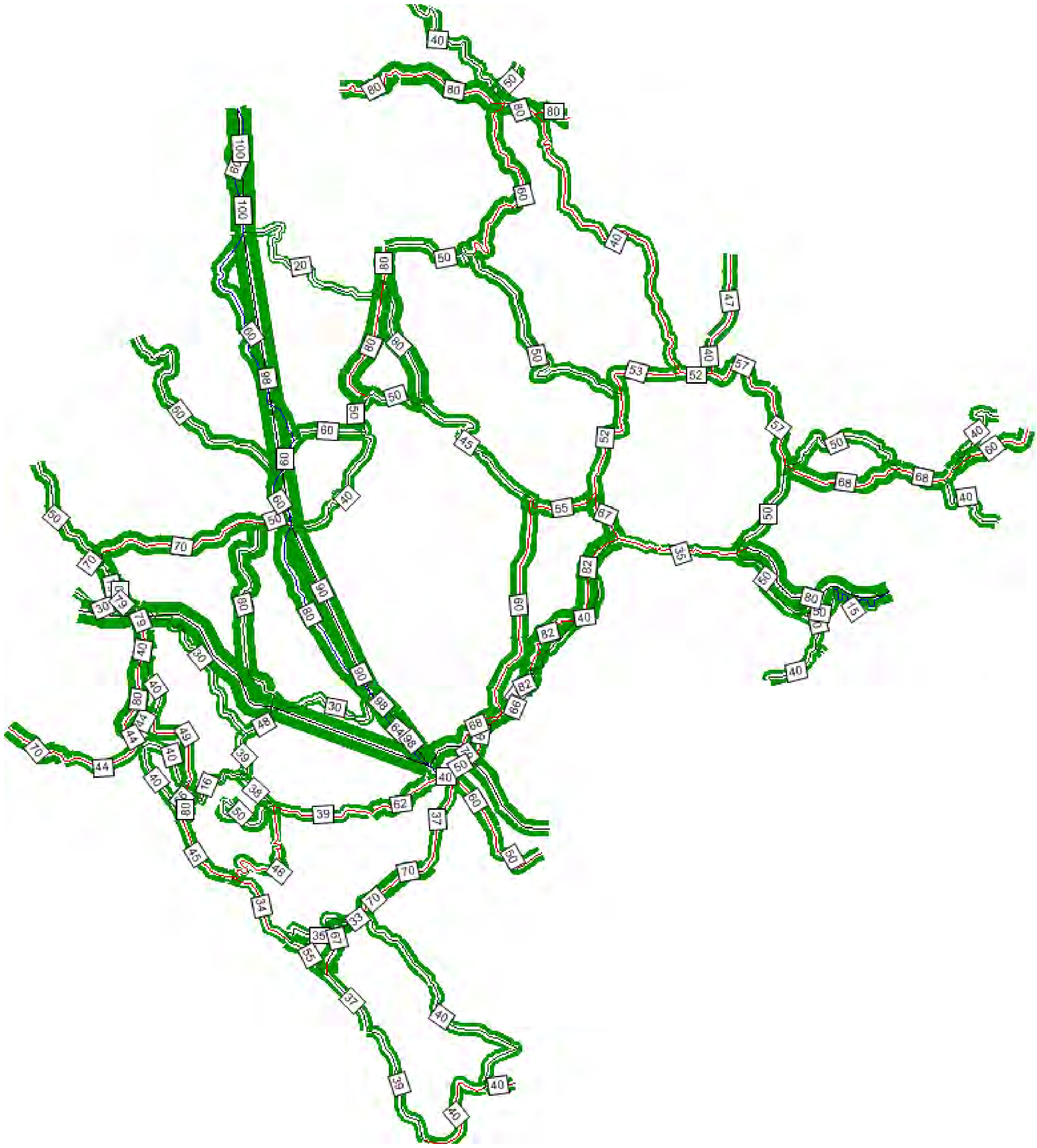
Year 2035 Scenario 3 Volume/Capacity Ratio



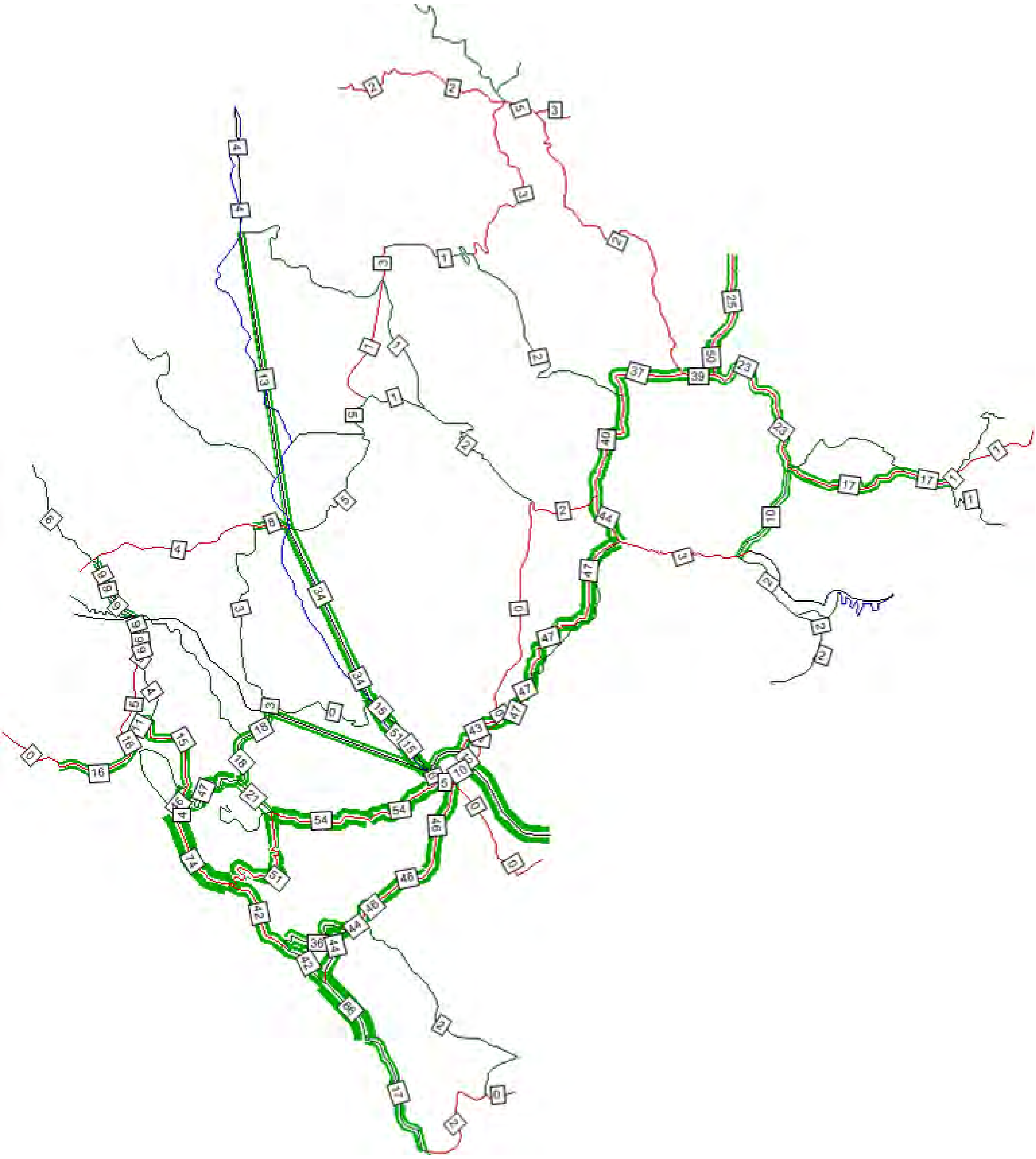
Year 2035 Scenario 4 AADT Flow



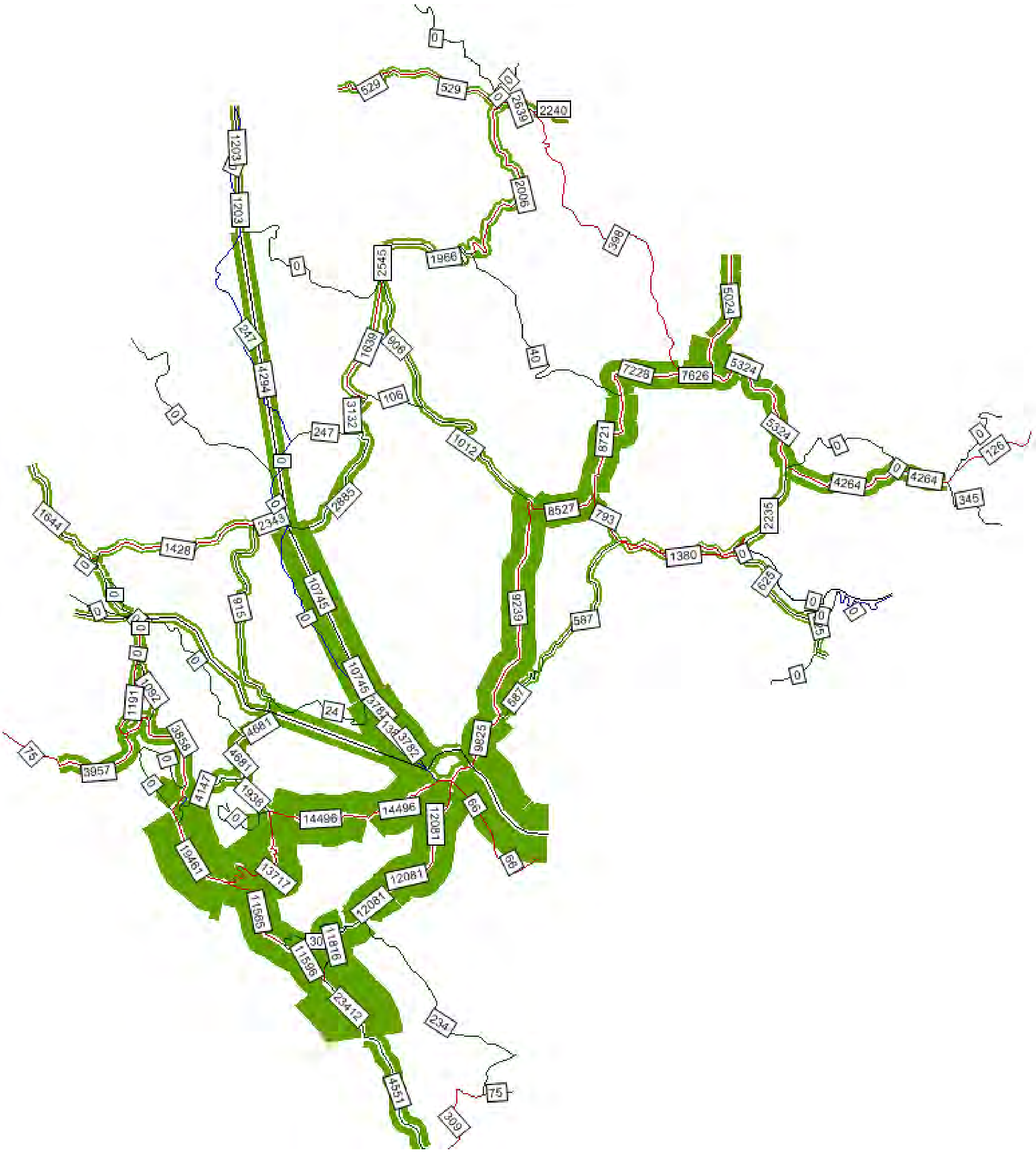
Year 2035 Scenario 4 Speed (km/h)



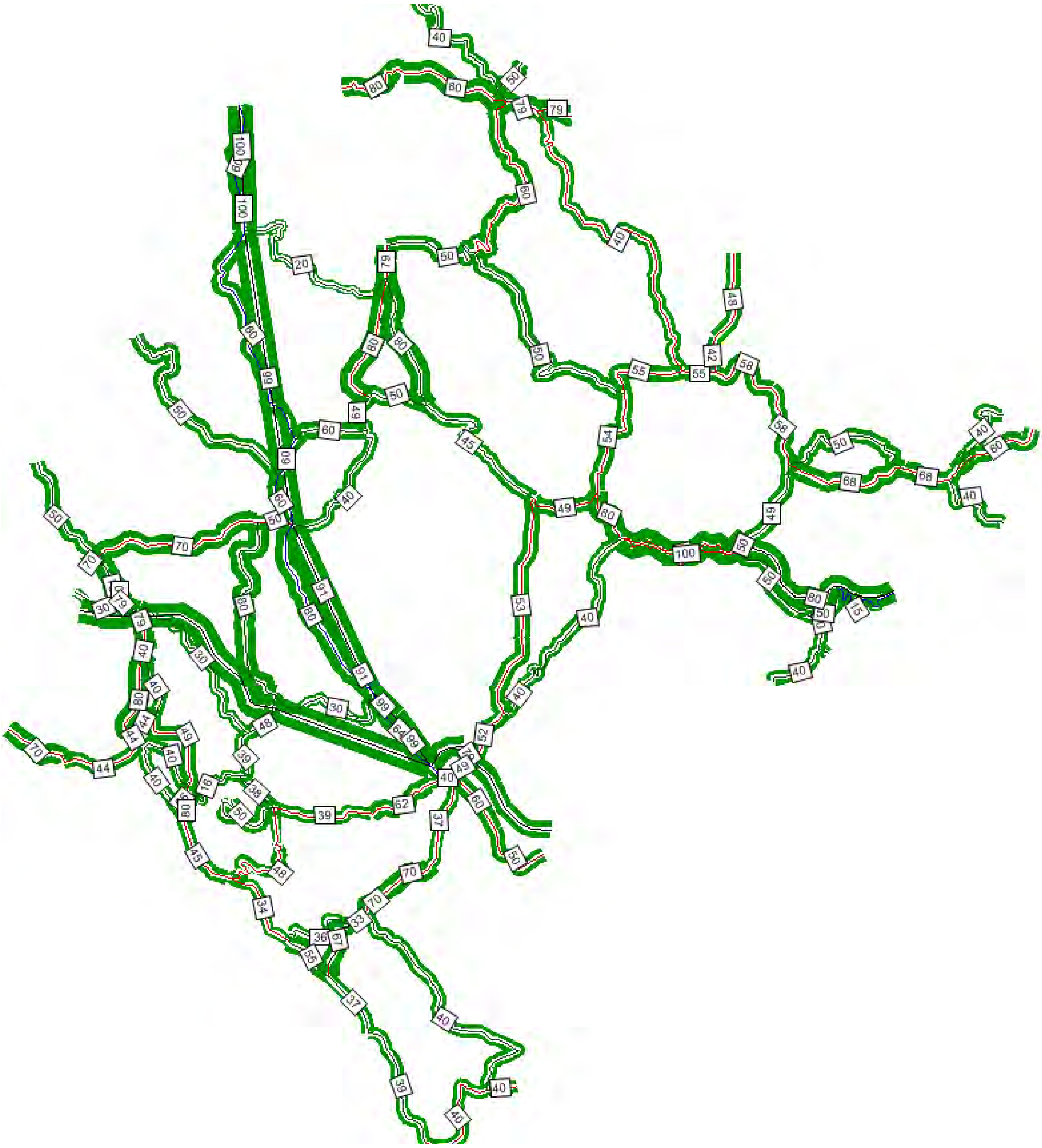
Year 2035 Scenario 4 Volume/Capacity Ratio



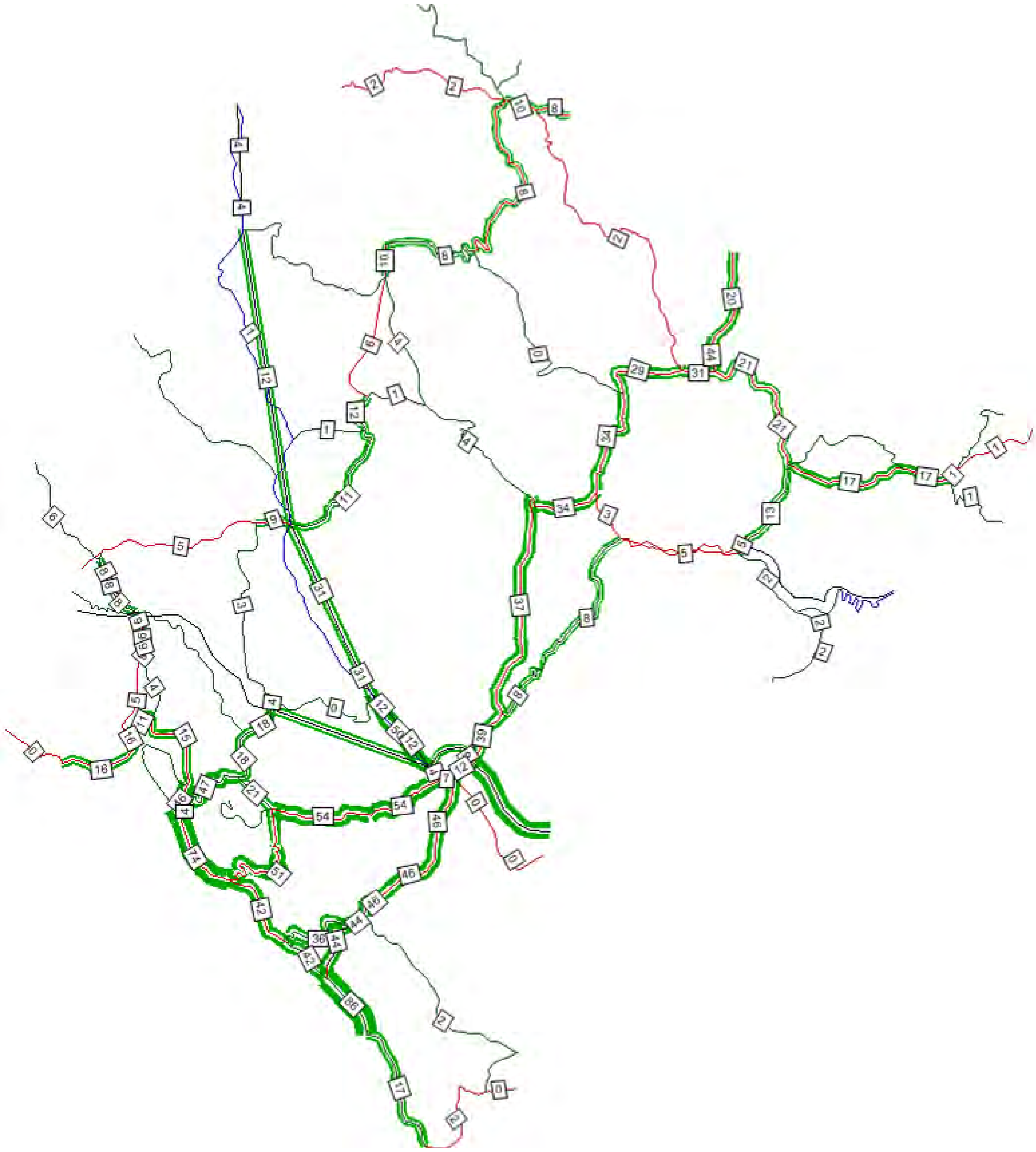
Year 2035 Scenario 5 AADT Flow



Year 2035 Scenario 5 Speed (km/h)



Year 2035 Scenario 5 Volume/Capacity Ratio



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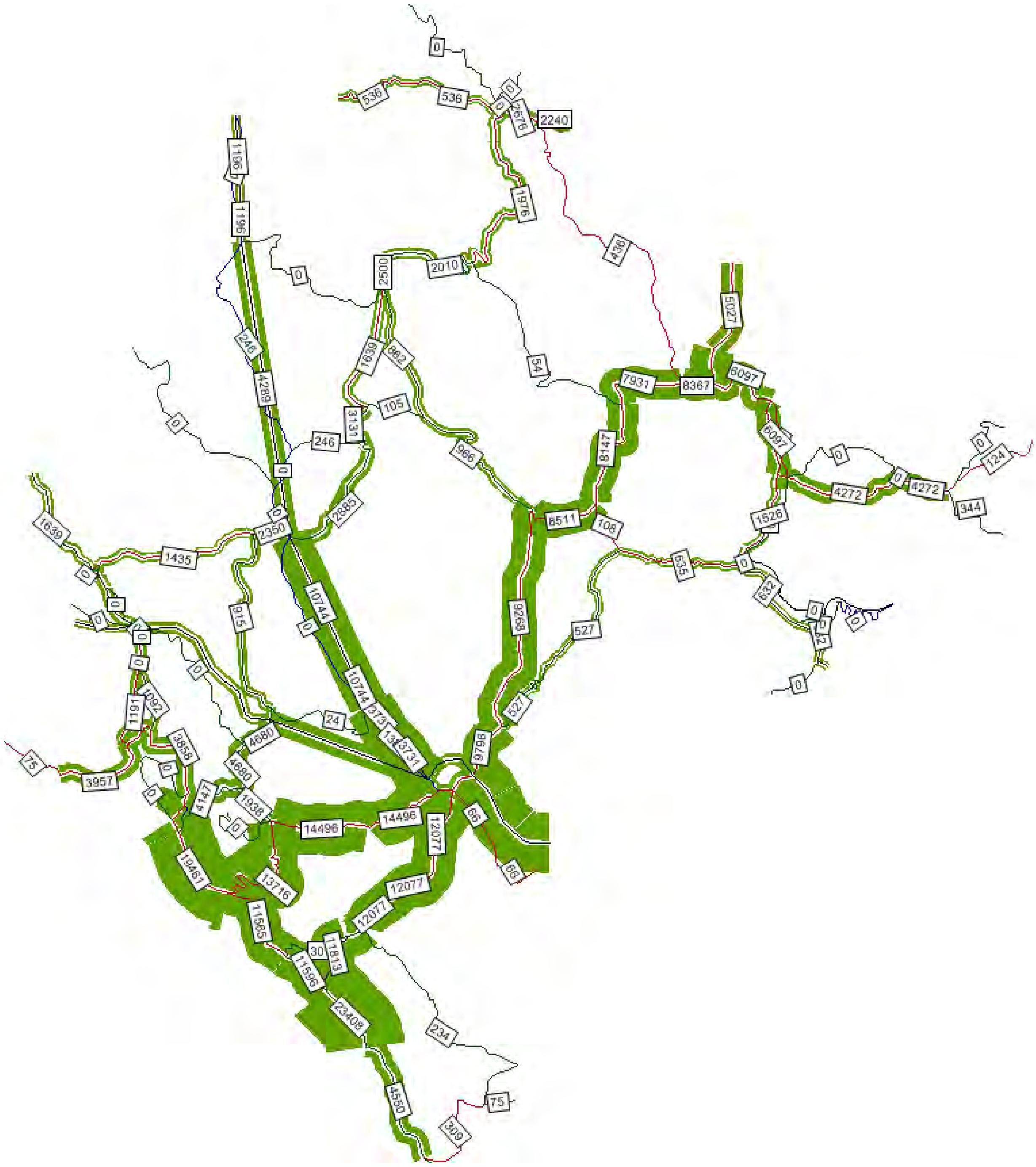
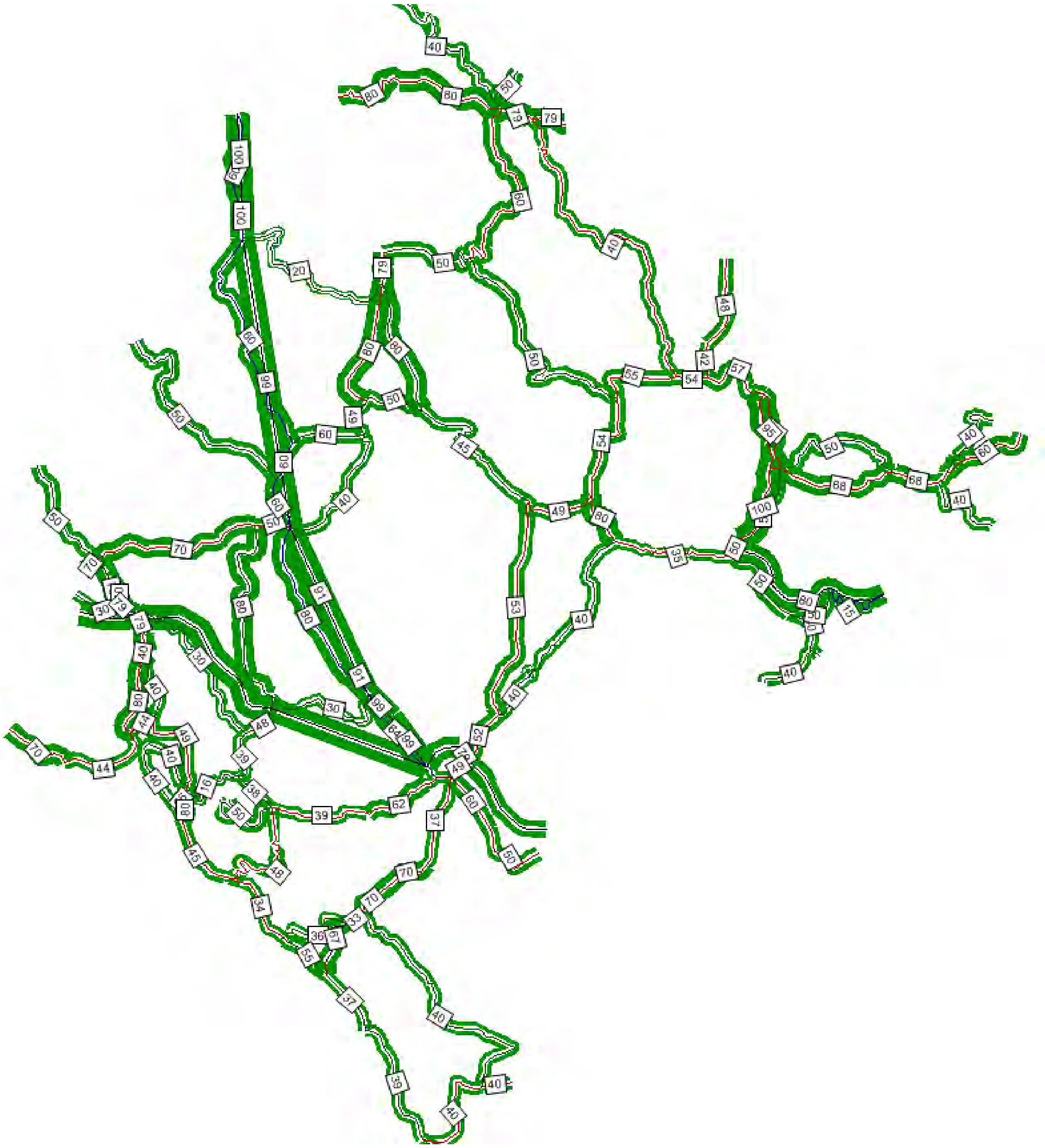
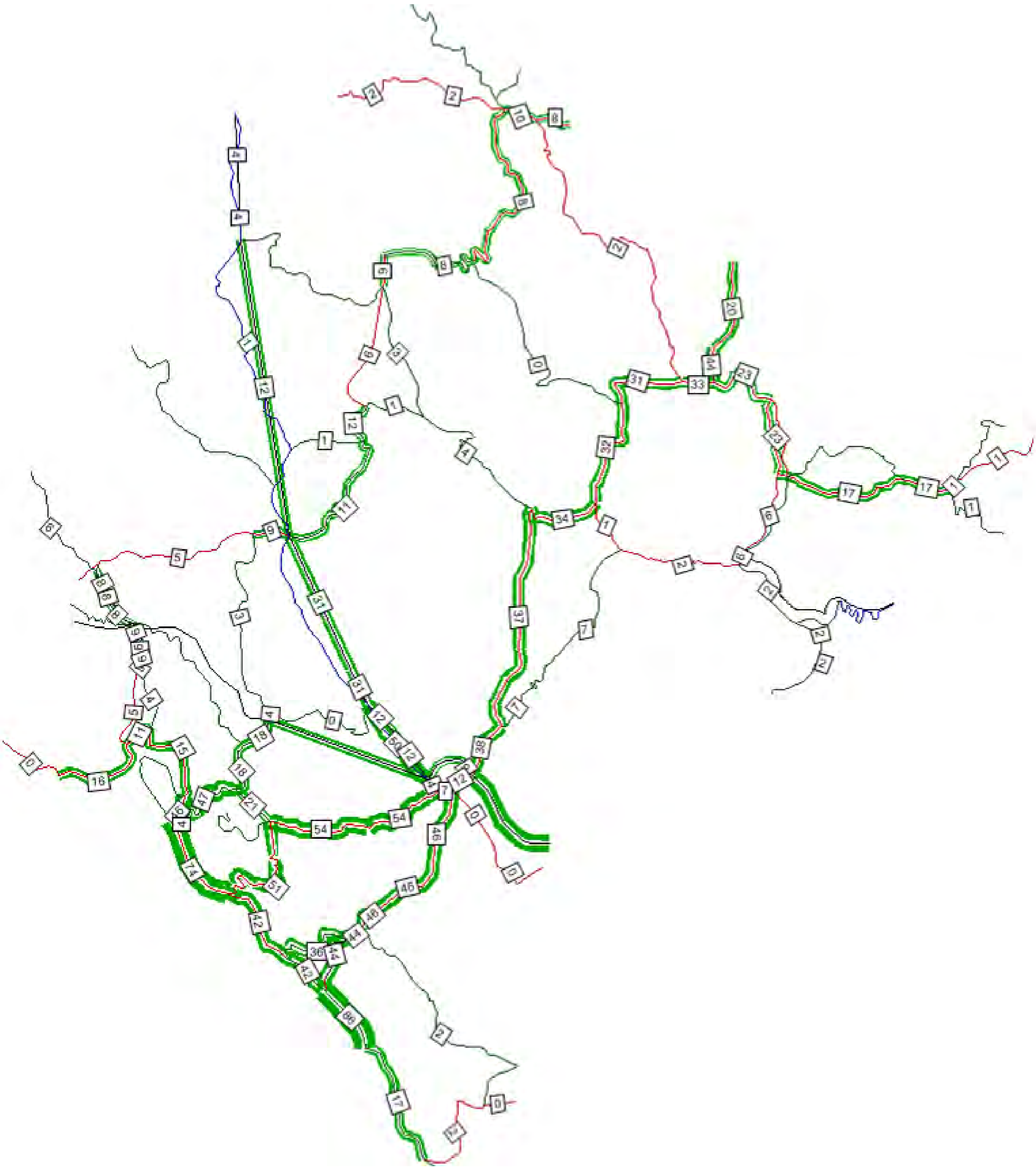


Year 2035 Scenario 6 Speed (km/h)



Year 2035 Scenario 6 Volume/Capacity Ratio



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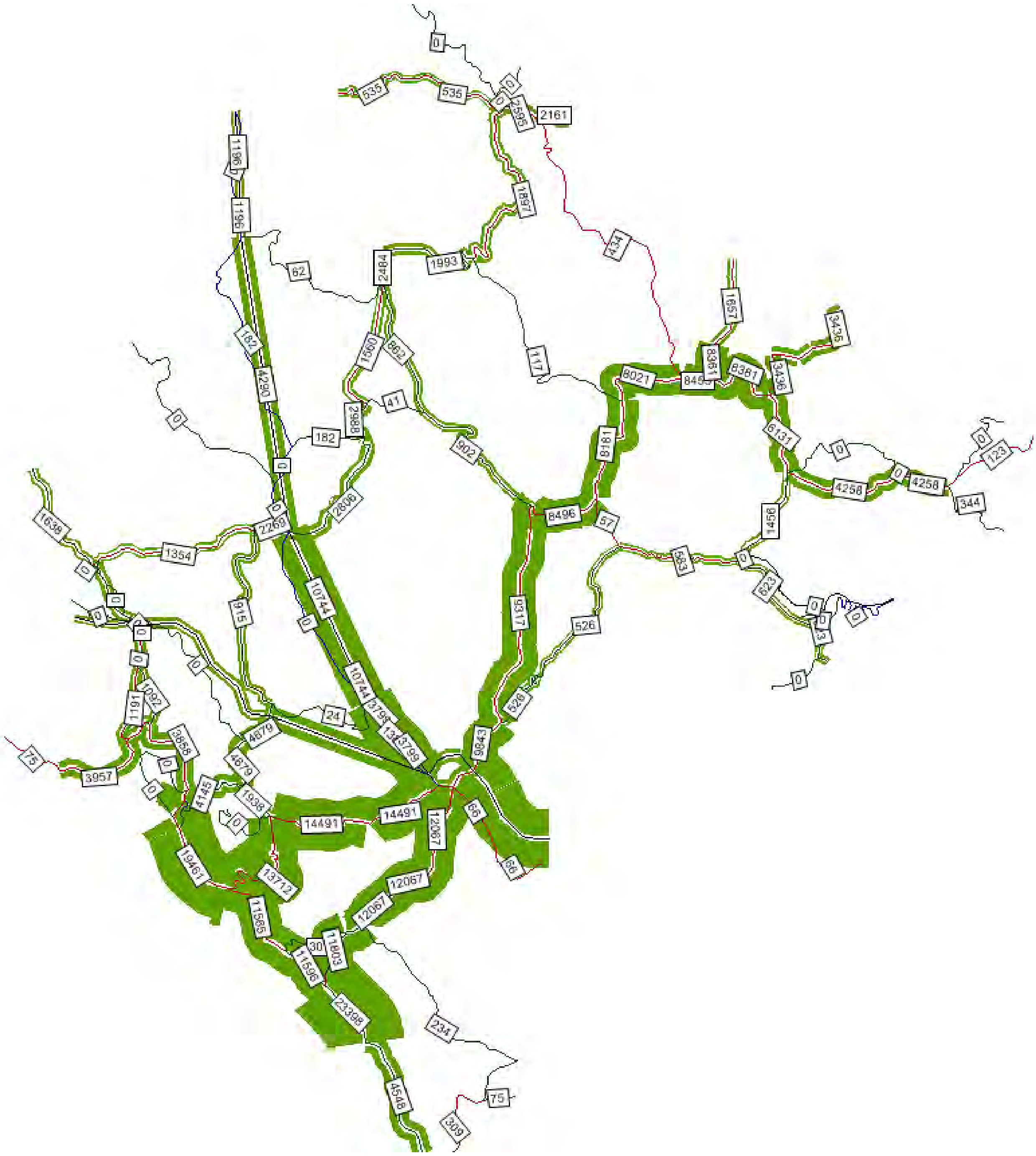
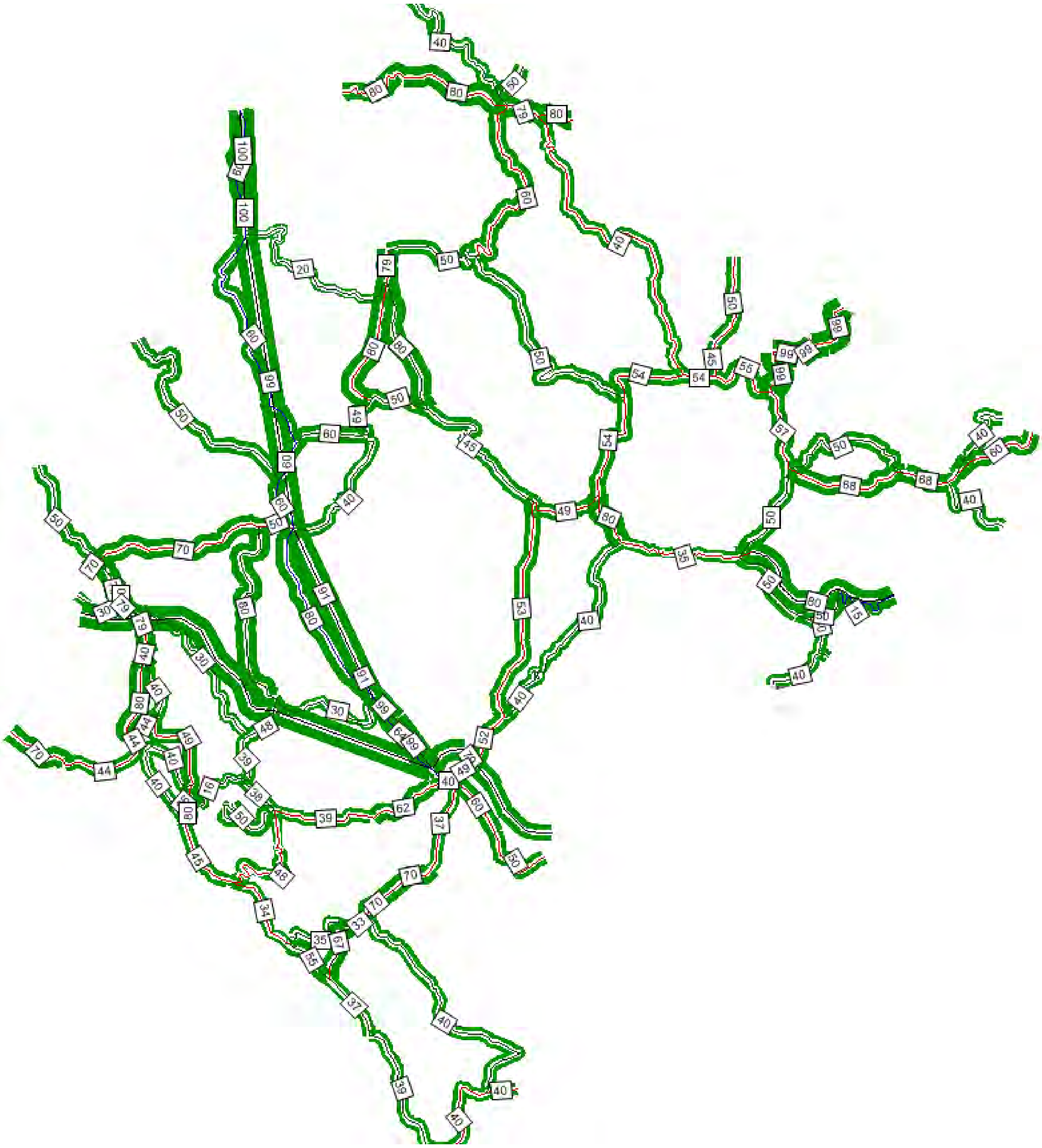
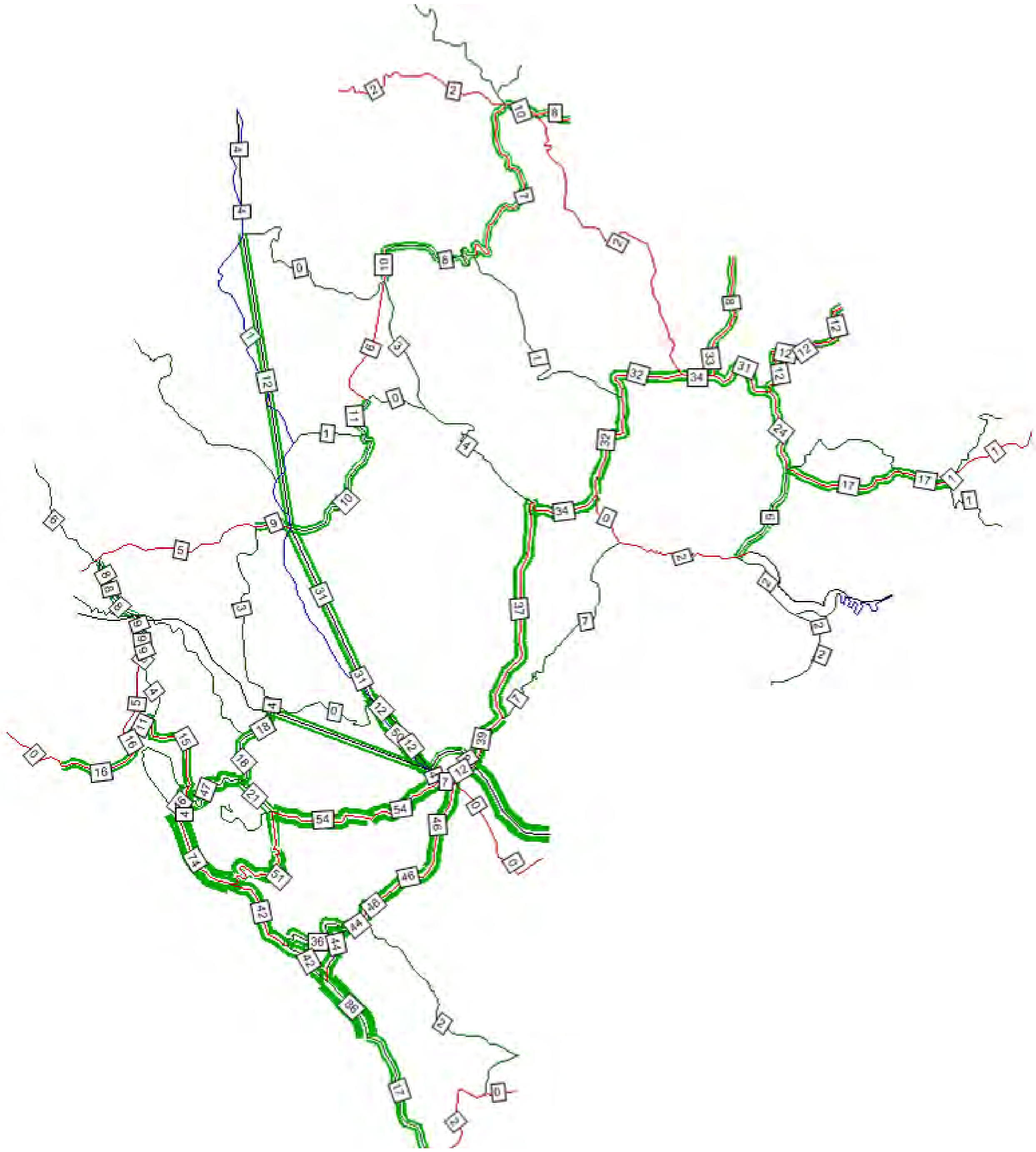


Year 2035 Scenario 7 Speed (km/h)



Year 2035 Scenario 7 Volume/Capacity Ratio



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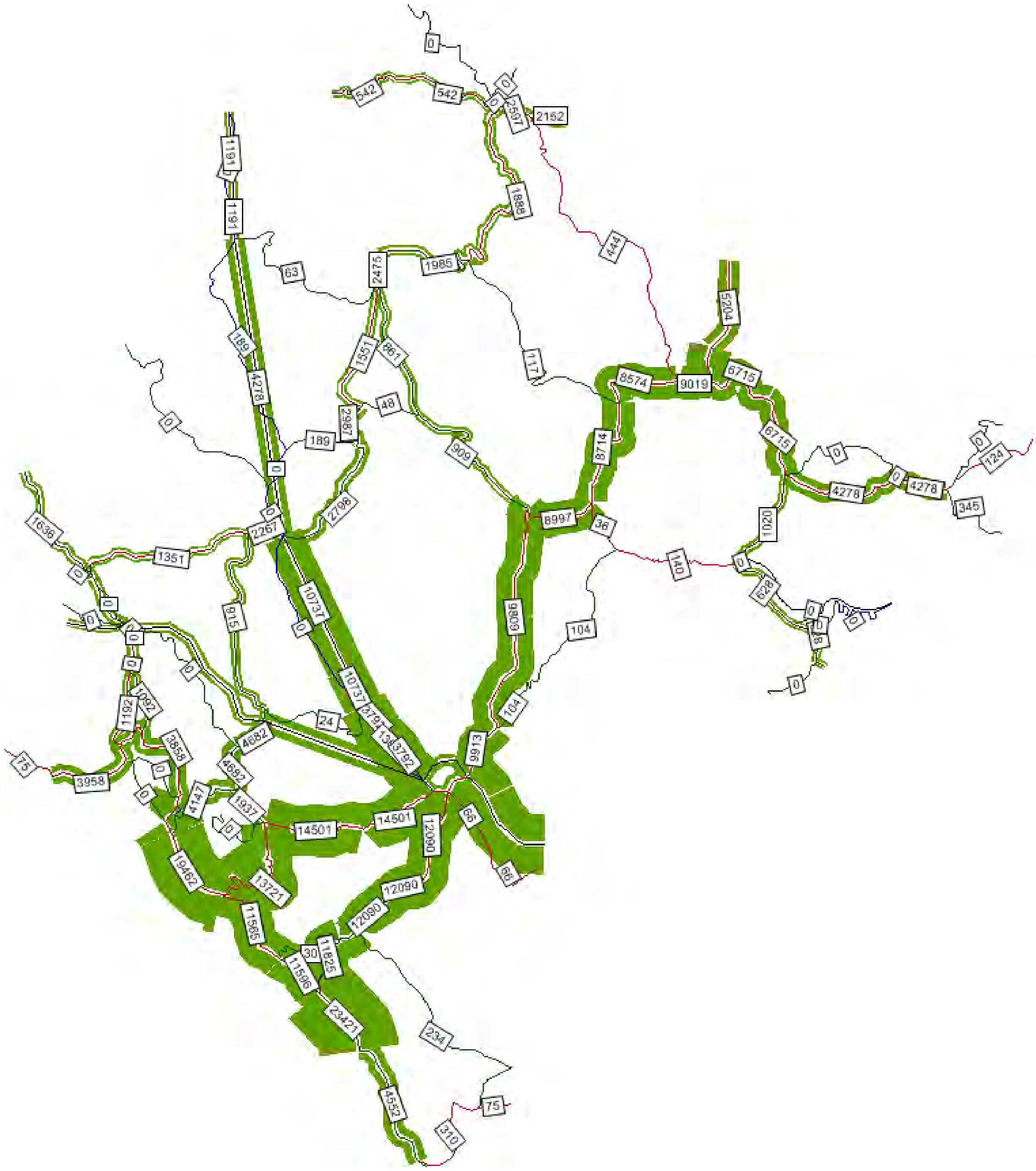

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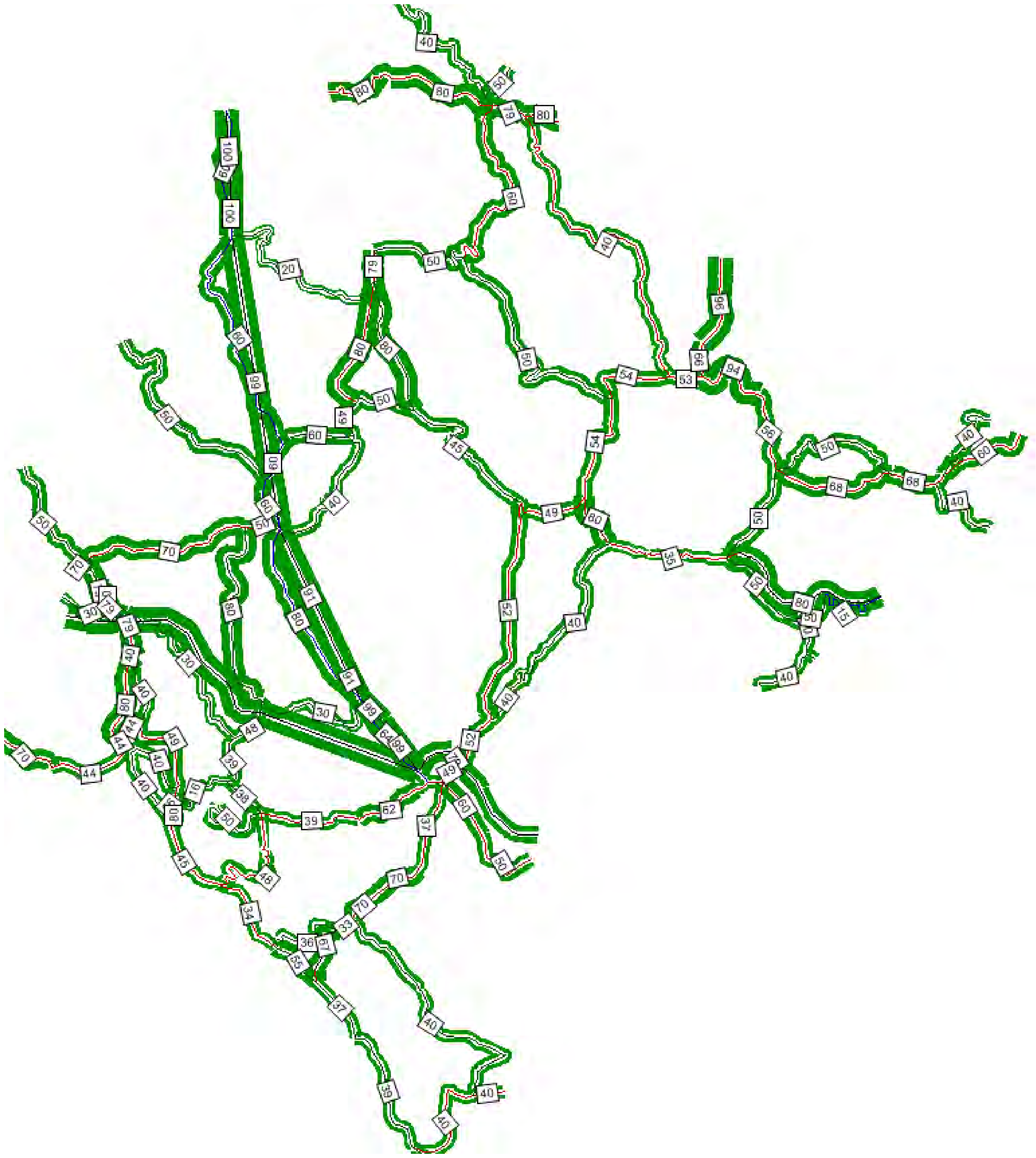

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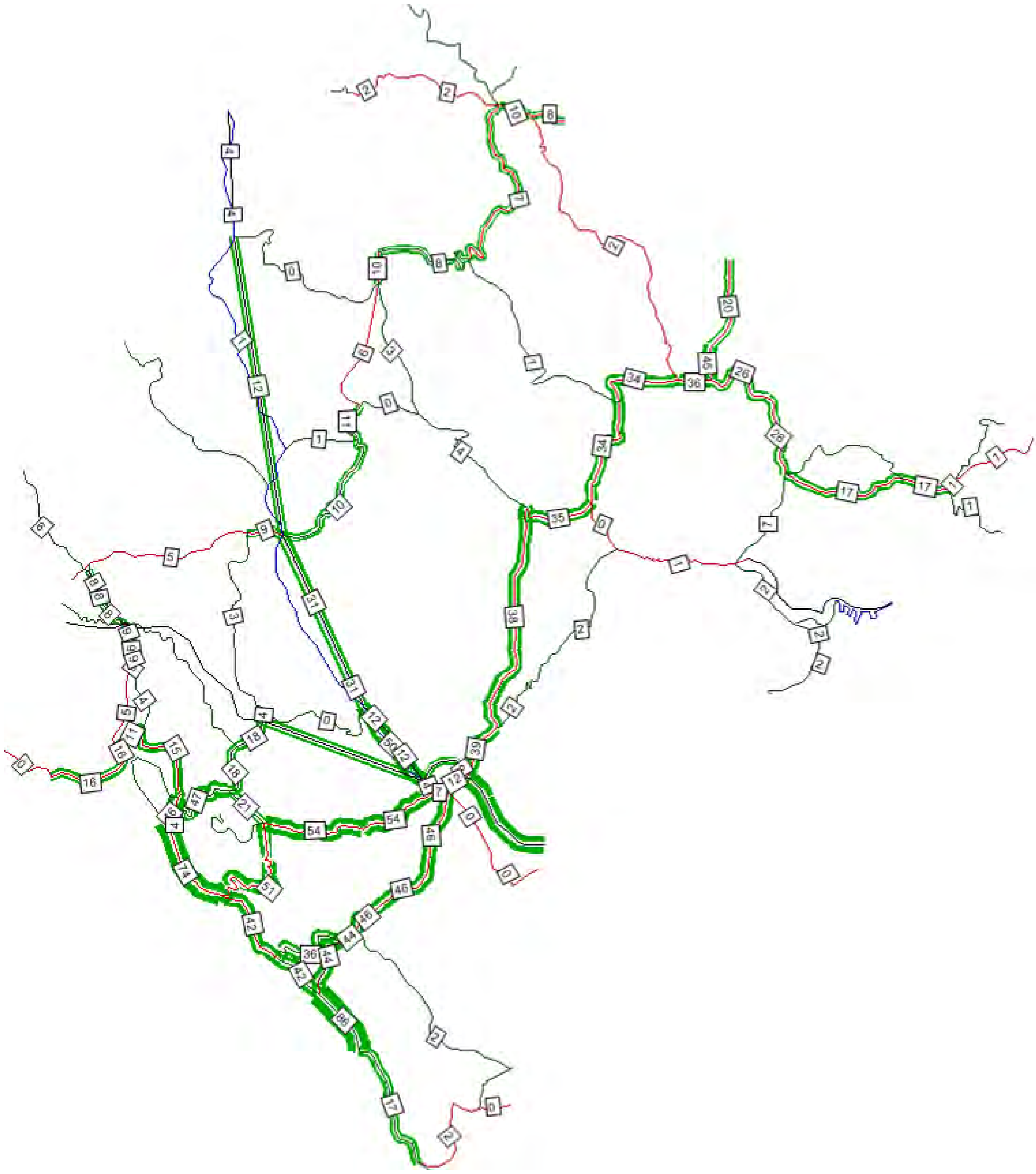

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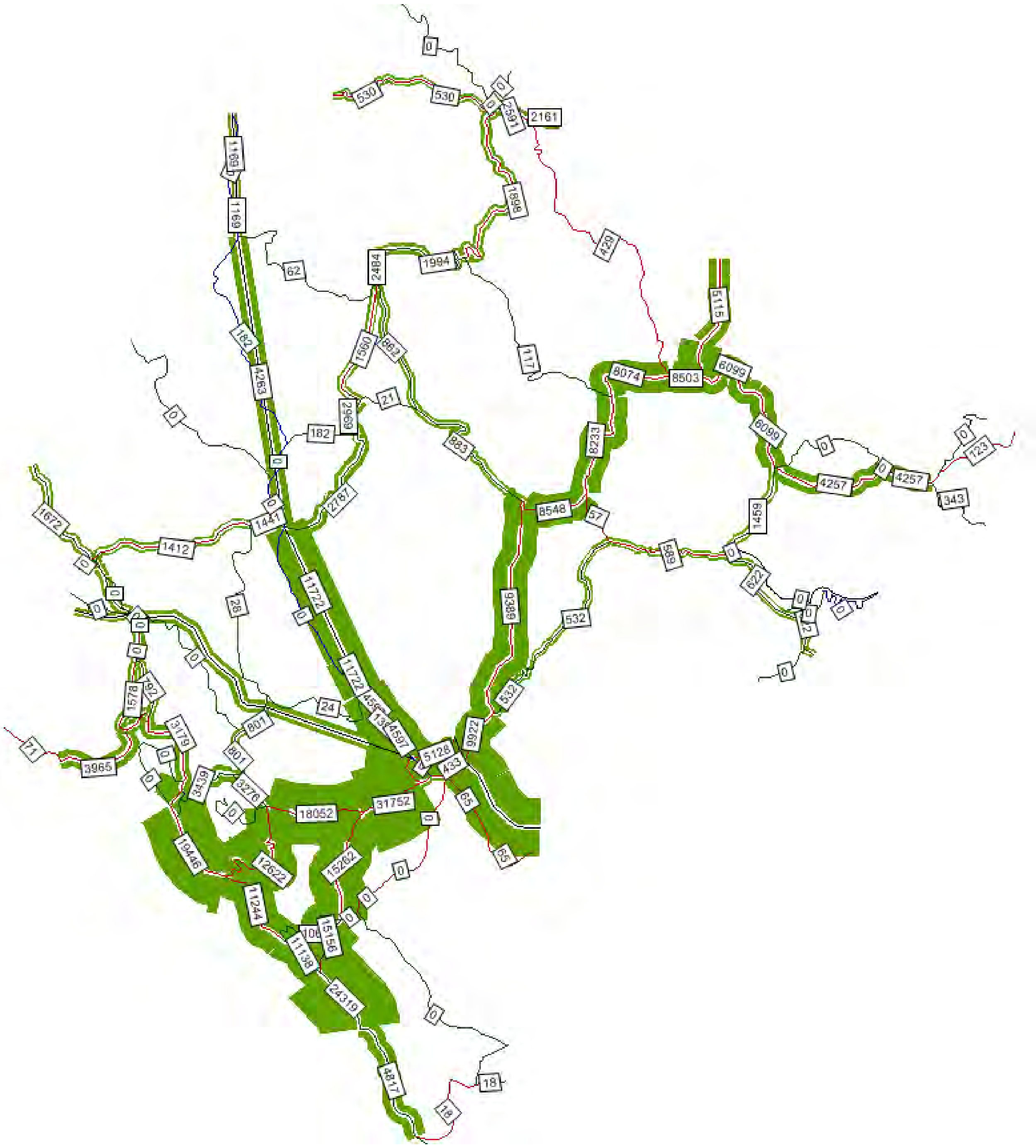
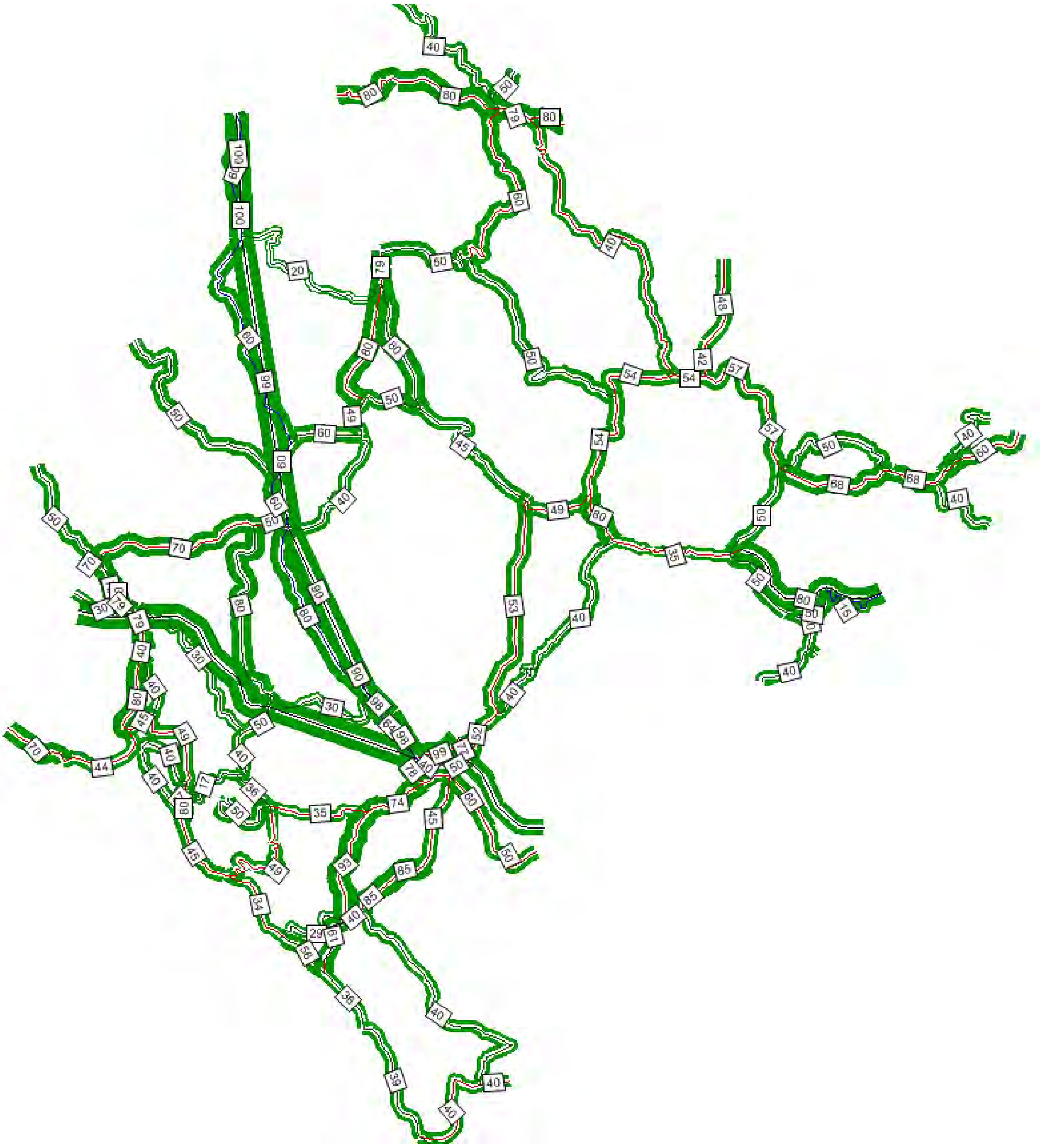
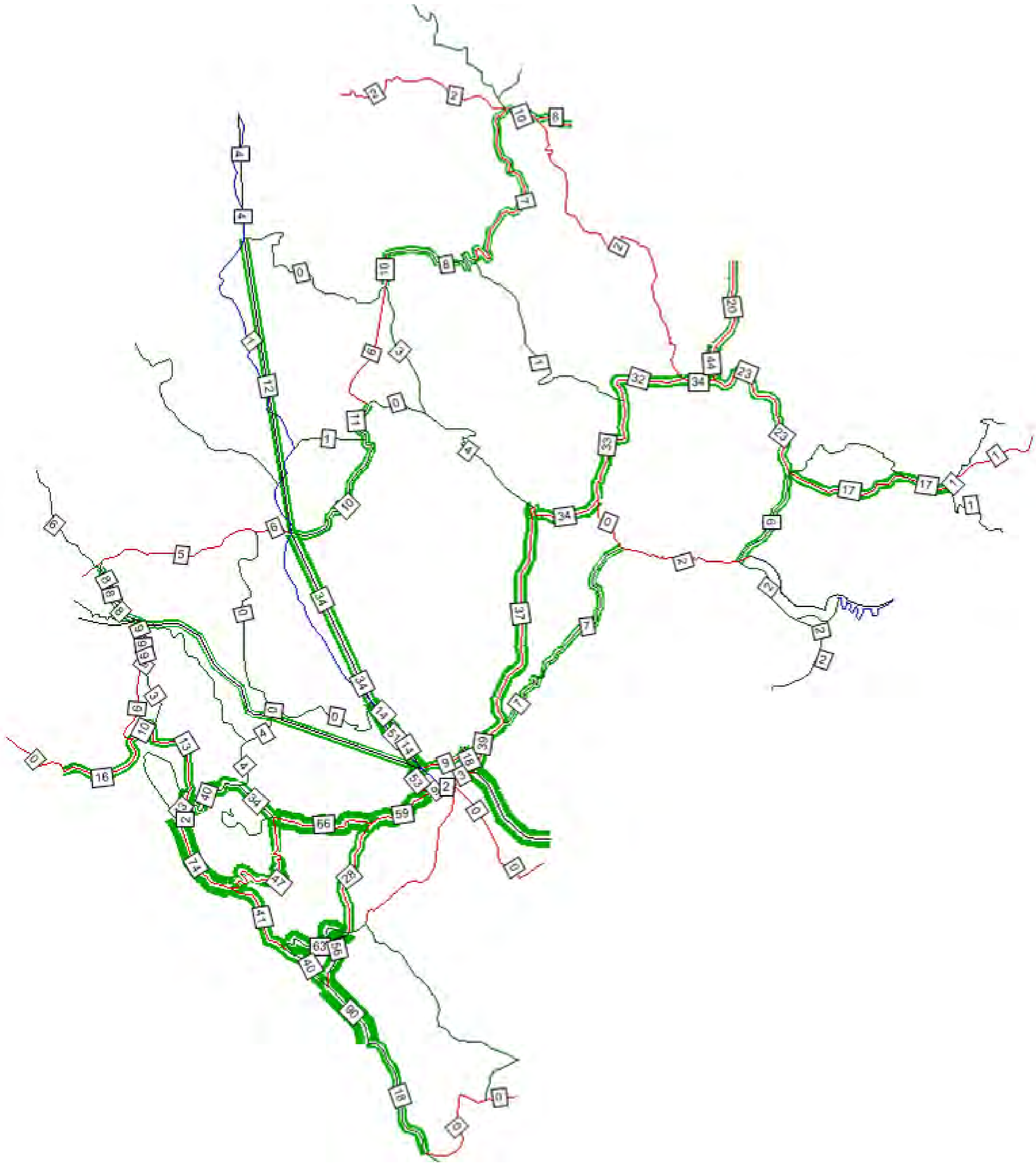


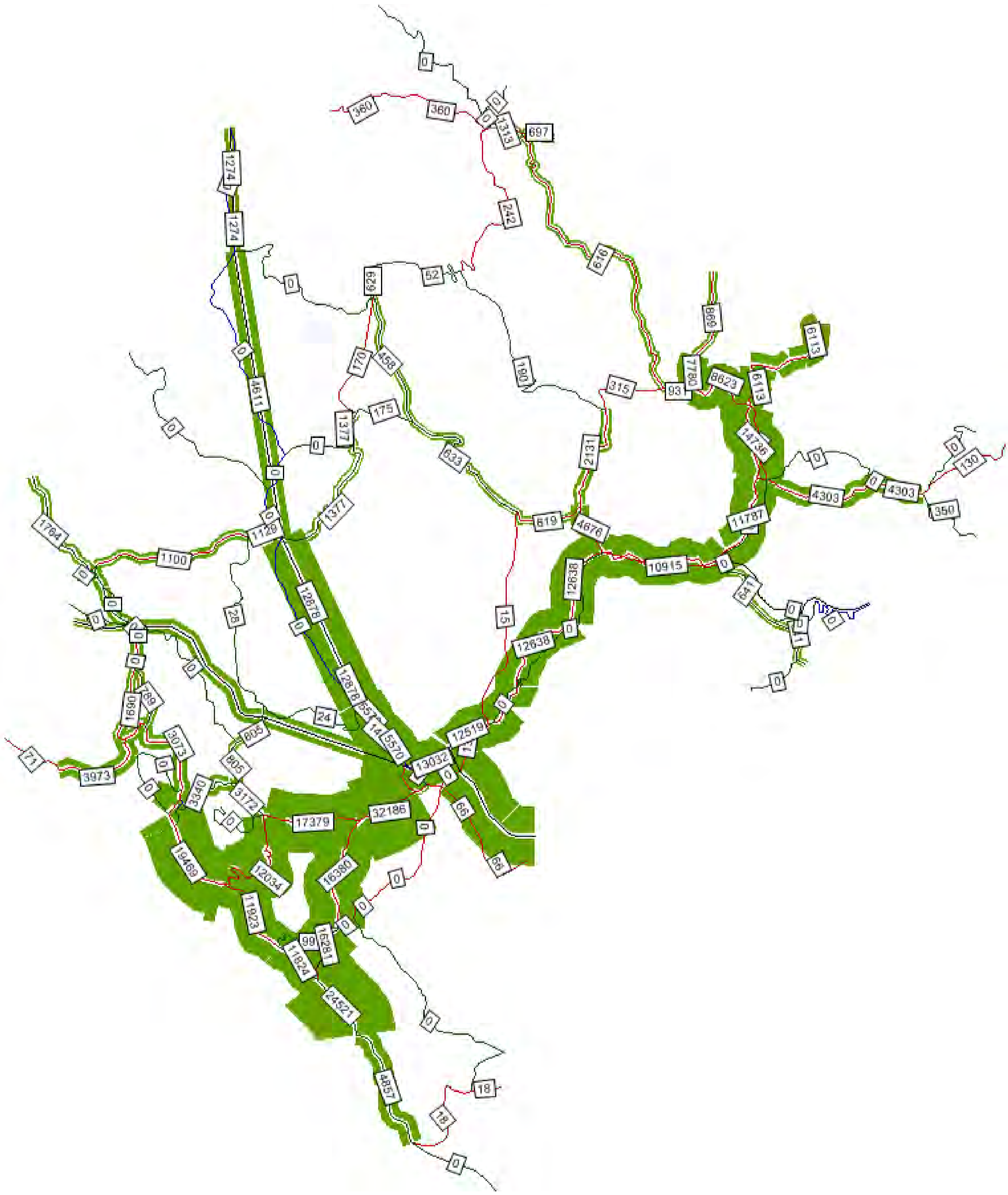
Year 2035 Scenario 15 Speed (km/h)



Year 2035 Scenario 15 Volume/Capacity Ratio

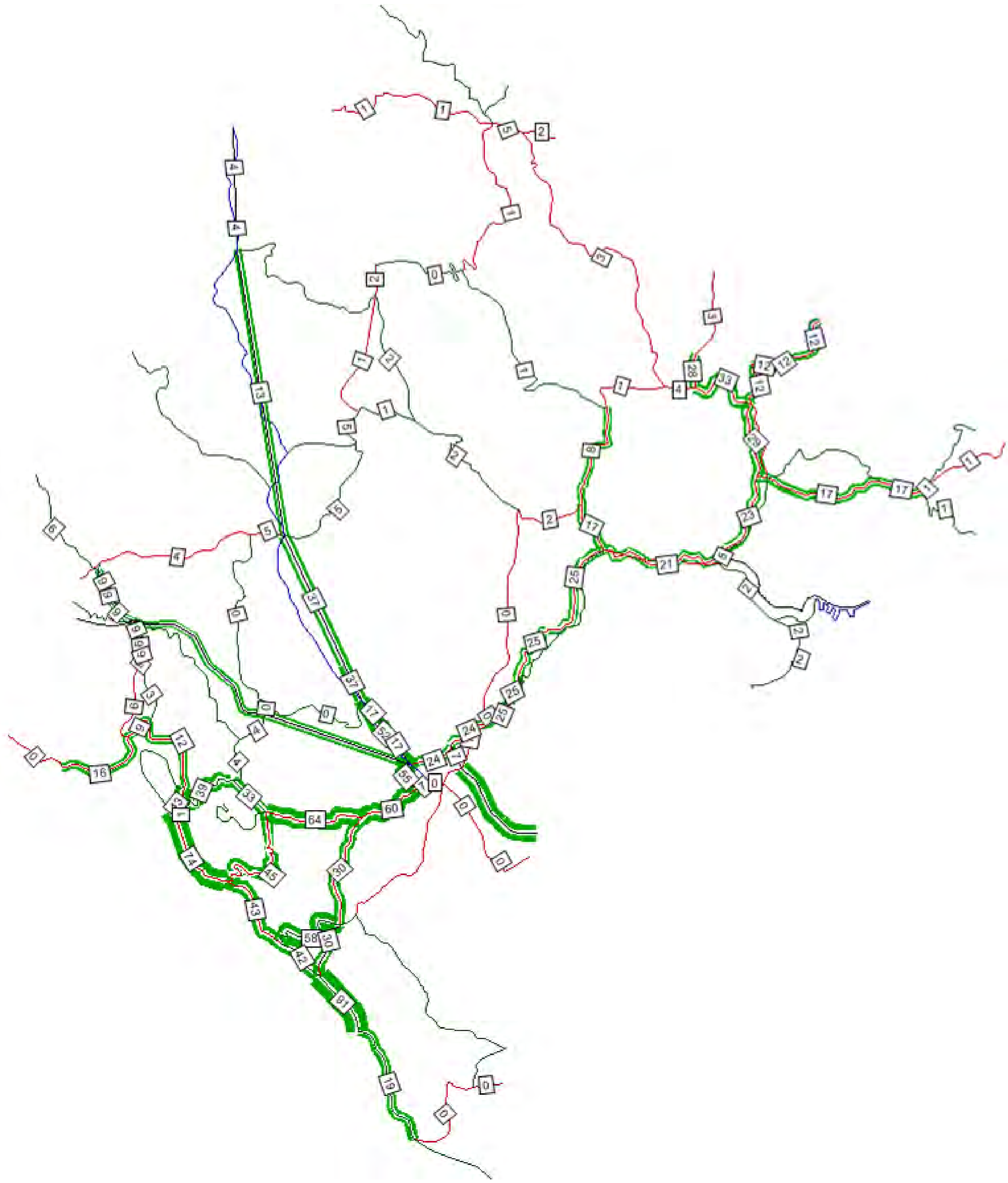


Year 2035 Scenario 20 AADT Flow



Year 2035 Scenario 20 Speed (km/h)

Year 2035 Scenario 20 Volume/Capacity Ratio



APPENDIX 12 NETWORK STATISTICS AND TRAFFIC PATTERNS

Global network statistics include the overall average speed, average travel and average travel time for each vehicle class. These are given for each forecast year in Tables A12.1 to A12.3. For the base year, these include the effect of generated traffic. Scenarios 1-8, 15 and 20 were chosen for the comparison of network speeds, distances travelled and travel time changes across the three tested time periods.

The DM Scenario figures show that the average network speed reduced gradually, particularly between 2012 and 2020 with the average network speed for all vehicles falling from 54.3km/h to 50.9km/h for cars. This reduction is likely to be due to increased demand on the roads and resulting congestion.

The change in network speed between 2012 and 2030 is much less pronounced across the scenarios tested. For example Scenario 20 experiences average network speeds for cars of 61.9km/h in 2012 and 60.1km/h in 2035. This suggests that the construction of the new road increases overall network speeds. It also indicates that the new road schemes are preventing the network from becoming congested thus reducing the overall speeds.

TABLE A12.1 AVERAGE NETWORK SPEED (KM/H)

Mode	Base	Scen 1	Scen 2	Scen 3	Scen 4	Scen 5	Scen 6	Scen 7	Scen 8	Scen 15	Scen 20
2012											
Car	54.3	56.0	56.1	54.3	55.9	54.5	54.5	54.5	57.5	56.7	61.9
LGV	55.0	55.9	56.7	55.0	56.8	55.2	55.5	55.1	58.2	57.6	62.8
HGV	52.6	54.2	54.6	52.6	55.2	53.7	53.5	53.2	55.3	54.7	60.5
2020											
Car	51.8	54.5	54.1	52.6	54.4	52.8	52.9	53.0	53.5	55.3	60.8
LGV	52.5	54.9	54.6	53.2	55.0	53.5	53.8	53.4	54.3	56.0	61.3
HGV	51.7	53.1	52.9	51.5	53.8	52.1	52.0	51.7	52.4	53.4	59.5
2035											
Car	50.9	53.5	55.9	51.5	53.1	51.8	51.9	52.1	52.5	54.0	60.1
LGV	51.4	53.8	57.8	52.0	53.8	52.3	52.6	52.2	52.9	54.5	60.3
HGV	50.3	52.1	54.4	50.6	53.1	51.3	51.4	50.8	51.5	52.4	59.5

The average travel distance decreases marginally over the analysed period from 51.4km in 2012 to 50.7km in 2035. HGV vehicles tend to experience longer travel distances than car and LGV vehicles for all three of the assessed years.

TABLE A12.2 AVERAGE TRAVEL DISTANCE (KM/VEH)

Mode	Base	Scen 1	Scen 2	Scen 3	Scen 4	Scen 5	Scen 6	Scen 7	Scen 8	Scen 15	Scen 20
2012											
Car	51.4	54.8	51.8	51.4	50.7	50.9	50.7	50.8	55.8	51.5	52.6
LGV	56.3	60.3	56.5	56.3	54.9	55.5	55.8	55.5	60.5	56.4	56.7
HGV	75.8	80.2	76.5	75.8	74.7	75.9	75.9	75.6	81.8	75.4	75.4
2020											
Car	51.0	52.0	51.1	51.6	51.1	51.1	51.1	51.2	51.0	51.9	53.2
LGV	55.5	55.6	55.5	56.2	54.8	55.4	55.7	55.4	55.5	56.5	56.7
HGV	75.4	74.9	74.4	75.2	73.8	75.0	75.0	74.7	74.8	74.4	74.4
2035											
Car	50.7	51.6	61.0	51.1	50.6	50.6	50.7	50.9	50.7	51.8	53.0
LGV	55.9	56.0	71.9	56.4	55.4	55.8	56.0	55.8	55.8	57.1	57.3
HGV	74.9	74.9	88.3	75.0	73.7	75.0	75.3	74.7	74.8	74.3	74.1

Travel time remains fairly constant across the modelled period at 1.0hrs, with cars and LGVs experiencing similar travel times, lower than the travel times of HGV vehicles.

Scenario 20 is clearly the most beneficial in terms of improved speeds and reduced travel times, as the entire North-South axis benefits from road network improvements. In the early years both scenarios 4 and 15 show a small degree of improvement, however the overall benefit is less pronounced. It should be noted that the best travel time savings are achived by HGVs.

TABLE A12.3 AVERAGE TRAVEL TIME (HRS/VEH)

Mode	Base	Scen 1	Scen 2	Scen 3	Scen 4	Scen 5	Scen 6	Scen 7	Scen 8	Scen 15	Scen 20
2012											
Car	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	1.0	0.9	0.9
LGV	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
HGV	1.6	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.4	1.2
2020											
Car	1.0	1.0	0.9	1.0	0.9	1.0	1.0	1.0	1.0	0.9	0.9
LGV	1.1	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	0.9
HGV	1.5	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.3
2035											
Car	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
LGV	1.1	1.0	1.2	1.1	1.0	1.1	1.1	1.1	1.1	1.0	1.0
HGV	1.5	1.4	1.6	1.5	1.4	1.5	1.5	1.5	1.5	1.4	1.2

All scenarios demonstrate improved journey time and journey speed results as compared with the base.

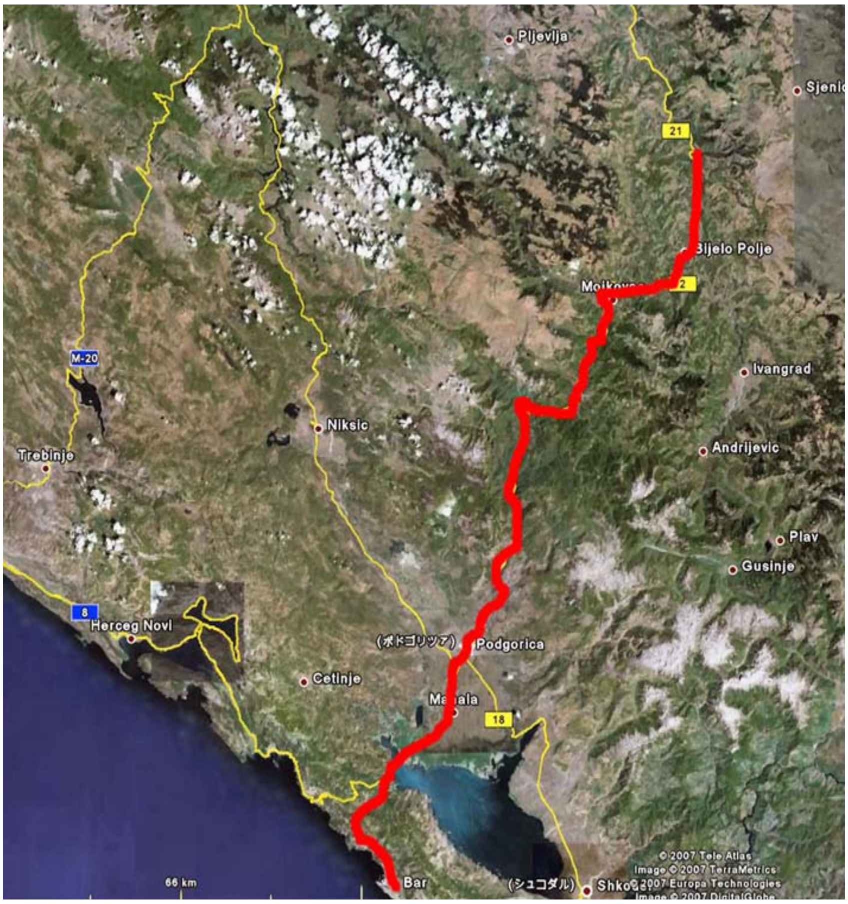
URS

SEETO Road Route 4 Investment Plan

Preliminary Enviornment and Social Impact Assessment and Resettlement Framework - Final

August 2012

Prepared for: Ministry of Transport & Maritime Affairs, Montenegro



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REVISION SCHEDULE

Rev	Date	Details	Prepared by	Reviewed by	Approved by
1	July 2012	Preliminary ESIA and Resettlement Framework	Ros Coverley Principal Environmental Consultant Mark Willett Senior Social Development Consultant	George Rutt Project Manager	Martin Edge Project Director
2	August 2012	Preliminary ESIA and Resettlement Framework	Ros Coverley Principal Environmental Consultant Mark Willett Senior Social Development Consultant	George Rutt Project Manager	Martin Edge Project Director

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1 INTRODUCTION

1.1 Project Background

The Government of Montenegro intends to develop an Investment Plan for the proposed Bar-Boljare Motorway, which forms part of SEETO Road Route 4. A multi-disciplinary consortium led by URS has been appointed to undertake the required motorway engineering, traffic, environmental, social and economic pre-feasibility studies.

The Bar-Boljare Motorway project (referred to in this report as SEETO Route 4) has been under development for several years: most recent engineering, traffic, environmental and economic studies were undertaken in 2008. In December 2007, the Government of Montenegro adopted a Decision to prepare a Detailed Spatial Plan for the Bar-Boljare Corridor. A 2 km wide (1 km either side of the proposed centreline) corridor was established in which development restrictions were applied. These restrictions remain in force today and are a source of tension, particularly in the Municipality of Podgorica, where they are perceived to be restricting infrastructure and economic development.

The Government of Montenegro is now reconsidering all previous technical options proposed by previous studies to identify an economically and financially feasible plan to bring the whole route between Djurmani (Bar) and the Serbian border (Boljare) to appropriate European standards.

In March 2012, the URS led consortium was appointed to undertake a 5 month study involving:

A capacity assessment of the existing SEETO Route 4 in Montenegro;

Preparation of an Investment Plan for the portion of SEETO Route 4 in Montenegro that optimises economic returns;

Environmental and social analysis of the Investment Plan.

1.2 Previous Environmental and Social Studies

Several studies have been undertaken in recent years:

Montengroinzenjering (2008) Spatial Plan of Montenegro until 2020 (March 2008)

This document was prepared for the Ministry of Economic Development. The first section provides an appraisal of the state of spatial development in Montenegro in relation to physical conditions and previous plans. The second section provides a projection of development and concepts of spatial organisation, development and use in Montenegro. The document contains a variety of maps showing traffic infrastructure, settlement distribution, vegetation, geology and pedology, erosion and earthquake hazard, climate zones and precipitation.

Louis Berger (2008) Feasibility Study for Two Motorways in Montenegro: Strategic Environmental Assessment - Overview and General Issues, Technical Memorandum 10A Strategic Environmental Assessment (SEA) for the Bar-Boljare Motorway (May 2008)

This SEA report, prepared for the Ministry of Transport, Maritime Affairs and Telecommunications (MTMT), contained generic information about Montenegro and the environmental impacts of a motorway project. It outlined general mitigation measures by which potential impacts could be avoided, reduced or compensated for. The report also identified where further study would be required in order to develop project specific environmental impact assessment (EIA).

Scott Wilson (2008) Bar-Boljare Motorway Environmental Report (September 2008)

This Environmental Report, prepared for IFC, reviewed the Louis Berger SEA, presented the Terms of Reference (TOR) prepared by the Ministry of Tourism and Environmental Protection for an EIA of the priority section (Smokovac-Mateševo), reported on a site visit undertaken in September 2008 and developed a TOR for social impact studies.

WINsoft and Geateh (2008) Strategic Environmental Assessment for Detailed Spatial Plan of Bar-Boljare Motorway (August 2008)

The SEA Report, prepared for the Ministry of Economic Development, provides useful background information on the (then) current legal regulations relating to planning and environment, landscape and the state of the environment, centres of population, protected areas (environmental, cultural-historical and water sources) as well as an overview of potential environmental and social impacts resulting from construction of a motorway from Bar-Boljare.

This report was approved by the competent authority (the former Ministry of Spatial Planning and Environmental Protection).

P-In@Enjering-Podgorica (2008?) Technical Report

This short report concentrates on the planning, environmental and engineering design issues relating to the Motorway between Djurmani and Podgorica, particularly the section between Vranjina and Tanki Rt (Skadar Lake crossing).

Faculty of Civil Engineering (2008?) Study on the Environmental Impact Assessment of Construction and Exploitation of the Motorway Sections Smokovac-Uvač and Uvač-Mateševo

The Smokovac- Mateševo EIA report was prepared on the basis of the concept design and associated traffic, hydrogeological, engineering geological and civil engineering studies for the priority sections (Smokovac-Uvač and Uvač-Mateševo) prepared by the Faculty of Civil Engineering. The report comprises two volumes:

Volume 1 - Description: Description of site and infrastructural facilities; description of variant solutions; description of design; description of environment - current state;

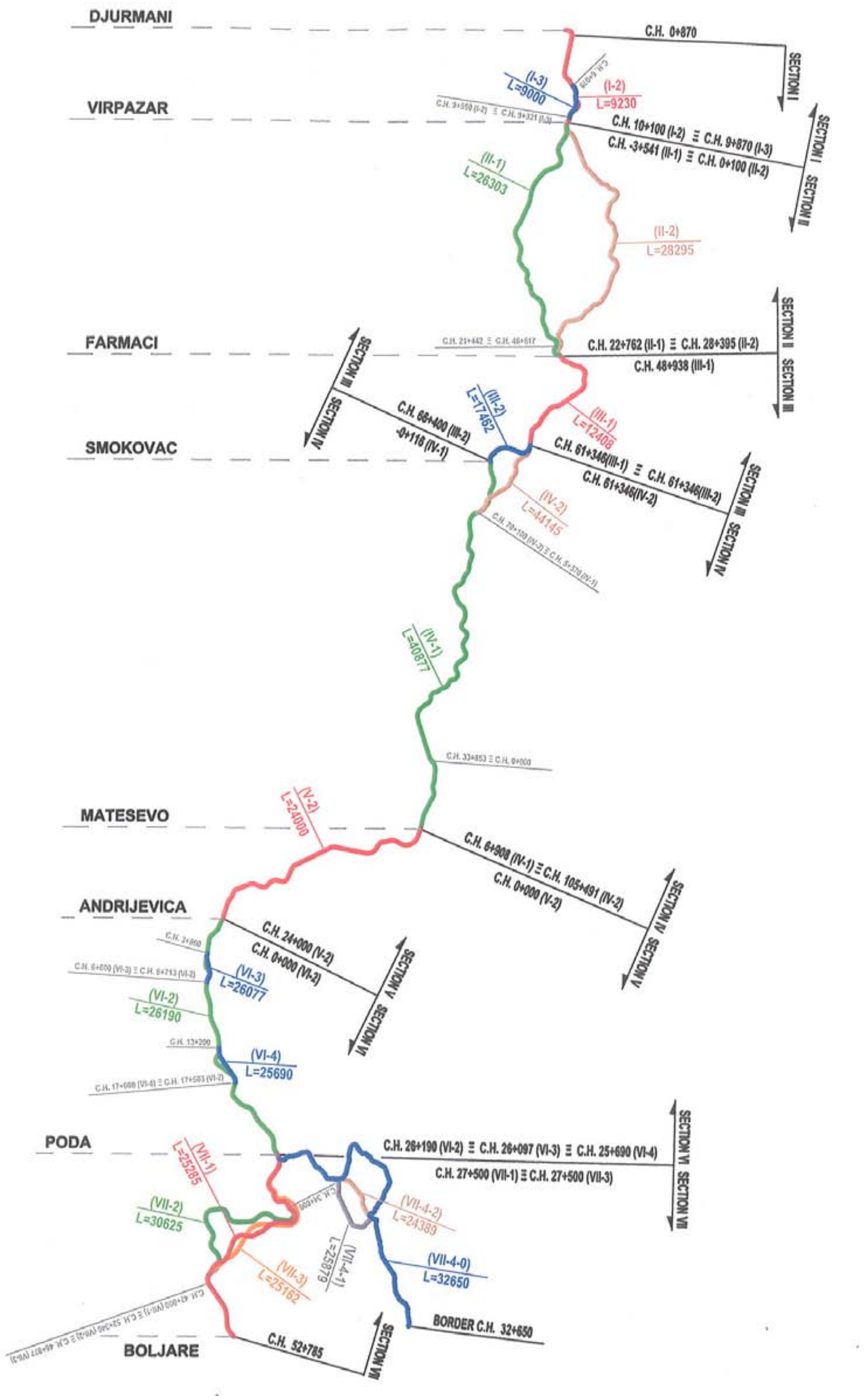
Volume 2 - Overview of Possible and Expected Environmental Impacts related to the Construction and Utilisation of the Bar-Boljare Motorway; possible and expected environmental impacts related to motorway construction of motorway sections Smokovac-Uvač and Uvač-Mateševo ; possible and expected impacts of the utilisation of the motorway sections Smokovac-Uvač and Uvač-Mateševo; measures to prevent, mitigate or remove harmful impacts.

This study has not been approved by the competent authority

1.3 Scope of the Environmental and Social Analysis

Development of the Investment Plan included the identification of a minimum of four alignment alternatives including the existing road: these are shown in Figure 1-1. The results of this phase were presented in the Technical Options Report issued in July 2012.

Figure 1-1: SEETO Road Route 4 - Technical Options



The Terms of Reference for the study (see Appendix A) require that an Environmental and Social Impact Assessment (ESIA) to European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), International Finance Corporation (IFC) and World Bank requirements is prepared, including several rounds of public consultation.

At a meeting with the Ministry of Transport, the Steering Group and the EIB in April 2012 it was confirmed that the environmental and social analysis undertaken would be at the level of a strategic overview. At the same meeting it was also confirmed that any environmental and social activities, reporting and consultation undertaken by the Consultant would fall outside the national EIA process. It is noted that there is no current national requirement for social impact assessment to be undertaken for projects in Montenegro.

The focus of the environmental and social inputs in this study has been directed towards influencing in practical ways the optional alignments being explored. The activities have been:

Undertaking a site visit/visits along the existing roads (April/June 2012);

Raising pertinent environmental and social issues within the engineering design team workshops;

Engaging in discussions with the Steering Committee as well as groups of stakeholders at key locations (Bar, Podgorica, Kolašin, Andrijevica, Berane and Bijelo Polje);

Adding to the body of environmental and social information available to the Client and prospective lenders.

This report presents the results of the preliminary environmental and social analysis of the alignment alternatives and the recommended Investment Plan.

1.4 Structure of Document

The following chapters are presented in this report:

1 Introduction

2 Policy, Legal and Administrative Framework

3 Project Description including Design Parameters

4 Environmental and Social Baseline

5 Assessment of Alternatives

6 Impact Assessment and Mitigation

7 Public Consultation

8 Project Resettlement Policy Framework is included in Appendix B.

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Montenegro as an Ecological State

The Parliament of Montenegro adopted the Declaration on Montenegro as an Ecological State on 20th December 1991. The declaration states that the country is '*establishing a state relationship with nature and calls upon all citizens … to protect the identity of the surroundings in which we live in the name of their own survival and the survival of their descendents*'.

Protection of the environment is supported by the Constitution of 1992 which states that '*Montenegro is a democratic, social and ecological state*.' Article 65 of the Constitution states that: '*The state shall protect the environment. Freedom of earning and free entrepreneurship shall be restricted by environmental protection*.'

In December 2000, the document 'Directions of development of Montenegro Ecological State' was adopted. The document was destigned to '*provide coherence between economic-technological development, social requirements connected to citizen's quality of life and environmental demands*.'

2.2 EIA Process in Montenegro

At the national level, a set of regulations has adopted which fully regulate the impact assessment of projects on the environment, namely:

- Law on Environmental Impact Assessment (Official Gazette of the Republic of Montenegro (OG) 80/05), a translation of this decree is included in Appendix C
- Decree on projects for which EIA shall be conducted (OG 20/07 from April 4, 2007),
- Rulebook on the contents of documentation submitted with an application for decision on the need for EIA study (OG 14/07 from December 21, 2007), a translation of this decree is included in Appendix D
- Rulebook on the contents of documentation submitted with an application for decision on the scope and contents of the EIA study (OG 14/07 from December 21, 2007 and
- Rulebook on the contents of the EIA Study (OG 14/07 from December 21, 2007).

The competent authority responsible for the implementation of the EIA procedure is defined by the Law on EIA. In this respect, the competent authority responsible for the implementation of the EIA procedure shall be: public administration body responsible for environmental protection (the Environmental Protection Agency) for projects for which approvals and permits are issued by other public administration bodies; and a local administration body responsible for environmental protection for other projects for which approvals and permits are issued by other local administration bodies.

Pursuant to the above, authorities that have jurisdiction in the area of environmental protection, in accordance with the obligations stipulated by the Law on EIA, participate in the process of issuing approvals for the implementation of projects for which obligation of undertaking EIA study is prescribed.

In accordance with the Law on Spatial Planning and Construction of Structures and provisions of the Regulation on projects for which EIA study shall be undertaken (Official Gazette of Montenegro 20/07 from 4 April 2007), obtaining approval from the competent authority responsible for conducting the EIA study on application for approval of the EIA study is a prerequisite for the issuance of building permits. Building permit for the project is issued by the line ministry in charge of the construction of structures, i.e. the Ministry of Sustainable Development and Tourism.

Pursuant to the Decree on projects which require the EIA (Official Gazette of the Republic of Montenegro 20/07 dated on 4 April 2007), List 1 concerning the projects which require the mandatory EIA includes also the projects in the area of energy production. According to Article 10, the impact assessment shall also be mandatory for the projects in infrastructure.

In Montenegro, the EIA (note: not ESIA as there is currently no requirement for social impacts to be considered) process starts at Preliminary Design. According to Law on EIA (OG 80/10), the EIA process is as follows:

Need for EIA
- submit application to Competent Authority (CA) on whether an EIA is required
- CA notifies organisations/public within 7 days that they can view application
- organisations/public can review.comment on application within 10 days of notification
- decision given with 10 days of expiry of application viewing
- if yes/CA establishes Environmental Impact Commission (EIC)

Scope and Content of EIA
- submit application to Competent Authority on Scope and Content of EIA
- CA submits application to EIC within 5 days
- EIC makes proposal within 15 days
- CA informs organisations/public within 7 days of EIC proposal that they have 15 days to review/comment
- within 20 days of deadline, CA gives decision

Developer has 12 months to prepare EIA

Public Debate on EIA
- submit EIA report to CA
- CA notifies organisations/public within 10 days of manner, time and venue for public viewing, submission of opinions and remarks, as well as time and venue for holding public debate
- public debate must not be less than 20 days from date that organisations/public were notified

Study Evaluation
- within 7 days of public debate, CA submits EIA report and public comments to EIC
- EIC has 30 days from receipt of EIA report and public comments to provide its response
- EIC can request modifications and amendments to the report
- CA has 10 days from receipt of EIC comments to decide whether to grant/reject application for approval of EIA report

If EIA approved, Developer has 2 years to obtain Project Execution Permit or Authorisation

Note: the EIA and public consultation for the SEETO 4 highway project may be carried out (and approved) section by section.

2.3 Government Agencies

The Ministry of Spatial Planning and Environmental Protection (MSPE) is the government body in Montenegro responsible for environmental policy and management. The Ministry was established in November 2008 and is responsible for the implementation of environmental legislation. The environment department has two units: one for environmental quality and one for environmental policy, economics and information systems.

The MSPE is responsible for organisations including: the Agency for Environmental Protection; the Hydro-Meteorological Service; the Public Institution Centre for Eco-Toxicological Testing; the Institute for Nature Protection and the Public Enterprise for National Parks of Montenegro.

Other ministries with responsibilities in the environment and social development sectors are:

- Ministry of Sustainable Development and Tourism
- Ministry of Agriculture and Rural Development
- Ministry of Health
- Ministry for Minority and Human Rights
- Ministry of Labour and Social Welfare
- Forest Administration
- Water Administration
- Human Resources Administration

Legislation, planning guidance and international conventions in force in Montenegro include those listed in the following paragraphs.

2.4 State laws and delegated legislation

Law on environment (Official Gazette (OG), No. 48/08 and 40/10);

Law on spatial planning and development (OG, No. 16/95, 28/05);

Law on strategic environmental assessment (OG, No. 80/05);

Law on environmental impact assessment (OG, No. 80/05);

Decree on projects for which EIA shall be conducted (OG, 20/07);

Rulebook on the contents of documentation submitted with an application for decision on the need for EIA study (OG, 14/07); a copy of this decree is included in Appendix D

Rulebook on the contents of documentation submitted with an application for decision on the scope and contents of the EIA study (OG, 14/07);

Rulebook on the contents of the EIA study (OG, 14/07);

Law on free access to information (OG, No. 68/2005)

Law on spatial development and construction of structures (OG, 51/08);

Law on integrated prevention and control of environmental pollution (OG, No. 80/05, amended 54/09);

Law on water (OG, No. 17/07);

Law on nature protection (OG, No. 51/08);

Decree on protection of rare, thinned, endemic and endangered plant and animal species (OG, No. 56/06);

Decision on putting certain flora and fauna species under protection (OG, No. 76/06):

Law on forests (OG, No. 55/00);

Law on game and hunting (OG, No. 52/08);

Law on national parks (OG, No. 56/09);

Law on fresh water fishery (OG, No. 11/07);

Law on air quality (OG, No. 48/07);

Law on air protection (OG, No. 25/10);

Law on ratification of Kyoto protocol (OG, No. 17/07);

Law on protection against noise in the environment (OG, No. 28/11);

Law on waste management (OG, No. 80/05 and 73/08).

Law on Gender Equality

Draft Law on Legalisation of Formal Structures[1]

Labour Law (O/G, No. 01-440/2)

Law on Expropriation (O/G, No. 55/00, 12/02, 28/06)

Law on Gender Equality (O/G, No. 46/07)

Law on Protection on Work (O/G, No. 79/2004)

2.5 Planning documents

National Strategy for Sustainable Development in Montenegro (2007);

Spatial Plan for areas with special purpose for coastal zone, Podgorica (2007);

Spatial Plan for Montenegro until 2020 (2008);

Master Plan - Strategy for development of tourism in Montenegro to 2020;

National Strategy of Biodiversity with Action Plan for 2010-15 (financed by GEF/UNDP);

Strategic Master Plan for waste management at state level, Republic of Montenegro (2004);

National Waste Management Policy (2004);

Decision on commencement of development of the spatial plan of special purpose areas for National Park 'Skadar Lake' and 'Biogradska Gora' (Official Gazette, No. 47/92).

2.6 International conventions and other documents

Law on ratification of Kyoto protocol (Official Gazette, No. 17/07);

New York Framework Convention on Climate Change (1992);

6th Community Environmental Action Programme, 1600/2002/EC;

European Landscape Convention, Florence (2002);

European Convention on the Protection of Archaeological Heritage (No. 66), London (1969);

Paris Convention on the Protection of World Cultural and Natural Heritage (1972);

Convention for the Protection of the Architectural Heritage of Europe (1985);

Rio Convention on Biological Diversity (1992);

Cartegna Convention on Bio-Safety (2003);

[1] At time of study preparation the draft law was being considered by Parliament.

Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (1971) ;

Bonn Convention on the Conservation of Migratory Species of Wild Animals (1979);

Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in the Environmental Field (1998);

Convention on International Trade in Endangered Species of Wild Flora and Fauna (1973);

Espoo Convention on Transboundary Effects (1991);

Vienna Declaration on Informal Settlements in Southeastern Europe (2004).

2.7 European legislation

Montenegro's status as a candidate country for the European Union was confirmed in December 2010: this is an on-going process. As part of the accession process, Montenegro will be required to harmonise its laws with those of the EU. In March 2012, discussions took place between the European Commission and the Montenegrin delegation in relation to a number of laws relating to justice, freedom and security. Discussions in relation to laws on science and culture are likely to take place at a later date.

European law operates through regulations (which have immediate and binding effect on each individual member state) and directives (which are binding as to the results to be achieved, but which leave the individual member state with the choice of form and means to achieve the results).[2]

Environment-related directives include the following:

EIA Directive (85/337/EEC, amended and extended by 97/11/EC and 2003/55/EC);

Strategic Environmental Assessment Directive (2001/42/EC);

Birds Directive (79/409/EEC)

Habitats Directive (92/43/EEC);

Water Framework Directive (2000/69/EC);

Waste Framework Directive (75/442/EEC as amended).

2.8 Requirements of Potential Financing Institutions

Each of the major international financing institutions (IFIs), for example, European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), International Finance Corporation (IFC) and World Bank requirements as well as other Equator Principles banks have their own requirements for environmental and social studies for the projects that they finance. These requirements are generally harmonised but not necessarily compatible between lenders in all respects.

Requirements have become increasingly prescriptive in recent years, particularly with the recent (January 2012) revision of the IFC Performance Standards (PS). For example, IFC PS1 Assessment and Management of Social Risks and Impacts (2012) requires not only a sufficient level of detail in the design (e.g. project footprint, locations of structures/borrow pits/waste dumps, quantities and sources of materials, duration of activities, numbers of workers) to make a meaningful assessment of potential impacts, but also the establishment of a management system to avoid/reduce or restore/compensate/offset risks and impacts.

[2] Home (2007) A short guide to European Environmental Law, www.anglia.ac.uk

This management system is to include: an environmental and social policy statement by the project proponent; risk and impact identification including consideration of areas of influence, associated facilities, trans-boundary, cumulative and supply chain impacts; management system, plans and agreements/contracts; action plan (defined timeline and priorities); organisational capacity and competence; emergency preparedness and response; stakeholder engagement; access to information; grievance mechanism; monitoring and review.

Development of an Environmental and Social Impact Assessment (ESIA) report to current standards will involve an experienced multidisciplinary team and may take 12 months or more.

A brief overview of the current requirements of the EIB, EBRD and IFC is presented below.

2.8.1 European Investment Bank

All public sector institutions based in the European Union are obliged to ensure that the projects they finance address certain EU laws including:

EIA Directive (85/337/EEC, amended and extended by 97/11/EC and 2003/55/EC);

Birds Directive (79/409/EEC)

Habitats Directive (92/43/EEC);

Sector-specific environmental directives.

The EIB requires compliance with the EIB Environmental and Social Handbook and the relevant:

EU environmental 'Acquis' (i.e. up to 300 EU directives) as defined in the EIB Sourcebook on Environmental Law;

All international conventions and agreements ratified by the EU;

EU social 'Acquis' as defined in the EIB Reference Book on Social Legislation and the EIB's Social Guidance Notes.

2.8.2 World Bank Group

The World Bank Group comprises 5 agencies: International Bank for Reconstruction and Development (IBRD); International Development Agency (IDA); International Finance Corporation (IFC); Multilateral Investment Guarantee Agency (MIGA) and International Centre for Settlement of Investment Disputes (ICISID).

The World Bank is an international financing institution that provides loans to governments for capital programmes and comprises the IBRD and the IDA. It is focussed on developing countries in fields such as human development, agriculture and rural development, environmental protection, infrastructure and governance. Its Operational Manual and Core ESIA Operational Policies (OPs) are applied to Project ESIAs.

OPs for public sector projects include:

OP4.01 - Environmental Assessment;

OP4.02 - Environmental Action Plans;

OP4.04 - Natural Habitats;

OP4.07 - Water Resources Management;

OP4.10 - Indigenous Peoples;

OP4.11 - Physical Cultural Resources;

OP4.12 - Involuntary Resettlement;

OP 4.20 - Gender and Development.

The activities of IFC and MIGA include investment in private sector projects and providing insurance and they have their own versions of Performance Standards.

The IFC Performance Standards (2012) are as follows:

PS1 - Assessment and Management of Social Risks and Impacts;

PS2 - Labour and Working Conditions;

PS3 - Resource Efficiency and Pollution Prevention;

PS4 - Community Health, Safety and Security;

PS5 - Land Acquisition and Involuntary Resettlement;

PS6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources;

PS7 - Indigenous Peoples;

PS8 - Cultural Heritage.

All projects involving one or more World Bank Group agencies have to apply the Environmental, Health and Safety (EHS) Guidelines originally developed by IFC.

The General EHS Guidelines (2007) apply to all projects and set specific minimum standards. They cover environment, occupational health and safety, community health and safety, and lifecycle impacts.

Sector specific EHS Guidelines have also been developed. The EHS Guidelines for Toll Roads includes:

General description of industry activities – design and construction phase, operation and maintenance phase;

Description of and management techniques for the specific impacts of the construction, operation and maintenance of large, sealed road projects including associated bridges and overpasses (excluding tunnelling);

Environmental issues – habitat alteration and fragmentation, stormwater, waste, noise, air emissions and wastewater;

Occupational health and safety – physical hazards, chemical hazards and noise;

Community safety – pedestrian safety, traffic safety and emergency preparedness;

Performance indicators and monitoring.

2.8.3 European Bank for Reconstruction and Development

EBRD's requirements for environmental and social assessment are set out in the EBRD Environmental and Social Policy (2008) which adds two additional performance standards to the IFC PSs listed above:

PS9 – Financial Intermediaries;

PS10 – Information Disclosure and Stakeholder Engagement.

EBRD has also published a set of sub-sectoral environmental and social guidelines, e.g. on road freight.

2.8.4 Equator Principles Banks

The Equator Principles Initiative, published in 2006, is currently being reviewed in line with changes in the IFC PSs and is due for re-issue in 2012. Over 70 financial institutions worldwide, including private banks, have adopted the principles.

The Equator Principles are as follows:

Principle 1: Review and Categorisation;

Principle 2: Social and Environmental Assessment;

Principle 3: Applicable Social and Environmental Standards;

Principle 4: Action Plan and Management System;

Principle 5: Consultation and Disclosure;

Principle 6: Grievance Mechanism;

Principle 7: Independent Review;

Principle 8: Covenants;

Principle 9: Independent Monitoring and Reporting;

Principle 10: Equator Principles Financial Institution (EPFI) Reporting.

These principles apply to projects where the loan is greater than US$ 10 million. Adherents are required to assess compliance with:

Applicable host country laws, regulations and permits;

If the host country is 'non-OECD' or not an OECD 'high income' country, the project is to comply with IFC PS 1-8 and IFC EHS Guidelines.

3 PROJECT DESCRIPTION INCLUDING DESIGN PARAMETERS

3.1 Background

Much of Montenegro's existing network of motorways and regional roads is characterised by narrow roads, steep slopes, absence of road shoulders or emergency lanes, tight curves, low radii and relatively high pavement degradation. These characteristics result in difficult and stressful driving conditions, low average vehicle speeds, higher vehicle operating costs and poor road safety, reducing Montenegro's competitive advantage against other transit corridors, and inhibiting economic development. Throughout the road network, as may be expected, existing residential, commercial and industrial development often occurs immediately adjacent to the roadside.

Part of Montenegro's motorway network lies on SEETO Route 4, which runs for around 600 km between Vatin (Romanian border) – Belgrade (Serbia) – Podgorica (Montenegro) – Bar (Montenegro). The Montenegrin portion runs for about 170 km from the Serbian border to the coast at Djurmani, where it intersects with SEETO Route 1, the Adriatic motorway. This 170 km also forms part of the European Road Number E65 from Malmo (Sweden) to Chania (Greece). The route is subject to significant seasonal tourist traffic, particularly from Serbia.

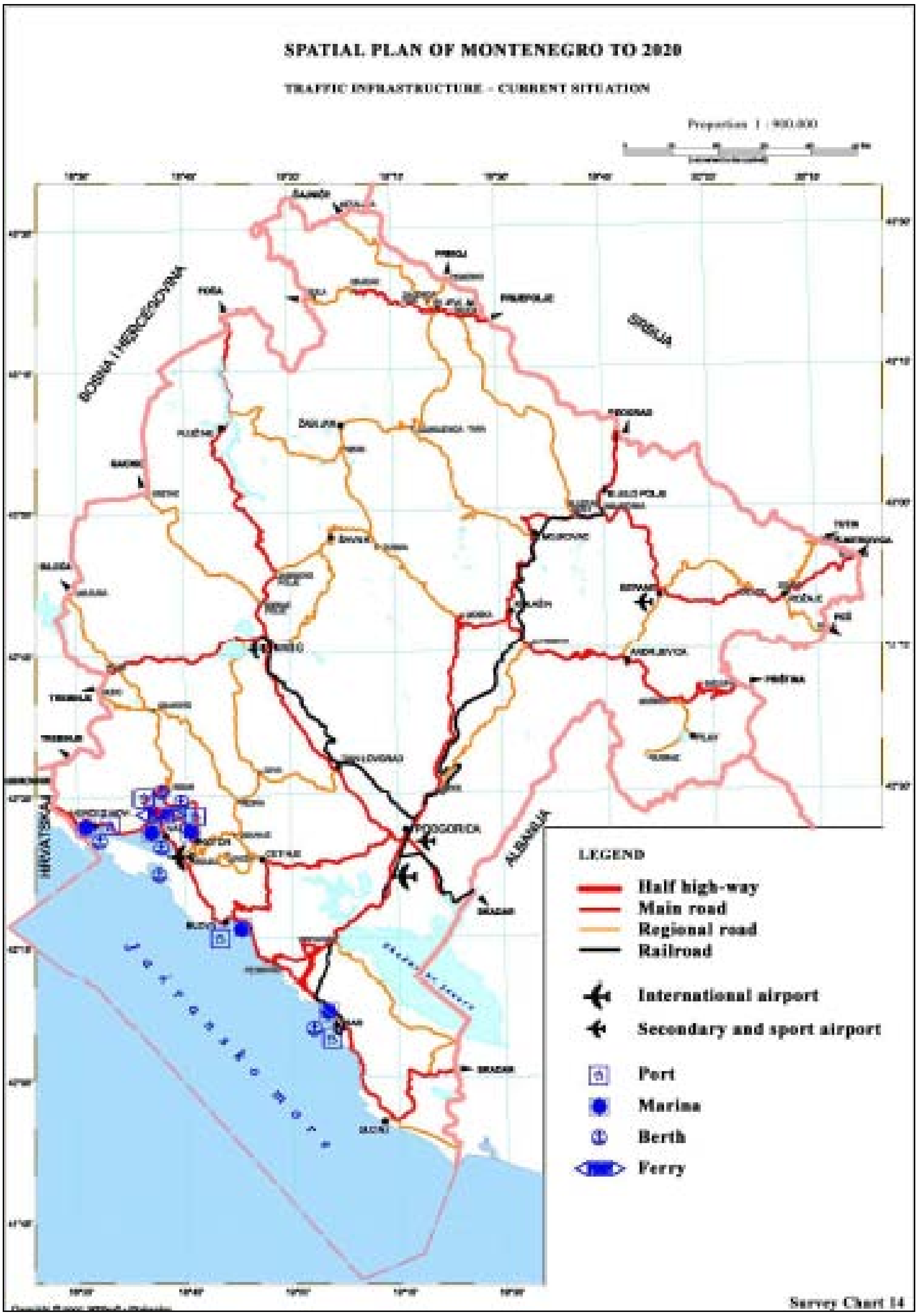
In the Podgorica area, in particular, most transit traffic passes through the city on urban roads leading to traffic congestion and traffic-related noise and air pollution, which affects a considerable proportion of the urban population. Recently a mini-bypass around the city has been constructed which is helping to alleviate traffic congestion. However, bottlenecks and delays are still experienced on a daily basis.

The main purpose of the proposed SEETO road route 4 is to increase Montenegro's competitive edge against other transit corridors in the region by improve road conditions and transit times for through traffic, and thus to stimulate economic development.

The Government of Montenegro wishes to develop an Investment Plan for the proposed SEETO Road Route 4. A multi-disciplinary consortium led by URS has been appointed to undertake the required motorway engineering, traffic, environmental, social and economic pre-feasibility studies.

The existing road network in Montenegroas recognised in the Spatial Plan is shown in Figure 3-1.

Figure 3-1: Montenegro - Traffic Infrastructure



3.2 General Design Standards

It is understood that the proposed SEETO road route 4 will be designed in accordance with the Trans-European North-South Motorway (TEM) Standards and Recommended Practice (3rd edn, 2002). TEM standards are applicable to a motorway which:

is specially designed and built for motor traffic and does not serve properties bordering on it;

is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other by a dividing strip (central reservation) not intended for traffic or, exceptionally, by other means;

does not cross at level with any road, railway or tramway track, or footpath;

is specially sign-posted as a motorway.

In addition, the motorway has:

hard shoulders of adequate width, on which no other than emergency stopping is allowed;

sufficient distance between interchanges;

is provided with its own police and maintenance services.

Where construction is undertaken in successive stages (phased construction), each section is to include the following:

full control of access;

hard shoulders or, in exceptional circumstances, lay-bys spaced at appropriate intervals.

TEM also recommends that there is:

complete side fencing of the motorway;

service are facilities provided in proportion to the volume of traffic.

The motorway should, wherever possible, avoid highly populated urban centres. Where urban areas are unavoidable, the location of connections to other routes should:

avoid city centres, business districts and residential zones in urban areas;

keep sections in urban zones as short as possible.

3.3 Environmental Design Standards

Integral to the TEM design standards are a number of measures to avoid and reduce potential environmental impacts.

Aesthetics and Landscape: The layout of the motorway must satisfy objective and universal aesthetic criteria from the viewpoints of the outside observer and, if possible, of the user. TEM recommends that motorway components (cuts, embankments, bridges, viaducts and overpasses) are architecturally designed so as to be integrated into the surrounding environment. For the user, TEM recommends that the layout of the motorway offers a succession of varied and pleasing landscapes, to avoid visual monotony.

Landscaping: Slopes of embankments and cuts should be protected from weathering by planting or sodding with a mixture of grass species and/or planting with appropriate species of bushes and trees. The use of leguminous species, fertilisers and geo-textiles may be required for plants to become established. The maintenance requirements of vegetation should be taken into account from the design stage.

Drainage Control and Pollution Prevention: The natural runoff pattern existing prior to construction must be maintained by constructing culverts, underpasses, bridges and drains as necessary.

Diversion of watercourses during the construction stage should be avoided as much as possible. Drainage runoff from the motorway and associated structures must be controlled to avoid erosion and prevent pollution.

In order to avoid polluting watercourses, contaminated runoff from the motorway should be collected and treated by measures such as:

Monolithic sedimentation reservoirs which use gravitational processes and (where necessary) sorption filters to separate out sediments, pollutants and oil products ;

Natural catchment basins (sedimentation lakes) located within or adjacent to natural water courses;

Biological purification using earth filters or artificial swamps;

Oil sorption filters.

Erosion Prevention: Any deforestation must be compensated for by replanting trees and seeding grasses along the sides of the embankments (or cuts). Appropriate means for controlling runoff must be installed.

Animal (Livestock and Wild Animal) Control: Fencing, usually consisting of a tight metal mesh, should be installed at the edges of the motorway property. The fence height should vary from a minimum of 1.5 m to a maximum of 2.5 m on sections characterised by heavy snowfall and greater numbers of animals. Where considered necessary, suitably sized and shaped overpasses and underpasses for animals may be required.

Anti-Noise Measures: The motorway must be located as far as possible from buildings in urban zones, and in any case far enough to avoid noise levels outside buildings greater than permitted by the legislation in force in the relevant country. TEM recommends that long, steep gradients and the use of rigid facings on side slopes are avoided where possible. Measures recommended by TEM to minimise noise impacts on residential zones include: covering embankment slopes with soil; noise screens, barriers and mounds; plantations (to reduce the perceived nuisance of traffic noise); speed limits for commercial vehicles.

Anti-Vibration Measures: Measures recommended by TEM to reduce vibration impacts on sensitive buildings include: the use of flexible pavements instead of rigid pavements; effective drainage, frost protection and timely repair/replacement of the road surface.

Anti-Air Pollution Measures: The motorway must be designed to avoid any situations of recurrent traffic congestion.

Road Lighting: Appropriate road lighting must be provided in the vicinity of brightly lit urban zones, at service areas, any toll station plazas and border crossing areas. TEM also recommends that lighting is provided on interchanges.

Tunnels: In rough terrain, traffic flow may be improved by the use of tunnels. Tunnels must be appropriately located, designed, drained, ventilated, lit and provided with safety features.

Safety Barriers: Safety barriers are to be installed at the edges of carriageways to prevent out-of-control vehicles from leaving the motorway. The need for installation is assessed on the basis of location, traffic volume and traffic flow composition.

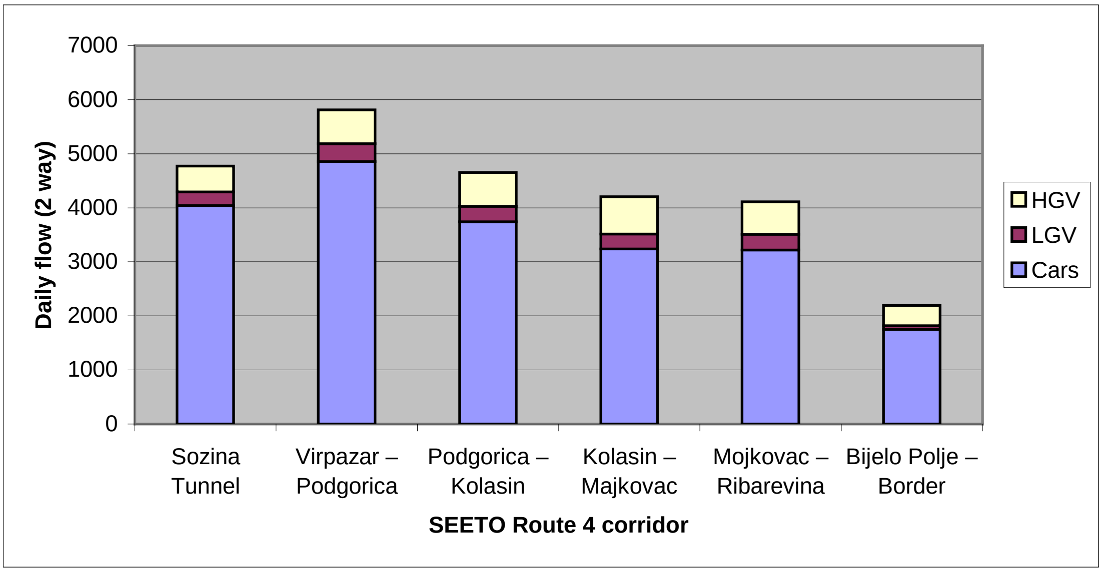
3.4 Traffic Volumes

Average annual daily traffic flow (AADT) for cars, light goods vehicles (LGV) and heavy goods vehicles (HGV) on the SEETO 4 route have been calculated on the basis of the Department of Transport data and automatic traffic counts at 23 sites on the Montenegro road network.

Overall the AADT traffic volumes are low, ranging from: 192 vehicles per day (97% cars, 2% LGV, 1% HGV) on the Mateševo-Kraljske Bare section to 4,654 vehicles per day (80% cars, 6% HGV, 13% HGV) between Podgorica and Kolasin, and 5,812 vehicles per day (84% cars, 6% LGV, 11% HGV between Virpazar and Podgorica.

The 2012 AADT volumes on the SEETO Route 4 corridor are shown in Figure 3-2. It can be seen that the volumes are around 4,000 vehicles. There is a clear pattern with traffic volumes reducing moving away from the coast and Podgorica, with volumes dropping to 2,000 vehicles close to the Serbian border.

Figure 3-2: 2012 AADT volumes on SEETO Route 4 corridor



Traffic volumes across Montenegro are low and do not warrant the need for a Dual 2 road design in their current state. This does not mean that the need for safety improvements and, for example, overtaking/climbing lanes are not required, as it can be seen that a high proportion of traffic tends to be HGV.

3.5 'Footprint' of SEETO Route 4 Motorway

The alternative alignments for the proposed motorway are shown in Figure 1-1 and discussed in some detail in Chapter 5. The length and 'footprint' of the various alternatives are detailed in Table 3-1. The values show the 'real land' that would be occupied by the proposed road works: the areas between the left and right edgelines of cuts and fills. It does not include other areas occupied temporarily or permanently by the works, e.g. borrow areas, spoil dumps, works depots, related facilities including rest stops, petrol stations and motels.

Table 3-1: Area Occupied by the Motorway

Alternative	**I-2**	**I-3**	
Road Length	4.0 km	4.3 km	
Open Road	7.00 ha	10.20 ha	
Bridges	6,343 m^2	748 m^2	
Alternative	**II-1**	**II-2**	
Road Length	20.3 km	22.6 km	
Open Road	105.15 ha	73.96 ha	
Bridges	73.0 ha	43.46 ha	
Alternative	**III-1**		
Road Length	9.5 km		
Open Road	51.9 ha		
Bridges	21.6 ha		
Alternative	**IV-1+III-2**	**IV-2**	
Road Length	31.7 km	27.6 km	
Open Road	157.72 ha	153.84 ha	
Bridges	136.5 ha	136.5 ha	
Alternative	**V-1**	**V-2**	
Road Length	17.1 km	18.0 km	
Open Road	95.72 ha	97.55 ha	
Bridges	54.6 ha	30.7 ha	
Alternative	**VI-2**	**VI-3**	**VI-4**
Road Length	22.6 km	22.4 km	21.3 km
Open Road	98.7 ha	99.04 ha	91.35 ha
Bridges	11.9 ha	11.9 ha	0.61 ha
Alternative	**VII-1**	**VII-2**	**VII-3**
Road Length	23.3 km	29.3 km	21.8 km
Open Road	113.7 ha	95.79 ha	71.29 ha
Bridges	22.7 ha	26.3 ha	24.1 ha

In order to calculate the maximum amount of land lost due to road construction (excluding other temporary or permanent land take), the alternatives with the greatest areas of open road have been selected: I-3, II-2, III-1, IV1+III-2, V-2, VI-3 and VII-1. These alternatives give a total road length of 129.5 km, an area of permanent land loss under road of 635.26 ha and an area of permanent/temporary land loss under bridges (depending on their size, construction and what they are being built over) of 298.48 ha.

4 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Social Baseline

The Strategy for Socioeconomic Development of Podgorica (2011) anticipates the SEETO Road Route 4 will strengthen economic life and connectivity of Bar, Podgorica, Koasin, Andrijevica, Berana and Bijole Polje and many rural settlements, with the following inter-related benefits in terms of social development:

- Reduced depopulation of the north through migration;
- Increased development of regional centres and towns (Bar, Berane, Bijelo Polje, Kolasin, Andrijevica);
- Development of commercial agriculture through better market links;
- Development of the hospitality, tourism, recreation and other service industries.

The draft Multi-annual investment plan for the Municipality of Berane 2010-2014 (April 2010) sets out specific areas of development potential in this part of the country, promotion of which it is anticipated would reverse declines in local industry, agriculture, population and living standards that have been experienced in recent decades. These include:

- Mining/quarying (of brown coal, clay, stone, granite etc)
- Crop, fruit and livestock agriculture and agro-processing
- Forestry and wood processing
- Non-timber forest products
- Fisheries
- Eco-tourism
- Mini hydro-power.

Any improvements in regional development that are catalysed by the SEETO Road Route 4 will be realised in conjunction with the ongoing adoption of appropriate policy, technical and capacity-building building measures, including adoption of market-based instruments, improved capital markets, clarity on real estate holdings, and education and training of the population.

General characteristics and trends of the Montengrin population and economy are described in detail in earlier project (and project-related) documentation, in particular the SEA for the project and the Detailed Spatial Plan for Montenegro. This section sets out broad areas in which social impacts of the project may be experienced and therefore mitigated (where appropriate) and monitored, including in relation to vulnerable sections of the population, and provides and outline of the following:

- Population
- Health
- Education
- Employment
- Agriculture
- Poverty
- Social Protection

4.1.1 Population

According to the 2011 Census of Population, Households and Dwellings in Montenegro, the total population of the country is 620,029, of which 49% is male and 51% is female.

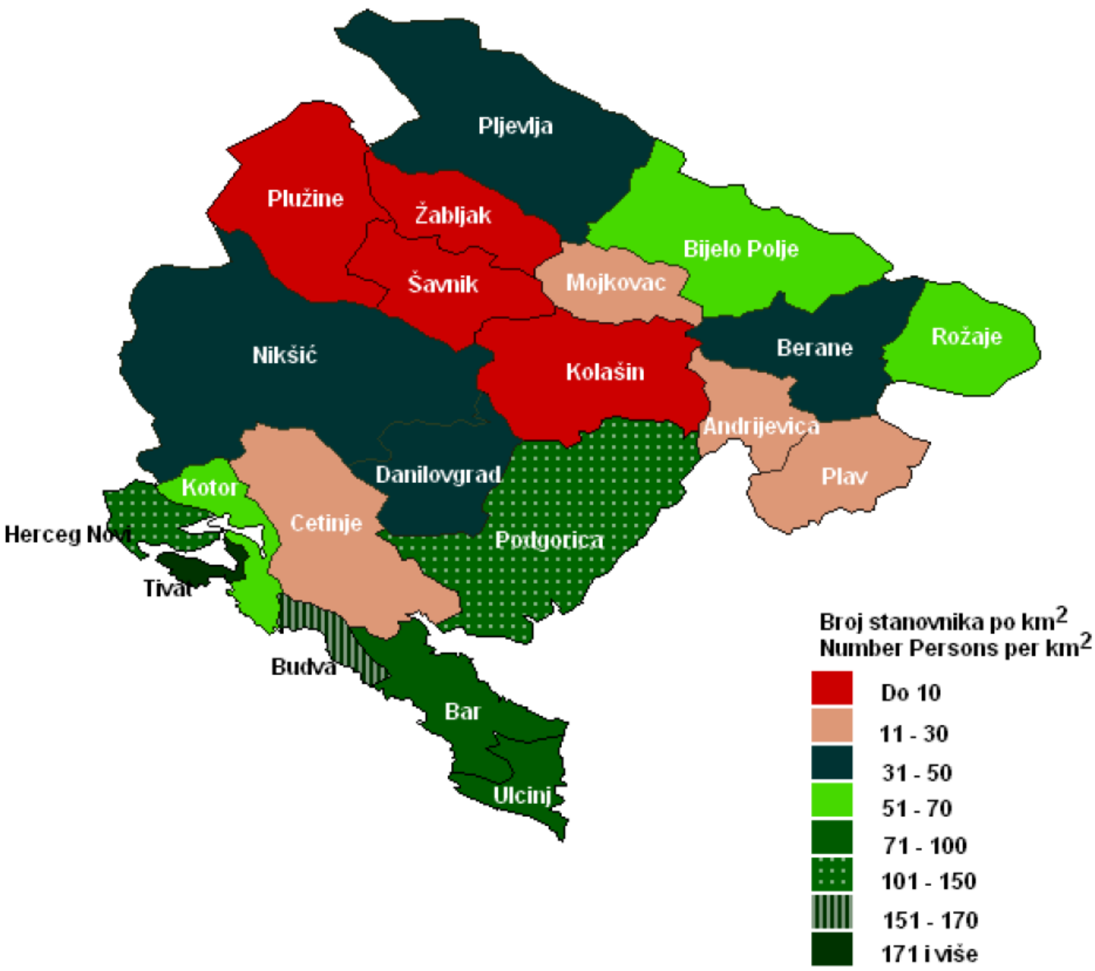
Of this, the populations of the municipalities through which the project road will be constructed are as follows:

Municipality	Population
Bar	42,048
Podgorica	185,937
Andrijevica	5,071
Kolasin	8,380
Berane	33,970
Bjelo Polje	46,051

Source: Monstat

Figure 4.1 below shows the population densities of the municipalities.

Figure 4.1 **Population Densities of the Municipalities of Montenegro**



With the highest population Podgorica municipality is also the most densely populated of the five affected municipalities; Kolasin and Andrijevica municipalities are the least densely populated.

Relative population densities have implications for the likely scale and concentration of social impact (particularly from land expropriation) and associated mitigation and compensation measures, by location.

4.1.2 Ethnicity

Montenegro is an ethnically diverse country, the following groups identified in the 2011 Census:

- Montenegrin
- Serb
- Bosniak
- Albanian
- Muslim
- Croat
- Bosnian
- Bosniak-Muslim
- Montenegrin-Muslim
- Montenegrin-Serb
- Egyptian
- Gorani
- Italian
- Yugoslavian
- Hungarian
- Macedonian
- Muslim-Bosniak
- Muslim-Montenegrin
- German
- Roma
- Russian
- Slovenian
- Serb-Montenegrin
- Turkish
- Other.

It is possible that project impacts will be felt differently by members some ethnic groups in comparison with others. For example, it may be that Roma (and/or other) populations and some internally-displaced people are more at risk of land expropriation impacts due to their poverty status and given that a greater proportion of them live in homes that are non-registered.

The following table shows Roma populations in each of the project-affected municipalities, with notably relatively high concentrations in Berane and Bjelo Polje (although it is not clear yet whether there will be any Roma people directly impacted by the project).

Municipality	Total Population	Roma Population
Andrijevica	5071	2
Bar	42048	203
Berane	33970	531
Bjelo Polje	46051	334
Kolasin	8380	0
Podgorica	185937	3988

Source: Monstat

A similar level of diversity as found with ethnicity exists in relation to religion and mother tongue; the project will need to ensure that any differential impacts and risks are identified and addressed accordingly.

4.1.3 Health

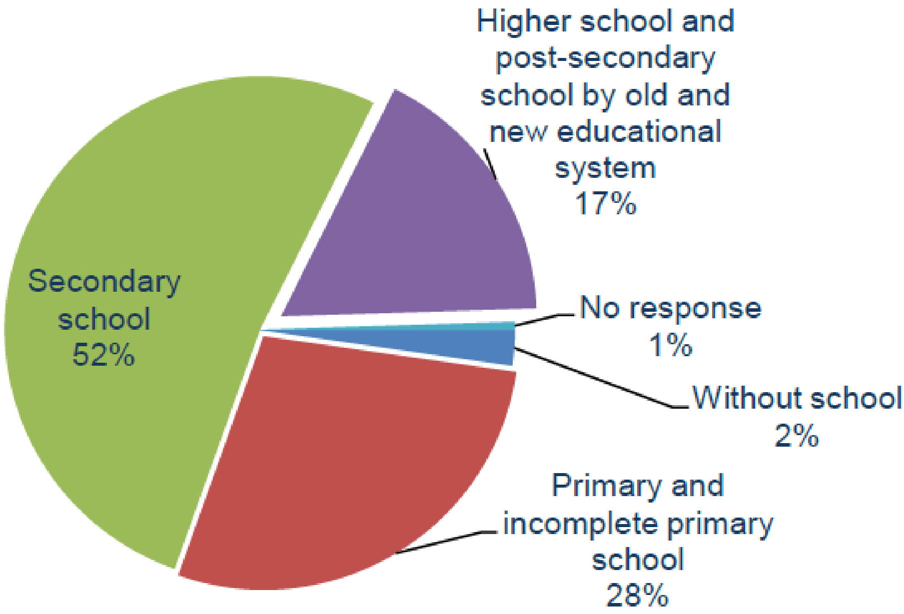
According to the population census of 2011, 11% of the population has disabilities – including 5% with impaired mobility, 2% with impaired sight, 1% with impaired hearing, 1% with cognitive illnesses, 4% with other disabilities. 6% of the population were recorded as having an illness.

Of the project Municipalities, the highest percentages of people with disabilities are in Bjelo Polje and Kolasin (14.1% and over – compared with Podgorica, less than 10%).
Households with sickness or disabled members may be considered to be vulnerable to project impacts.

4.1.4 Education

Figure 4.2 below illustrates education levels attained in Montenegro.

Figure 4.2 Education Levels of Montenegrin Citizens



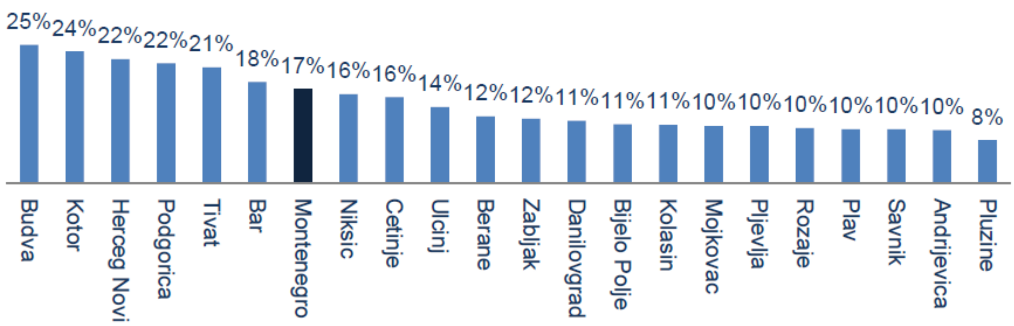
Source: Monstat

According to Monstat, the average age of population with secondary school-level of education (excluding those currently attending school) is 44 years, and the average age of persons with primary school as the highest level completed is 56. The highest level of education is among the age group 25 to 29 years, of which 28% of population has a university education.

By implication, large sections of the rural population of Montenegro, who are known to be elderly, are also disadvantaged in terms of their level of education compared to younger generations.

Figure 4.3 illustrates the percentages of people holding higher education qualifications by municipality.

Figure 4.3: Percentage of population with higher education, by municipality

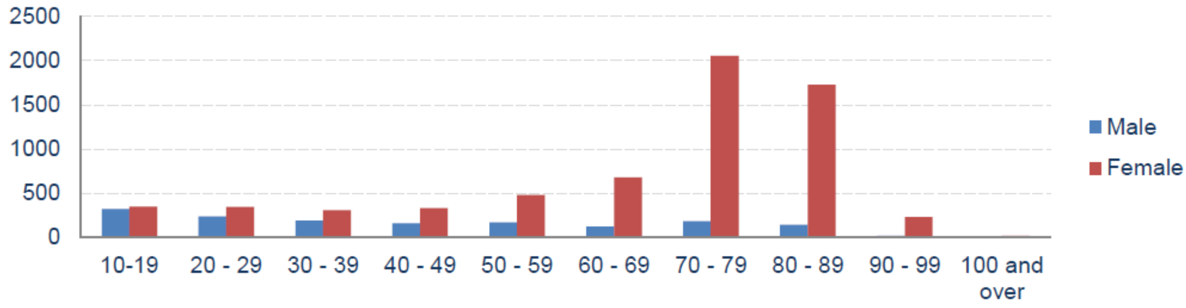


Note that the northern municipalities of Berane, Bjelo Polje, Kolasin and Andrijevica all have below-average proportions of people with higher education, probably reflecting a 'brain drain' of the youth to the centre of the country.

Illiteracy

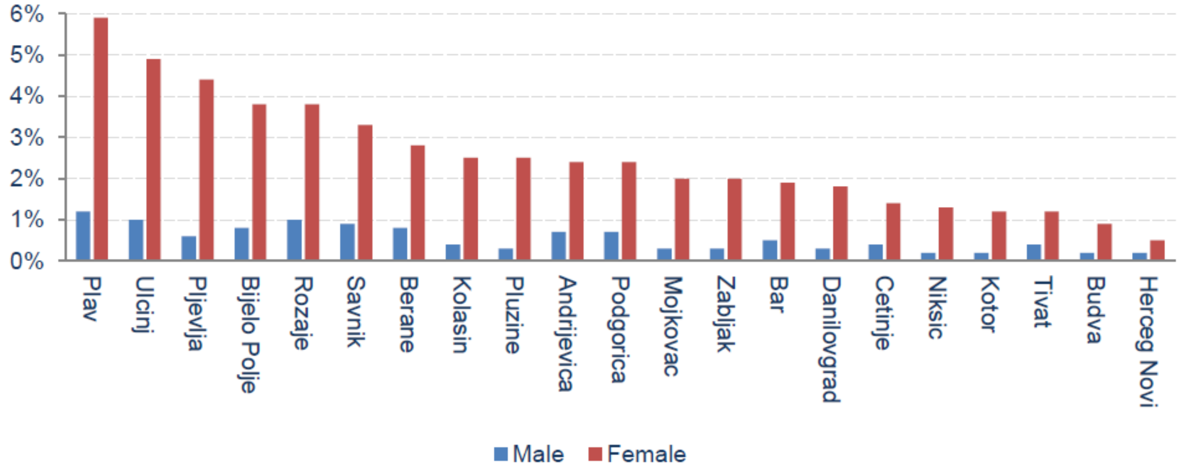
According to the 2011 Census, 1.5% of the population aged over 10 years old is illiterate with an average age of 62 years. The majority of illiterate people are women, with ratios significantly increasing with age, as shown by figure 4.4 below.

Figure 4.4: Illiterate persons by age and sex



Illiteracy rates also vary by municipality, with Berane, Bijelo Polje and Kolasin Municipalities all having higher rates than Podgorica and Bar, as illustrated by figure 4.5 below.

Figure 4.5 Illiteracy Rates by Municipality



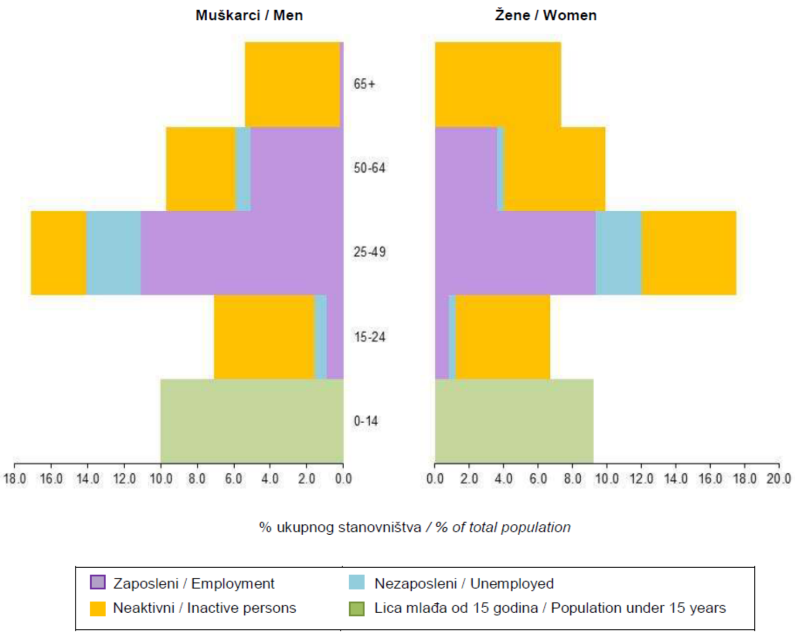
Literacy has significant implications in terms of vulnerability and of managing project impacts, engagement and communications with affected populations.

4.1.5 Employment

According to labour force survey data for the first quarter in the 2012, unemployment was at 20.7% (representing an increase of 17.2% compared with the previous quarter).

Figure 4.6 below shows employment activity by sex and age group. As can be seen, women make up a greater proportion of the "inactive" population than men (smaller percentages of unemployed women between the ages of 15 and 64 probably reflects this). A greater proportion of men are in employment, and men work until an older age (officially that is; much of women's work in all age groups is not paid and thus goes unrecorded).

Figure 4.6 Activity by Sex and Age Groups, Montenegro 1st QUARTER 2012



4.1.6 Agriculture

Age and Gender Balance in the Agricultural Employment

A total population of 98 949 is employed on agricultural holdings of which 60% are men and 40% are women. 24% of the total agricultural labour force are aged 65 and over. 7% are aged 24 years and younger.

These statistics reflect migratory trends in the country, where young people are leaving agriculture for employment in the central and southern regions. The higher percentage of men than women in the agricultural workforce probably reflects, in part, the fact that much of women's work is unpaid and therefore uncounted.

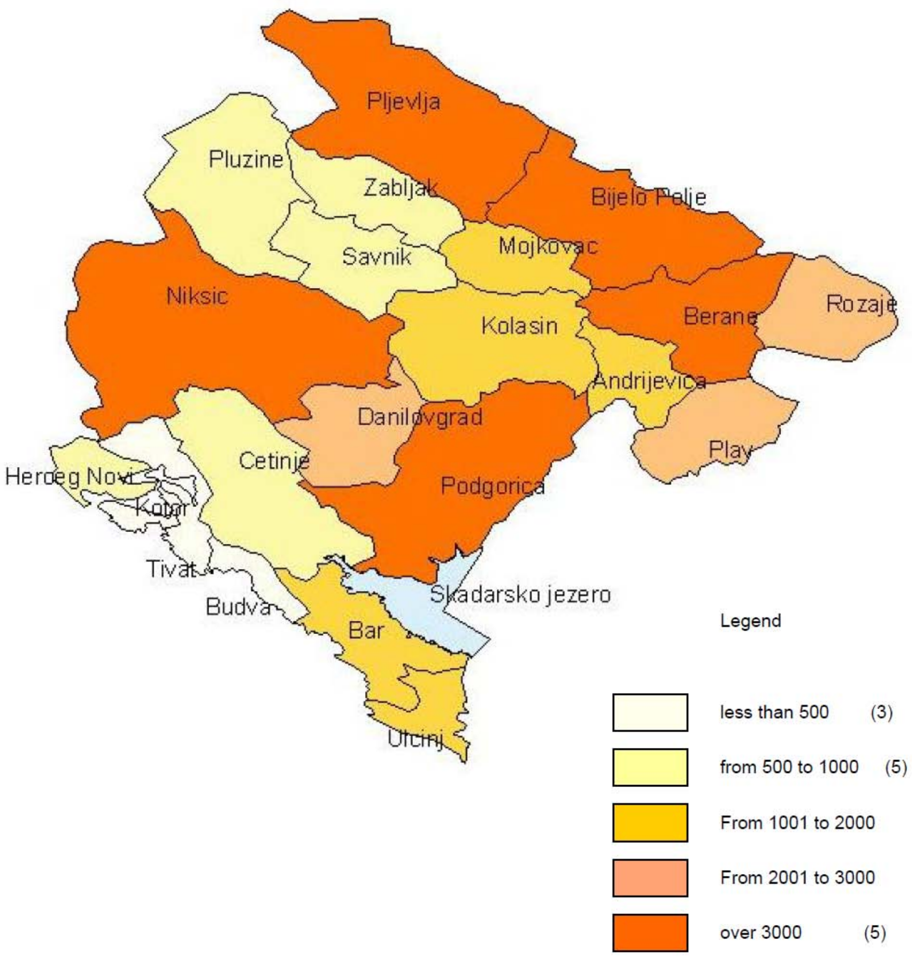
It will be important to assess the extent to which the project influences migratory trends and the development of agricultural economy in the country. It could be positive northern populations are able to 'commute' (for employment and trade) rather than migrate to the centre and south due to quicker transport links, and thus become more able and inclined to invest in their places of origin; and as people from the centre and south of the country travel north more frequently for leisure or investment (for example in tourism or property).

According to the 2010 Agricultural Census, 95% of all farmed land in Montenegro is held in family agricultural holdings. The average family agricultural holding has 6.0 ha of total available land of which an average of 4.6 is utilised.

From a project perspective, this reflects the fact that a significant percentage of the family-held agricultural land to be expropriated is likely to be under-utilised.

Figure 4.7 below shows the number of family agricultural holdings by municipality, revealing relatively high numbers in the municipalities of Podgorica, Berane and Bijelo Polje (over 3,000), and moderate numbers in Kolasin and Andrijevica (1001-2000).

Figure 4.7 Number of family agricultural holdings by municipalities:



Source: Agricultural Census 2010

Crops

According to the 2010 Agricultural Census, the area of utilised agricultural land area on family agricultural holdings is 72.2% of the total available land and the average area of utilised agricultural land area per family agricultural holding is 4.4 ha. Other land categories, such as kitchen gardens, vineyards, orchards, and nurseries, together comprise slightly less than 4%.

Primary crops farmed on arable land are cereals (31%, mainly maize), fodder (24%, mainly clover) and potato (22%). Potato is the crop most prevalently cultivated in kitchen gardens.

Other significant vegetable and fruit crops include water watermelon, cantaloupe, tomatoes, pepper, particularly around Podgorica3.

The majority of utilised agricultural land comprises meadows and pastures (96%).

Orchards

91% of the area covered by orchards is in family agricultural holdings, 65% of which is continental fruit, 20% is olive grove and 15% is citrus.

Vineyards

According to the Census of Agriculture 2010, approximately 87% of vineyard area is owned by commercial entities, and approximately 13% by family agricultural holdings. 81% of vineyards are located in Podgorica.

Over 87% of total vineyard area is appellation grape varieties. 5% is for table varieties and 8% comprises of other varieties.

Livestock

Livestock breeding is an important agricultural activity in Montenegro as can be seen from the following statistics from the 2010 Census of Agriculture:

- 67% of agricultural holdings (96% of which are family holdings) are engaged in livestock breeding, of which:
    - 75% breed cattle, of which 98% are in family agricultural holdings and 64% are diary. The average number of cattle per holdings is 3.3 head.
    - 19% breed sheep, of which 99% are in family agricultural holdings and 57.5% are dairy. The average number of sheep per holding is 37.6.
    - 11% breed goats of which 60% are dairy. The average number of goat per agricultural holding is 10.

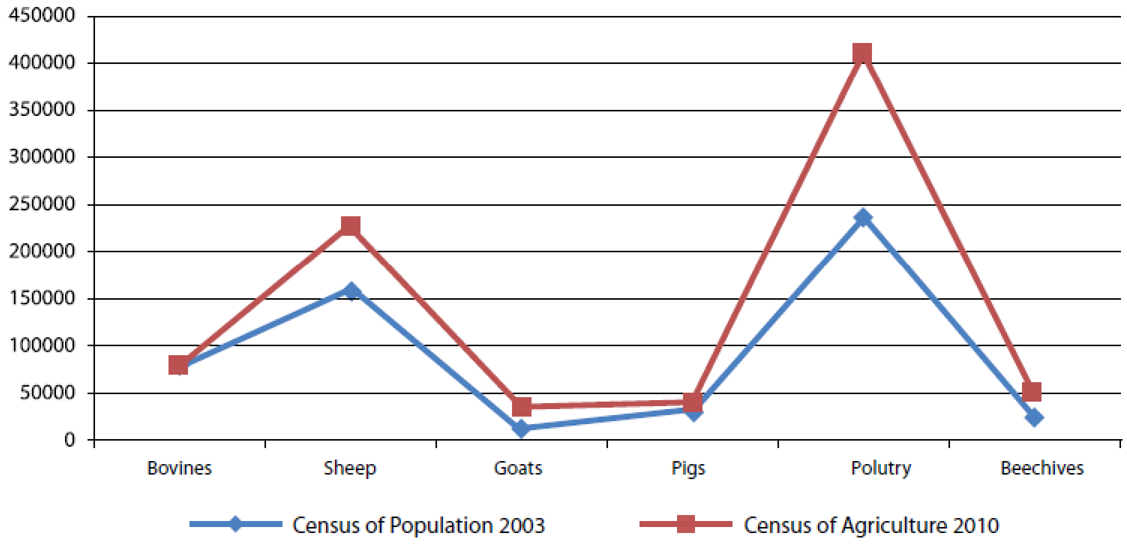
- 13,469 holdings keep pigs, 3.5% of which are breeding sows. The average number of pigs per holding is 3.5.

66% of poultry are in family agricultural holdings (average 25 head/holding), with approximately 38% raised by commercial ventures (average 23,310/holding).

Comparing data from the 2010 Census of Agriculture with the data from the 2003 Census of Population, it can be seen that the number of livestock reared on family agricultural holdings has increased significantly in recent years (with the exception of cattle, which decreased by over 2%): sheep (42.3% increase), goats (158% increase); pigs (37%); poultry (74%); and beehives (104%).

[3] Strategy for Socioeconomic Development of Podgorica (2011)

Figure 4.8 Number of livestock by types, poultry, and beehives on family agricultural holdings



Source: 2010 Agricultural Census

This suggests that potential project impacts on livestock husbandry (such as grazing, animal safety and access) should be carefully considered.

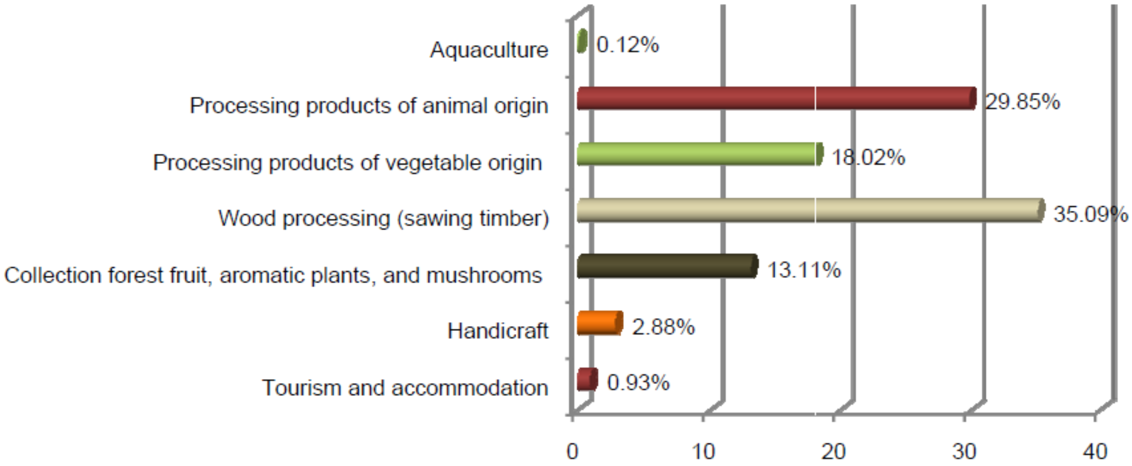
Other Livelihood Activities

According to the Census of Agriculture 2010, there is considerable diversity of economic and livelihood activities carried out by households of agricultural holdings in Montenegro, in addition to simple agricultural production, both on the holding itself and elsewhere, including the following:

- Tourism and accommodation
- Handicraft production
- Collection of non-timber forest products (fruits, herbs, mushrooms etc)
- Packaging of agricultural produce (crop, animal)
- Aquaculture (fish, molusc, crayfish and water plants)
- Wood processing (sawmill)
- Hairdressing
- Grocery shops
- Accountancy
- Education

Figure 4.9 illustrates the proportion of ‘extra’ activities carried out on the agricultural holding itself.

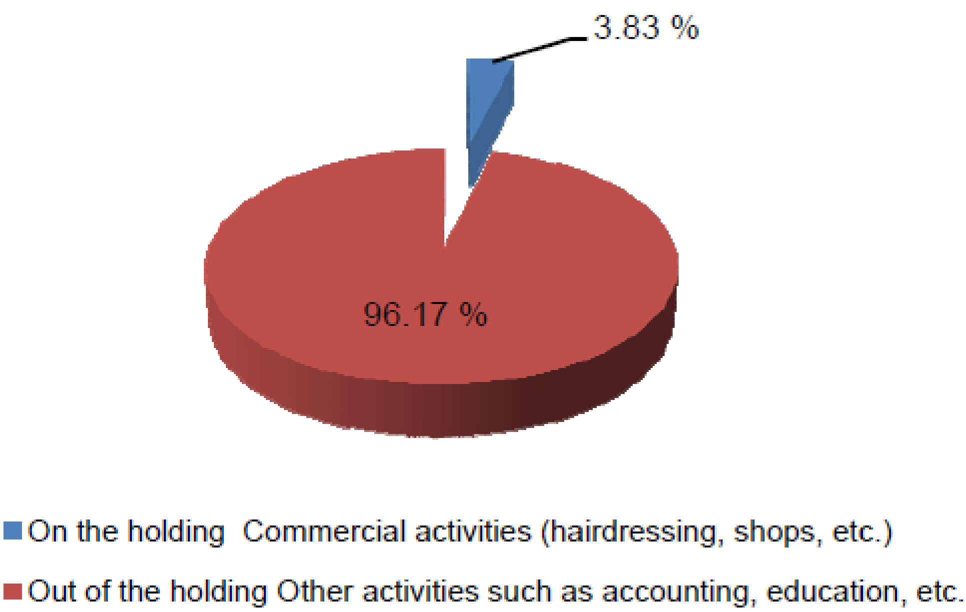
Figure 4.9: Additional Livelihood Activities Carried Out on Agricultural Smallholdings In Montenegro



Source: 2010 Census of Agriculture

Notably, the majority of ‘extra’ activities are not located on the agricultural holding itself, as showing in figure 4.10 below, which probably reflects greater opportunity (and income) in non-agricultural areas of activity and increasingly towards urban areas.

Figure 4.10: Proportion of ‘Extra’ Livelihood Activities Carried Out ‘On’ and ‘Off’ the Agricultural Holding



Source: Monstat

The significance of this livelihoods diversity to the project is in recognising that livelihood strategies are diverse, which in turn affects how impacts will be felt and adjusted to at household level between households – for example in relation to expropriation of agricultural land where those households who depend on the land as their primary source of income or subsistence may feel its effects more greatly than those who have other income streams.

Agricultural Development Initiatives
The agricultural sector is regarded by the Government as primary sector for development, alongside tourism, and has received support in the following areas:

- Investment in fruit, vegetable, herbs and berries processing plants
- Increasing loan credit for agricultural investments
- Training and extension
- Subsidised Livestock Improvements
- Support to senior citizens working in agriculture
- Registration of winemakers

Forestry

The Strategy for Socioeconomic Development of Podgorica (2011) describes the importance of forests to the economy and local livelihoods in Montenegro. Forests and forest land cover an area of approximately 738,000 ha, or about 53.4% of the total area. 60% of the population is connected to villages and areas that are rich in forests. Forest products (timber and non-timber) provide fuel, building materials and opportunities for recreation and tourism, thus providing a basis for the development of entrepreneurship and employment creation.

4.1.7 Poverty

According to Monstat Release 'Poverty Analysis in Montenegro in 2010' (December 2011), the absolute poverty line for Montenegro in 2010 was €169.98 per adult. In 2010 6.6% of the population had equivalent consumption below the absolute poverty line, with higher poverty risk and severity in rural areas in comparison with urban population.

There are significant differences in the extent of poverty in the region between the North and other parts of the country. Table 4.1 shows that the poverty rate in North region is almost double higher than poverty rate in the Central region and four times higher than that of the Southern region. The poverty rate in the northern region was 10.3% in 2010, with 28.9% of the total population of Montenegro, but also 45.2% of all the poor.

The poverty rate in Central region is 5.9%, and in the south 2.6%.

Table 4.1 Poverty Estimations by Geographic Areas, 2010:

Regions	Poverty rate	Relative poverty risk	Share of the poor	Share of total population
North	10.3%	1.56	45.2%	28.9%
Center	5.9%	0.89	47.9%	53.6%
South	2.6%	0.39	6.9%	17.5%

Table 4.2 shows illustrates the higher poverty rate in rural areas compared with urban areas. In urban areas poverty rate in 2010 was 4.0%, while in rural areas it was 11.3%. 60.5% of the poor population lives in rural areas.

Table 4.2 Poverty Risk by Location, 2010

	Poverty rate	Relative poverty risk	Share of the poor	Share of total population
Urban areas	4.0%	0.61	39.5%	64.7%
Rural areas	11.3%	1.71	60.5%	35.3%

Factors found by the report to significantly correlate with poverty include the following:

- Unemployment and "inactivity", particularly for heads of household
- Level of education, particularly for heads of household
- Size of household (larger households have higher poverty risk)

4.1.8 Social Protection

The Strategy for Socioeconomic Development of Podgorica (2011) provides an overview of the operation of the social protection system in Montenegro, particularly in the capital. The primary purpose of the system is the provision of minimum social security to poor and vulnerable groups, making it the most important mechanism for alleviating the worst consequences of poverty.

Beneficiaries of the social protection system include: children without parents; educationally neglected, and neglected children; children whose development is hindered by family circumstances; disabled persons and persons with difficulties in psychological and physical development; persons without income; handicapped persons; elderly people without family care; people with socially unacceptable behaviour; and families in need, which due to special circumstances require an appropriate form of social and child protection.

Social protection policy and strategy is captured in a number of key documents, including the following:

- "Strategy for Social and Child Protection in Montenegro for the period 2008-2012," (2007)
- "Strategy for the Development of Social Protection of the Elderly in Montenegro, 2008-2012," (2007),
- Alleviation of poverty and social exclusion" (2007),
- National Strategy for Resolving Issues of Refugees and Internally Displaced Persons (2005-2008)",
- National Action Plan for the Decade of Roma, Ashkali and Egyptians in Montenegro "(2007)"
- Strategy for the Integration of Persons with Disabilities in Montenegro "(2007).

It will be important to draw on the experience and resources of social service providers in identifying and addressing the needs of vulnerable groups who may be impacted by the development of the SEETO Route 4 project.

4.1.9 Affected Settlements

This section identifies the settlements along the route which are likely to be affected by the project. A more precise identification of settlements located within approximately 500 m either side of the proposed route alternatives is presented in Chapter 5 Assessment of Alternatives.

1. Djurmani-Smokovac

The Djurmani-Smokovac corridor[4] covers an area of around 450 m^2, approximately 50 km long, including:

Bar: whole cadastral munipalities of Čanj, Sutomore, Mišići, Zankovići, Sozina, Gluhi Do, Limljani, Bukovik, Sotonoći, Bojevici, Brijege, Orahovo, Dupilo, Virpazar, Popratica, Brdani and Komarno;

Cetinje: part of cadastral municipality Čukoviči and whole cadastar municipalities of Dodoši and Žabljak;

Podgorica: whole cadastral municipalities of Vranjina, Bijelo Polje, Gostilj, Vukovici, Mahala, Gulobovci, Grbavci, Cijevna, Goljemadi, Botun, Lijesnje, Donji Kokoti, Dajbabe, Draževina, Beri, Farmaci, Donja and Gornja Gorica, Podgorica 1, 2 & 3, Baloci, Tološi, Velje Brdo and Rogami.

2. Smokovac-Mateševo

The Smokovac-Mateševo corridor extends over an area of around 350 m^2, approximately 40 km long, including:

Podgorica: whole cadastral municipalities of Dojani, Cerovice, Durkovici, Radeća, Mrke, Bioći, Ubli, Blizna, Momće, Klopot, Pelev Brijeg, Bolje Sestre, Lutovo, Duške, Brskut, Stupovi, Lijeva Rijeka, Grbi Do, Slacko, Lopate, Veruša, Trebešnica and part of the cadastral Opasanica;

Kolašin: whole cadastral municipalities of Kosa, Jabuka, Donja Tara, Padež and Mateševo.

3. Mateševo-Bojare

The Mateševo-Boljare corridor covers an area of around 600 m^2, approximately 70 km long, including:

Kolašin: whole cadastral municipalities of Sunga, Kraljske Bare and Vranještica;

Andrijevica: whole cadastral municipalities of Oblo Brdo, Kralje, Andrijevica, Bojovići, Gnjili Potok, Sjenozeta, Slatina I, Seoce, Slatina II, Zabrde, Trešnjevo I, Rijeka Marsenića, Trešnjevo II and Trepča;

Berane: whole cadastral municipalities of Vinicka I and II, Donja Rženica, Buče I and II, Pešca, Lužac, Donja Luge, Petnjica, Crni Vrh, Dolac, Berane, Budimlje, Zaostro, Polica, Bubanje, Štitari, Poda and Lozna;

Bijelo Polje: whole cadastral municipalities of Crnce Laholo, Radulovići, Kradenik, Goduša, Dubovo, Ivanje, Godijevo, Sipanje, Boljanina and part of the cadastral municipality Korita.

A more detailed analysis of settlements located within 500 m of the existing roads and proposed new alternative road alignments is presented in Chapter 5 Assessment of Alternatives.

[4] Based on a zone 1 km either side of the Bar-Boljare alignment proposed in 2008

4.2 Flora and Fauna (including Biodiversity)

According to the Introductory Report on Nature Conservation[5], Montenegro's diversity of geology, landscapes, climate types and soils, and its position on the Balkan Peninsula and Adriatic Sea, have created conditions for the development of a highly diverse biodiversity, making Montenegro one of the biodiversity 'hot spots' of Europe and the world.

Montenegro has a very wide range of ecosystems and habitat types for a country of its size. Flora and fauna occur in zones from the cold mountainous north and south to the warm Mediterranean coast to the west. Biodiversity is also influenced by the presence of Alpine flora and fauna on tops of coastal mountains, and by the intrusion of warm air and elements of Mediterranean flora and fauna through river valleys and canyons into the mountains.

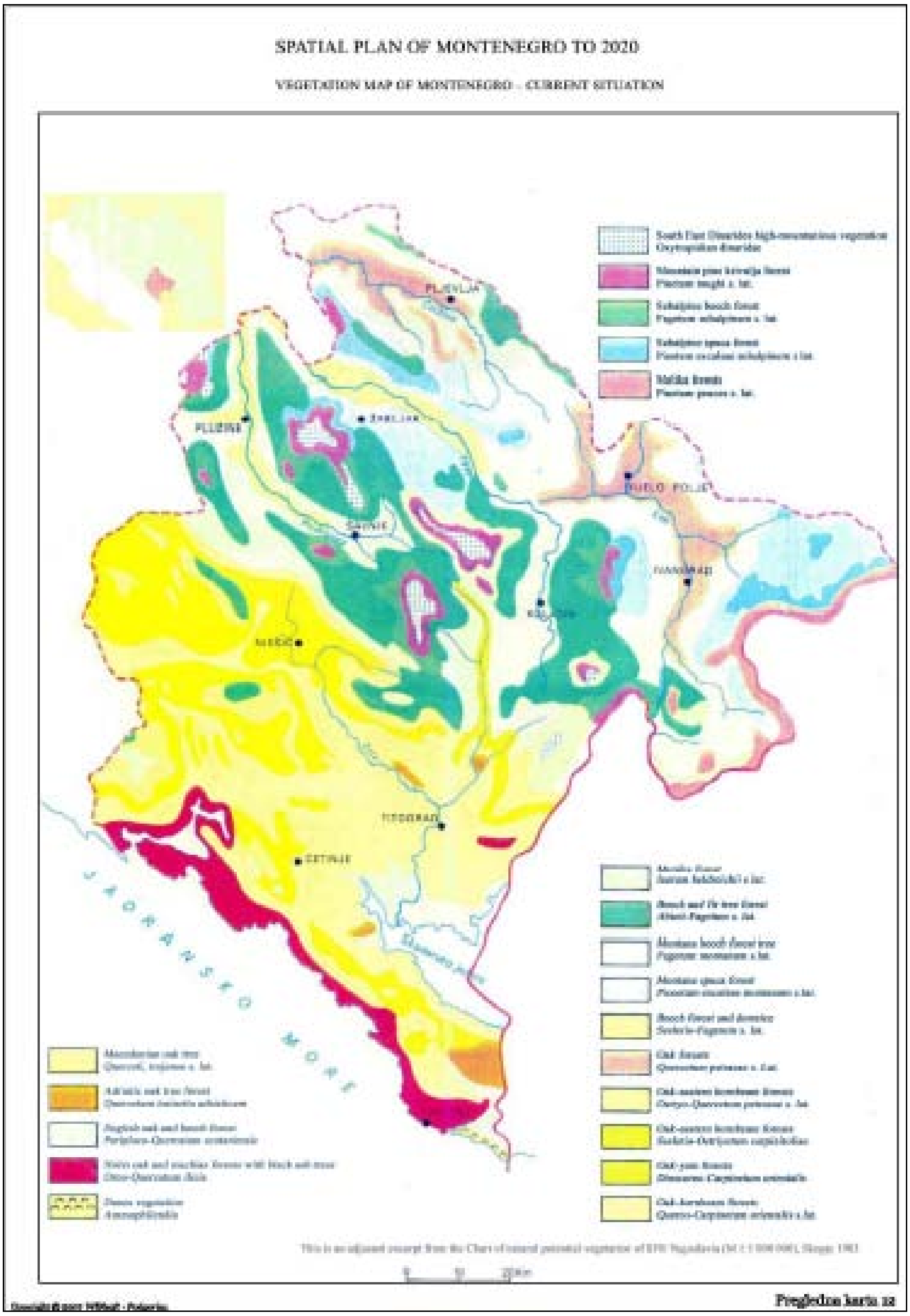
During the last (Quaternary) Ice Age, a significant part of today's flora and fauna survived the glaciations and both 'glacial relicts' and remnants of older tertiary flora and fauna are found in sheltered warm river valleys and canyons. Consequently, there is considerable endemism[6] in Montenegro.[7]

There is no formal, widely recognised classification of ecosystems but the following types can be distinguished: alpine, forest, dry grassland, freshwater and marine. Other distinctive types of habitat occur: coastal, karst, caves and canyons.

Figure 4-11, from the Spatial Plan to 2020, shows the distribution of main vegetation types within Montenegro. Mountain forests are the most extensive ecosystem in Montenegro in terms of area, occupying 54% of the territory (including natural forests which cover around 45% of the land). Beech and oak forests are found in the south and west whereas beech and fir forests are found in the more mountainous regions to the north. Pine forests are found along the Lim River in the north-east of Montenegro.

[5] Ministry of Spatial Planning and Environment (2010) Introductory Report on Nature Conservation in Montenegro prepared for Bern Convention Standing Committee Meeting in Strasbourg December 2010
[6] Endemic means unique to a defined geographic location
[7] Over 220 endemic plant species and sub-species are registered for Montenegro

Figure 4-11: Montenegro - Vegetation Types



From Bar to Boljare, the proposed motorway first passes through the zone with Mediterranean dendoflora, mainly in the maquis bushland in the coastal area (Đurmani). The route continues through sub-Mediterranean dendroflora (pseudomaquis) from Gluhi Dol to after Pelev Brijeg. From Pelev Brijeg and the Veruša River, across the valley of Lim up to Bihor and Boljare on the border with Serbia, the route passes through areas of continental and sometimes even alpine flora.

Typical representatives of the maquis are: Holm Oak *Quercus ilex*, Mock Privet *Phylirea media*, Bay Tree *Laurus nobilis*, Oriental Hornbeam *Carpinus orientalis*, Prickly Juniper *Juniperus oxicedrus*, Purple Spurge *Euphorbia peplis* and Prostrate Spurge *E. maculata*, Jerusalem Sage *Phlomis fruticosa*, Sweet Broom *Ruscus aculeatus*, White Asphodel *Asphodelus albus* and Honeysuckle *Lonicera* sp.

Pseudomaquis is represented by: Pomegranate *Punica granatum L*., *Phylirea media*, Jerusalem Thorn *Paliurus spina–christi*, Raywood Ash *Fraxinus oxicarpa*, Common Hawthorn *Crataegus monogyna*, Oriental Hornbeam*Carpinus orientalis*, Prickly Juniper*Juniperus oxicedrus*, Purple Spurge *Euphorbia peplis* and Prostrate Spurge *E. maculata*, Jerusalem Sage *Phlomis fruticosa*, Sweet Broom *Ruscus aculeatus*, White Ashphodel *Asphodelus albus* and Honeysuckle *Lonicera* sp.

Potential (primary forest) vegetation in the Smokovac-Matesevo section comprises a number of forest communities, including those specific to this climate (zone). In lower terrains, the motorway stretches through the belt of thermophile (heat loving) forests with Macedonian Oak (*Quercetum trojanae montenegrinum* Blečić et Lakušić) and belt of thermophile Eastern Hornbeam forests (*Seslerio-Ostryetum* Horv. et H-ić 50), and through a belt of thermophile Beech forests (*Seslerio-Fagetum moesiacae* Blečić et Lakušić 70) and belt of Mountain Beech forests (*Fagetum moesiacae montanum* Blečić et Lakušić 70) in higher terrains.

Significant plant communities also include *Campanulo-Moltkietum patraeae* (H-ić 1963), growing in fractures of rocks and in rocky thermophilic habitats.

Long-lasting negative anthropogenic impacts (unorganized cutting and clearing of forests, browsing by cattle, forest fires, etc) have caused regressive succession of forest vegetation and disappearance of scrub formations, rocky ground and meadows (secondary and tertiary vegetation forms).

The *Rusco-Carpinetum orientalis* (Blečić & Lakušić 1966) community is developed on barren soil in lapies of kartsic blocks (Bioče, Duga, Klopot, Pelev Brijeg, Lutovo). Due to excessive cutting of wood, it is represented by underbrush, with dominant Oriental Hornbeam *Carpinus orientalis*. Specific species include Sweet Broom *Ruscus aculeatus*, Flowering Ash *Fraxinus ornus*, Prickly Juniper *Juniperus oxycedrus*, *Petteria ramentacea*, Downy Oak *Quercus pubescens*, Macedonian Oak *Q. trojana, cer* Turkey Oak *Q. cerris*, European Nettle Tree *Celtis australia*, Pomegranate *Punica granatum*, Cornelian Cherry *Cornus mas*, Montpellier Maple *Acer monspessulanum*, Field Maple *Acer campestre*, Burning Bush *Dictamnus albus*, Scorpion Vetch *Coronilla emerus ssp. emeroides*, Euphorbia *Euphorbia wulfeni*i, Clematis *Clematis flammula*, King's Spear *Asphodeline lutea*, *Asphodelus microcarpus*, Autumn Moor Grass *Sesleria autumnalis*, Italian Arum *Arum italicum*, Snowdrop *Galanthus nivali*s and Wild Asparagus *Asparagus acutifolius*.

The *Quercetum trojanae montenegrinum* (Blečić & Lakušić 1975.) community is mostly present in fragments in the area of Bratonožići. Due to century long exploitation, Macedonian Oak has almost disappeared in this area, replaced with different sorts of shrub.

The *Seslerio autumnalis - Ostryetum carpinifoliae* (H-t & H-ić 1950. prov.) community is present as low forests and underbrush. It gradually passes into degraded beech forest. Since Hop Hornbeam *Ostrya carpinifolia* is being used as firewood, preserved forests are quite rare, while low forests are more often. This community also consists of the following: Downy Oak *Quercus pubescens*, Turkey Oak *Q. cerris*, Sessile Oak*Q. petraea*, Montpellier Maple *Acer monspessulanum*, Silver Lime *Tilia tomentosa*; Smoke Bush *Cotinus coggygria*, Snowy Mespilus *Amelanchier ovalis*, *Cotoneaster tomentosa*; Autumn Moor Grass *Sesleria autumnalis*, Dwarf Sage*Carex humilis*, *Mercurialis ovata*, Wall Germander*Teucrium chamaedrys*, White Swallow Wort *Cynanchum vincetoxicum*, Oregano *Origanum vulgare*, Wild Asparagus *Asparagus acutifolius*, Oxeye Daisy *Leucanthemum vulgare* and Valerian *Valeriana officinalis*.

Thermophile beech forests and *Seslerio-Fagetum moesiacae* (Blečić et Lakušić 70) are partly specific to this climate and partly have anthropogenic origin, often formed by degradation of mountain forests with beech. Further degradation has transformed them into low forests and underbrushes. In addition to beech, these communities include: Hop Hornbeam *Ostrya caprinifolia,* Flowering Ash *Fraxinus ornus*, Montpellier Maple *Acer monspessulanum*, Downy Oak *Quercus pubescens* and Turkey Oak *Q. cerris*. Near-ground flora is represented by Autumn Moor Grass *Sesleria autumnalis*.

Mountain beech forests *Fagetum moesiacae montanum* (Blečić et Lakušić 70) spread from 900 up to 1,200 m above sea level, where they mix with fir. The Beech *Fagus moesiaca* is dominant in the tree floor, as well as within bush floor, which indicates its mono-dominance. Within bush floor, only the following species are numerous: Alpine Honeysuckle *Lonicera alpigena*, Alder Buckthorn *Rhamnus frangula*, Mountain Ash *Sorbus aucuparia*, Whitebeam *S. aria* and Raspberry *Rubus ideus*. Systems which are strongly transformed have certain percentage of heliophite: Birch *Betula verrucosa* and Aspen *Populus tremul*a.

The *Campanulo-Moltkietum patraeae* (H-ić 1963) community grows in fractures of rocks and rocky thermophilic habitatas in Bioče, Duga, Dromira, Lutovo and Klopot. Dominant species is Moltkia *Moltkia petraea*, and specific species in this area are also Pyrethrum Daisy *Tanacetum cinerarifolium*, Chimney Bellflower *Campanula pyramidalis*, Giant Scabius *Cephalaria leucantha*, *Seseli globiferum*, Common Sage *Salvia officinalis*, as well as species such as Illyrian Iris *Iris ilyrica*, *Lasiagrostis calamagrostis*, Wall Rue Fern *Asplenium ruta muraria*, Maidenhair Spleenwort *A. trichomanes*, *Asperula scutellaris*, Yellow Germander *Teucrium flavum*, Mountain Germander *T. montanum*, *Hieracium waldsteinii ssp. plumulosum*, Winter Savory *Satureja montana*, Globe Daisy *Globularia cordifolia*, *Fumana vulgaris*, Blue Lettuce *Lactuca perennis* and Grassy Bells *Edraianthus tenuifolius*.

The *Stipo-Salvietum officinalis* H-ić (1956.) 1958.) community is the most spread association of meadow species in Sub-Mediterranean area of the motorway route (Bioče, Bratonožići). Featured and dominant species of this community are: Common Sage *Salvia officinalis*, Sharp Awned Feather Grass *Stipa bromoides*, Winter Savory *Satureja montana*, *Micromeria parviflora*, *Genista sericea*, Blue Hair Grass *Koeleria splendens*, *Onosma echioides*, Tunic Flower *Petrorhagia saxifraga*, *Campanula lingulata*, Felty Germander *Teucrium polium*, Wall Germander *T. chamaedrys*, Mountain Germander *T. montanum*, *Euphorbia spinosa*, *Inula viscose* and *Asperula scutellaris*.

The *Trifolio-Armerietum canescentiis* (Tomić 1970.) community is widespread in the belt of eastern hornbeam and mountain beech forests, represented by meadow community, with dominant species: *Armeria canescens*, Crimson Clover *Trifolium incarnatum*, Red Clover *T. pratense*, White Clover *T. repens*, Field Clover *T. campestre*, Bulbous Blue Grass *Poa bulbosa*, Hoary Plaintain *Plantago media*, Soft Brome *Bromus mollis*, *Ornitnogalum tenuifolium* and Dropwort *Filipendula hexapetala*.

Mesophilic (moderate temperature loving) meadows belong to the *Pancicion* (Lakušić 64) association, named after the species *Pancicia serbica*, which is widely found on Bjelasica. The association is significant not only from scientific, but also from economic aspect, since it contains a number of endemic species and relicts of the Tertiary age, and includes grassy meadows significant for cattle breeding. These mountain meadows represent secondary vegetation formed due to human impact on natural – climate featured ecosystems. Due to development of summer pastures and sheepfolds, plant species sensitive to nitrate have been disappearing, replaced with elements of tertiary anthropogenic vegetation.

Species protected by national legislation as rare, endangered or endemic (Decision on putting certain flora and fauna species under protection, Official Gazette of RoM 76/06) found in the area of the planned motorway route are as follows: *Eryngium palmatum*, Snowdrop *Galanthus nivalis*, Ivy Leafed Cyclamen *Cyclamen hederifolium*, *Colchicum hungaricum*, Early Purple Orchid *Orchis morio L. subsp. Morio*, *Romulea linaresii* Parl. subsp. *graeca* Béguinot, Widow Iris *Hermodactylus tuberosus* (L.) Miller and *Pancicia serbica* Vis.

The most significant endemic species in the context of this study are *Petteria ramentacea* (groundrock of Sub-Mediterranean zone), Grassy Bells *Edraianthus tenuifolius* (groundrock), Moltkia *Moltkia petrea* (fractures of rocks), *Rhamnus orbiculata* (groundrock of Sub-Mediterranean zone), Dalmatian Crocus *Crocus dalmaticus* and *Crocus weldenii* (groundrock meadows of Sub-Mediterranean zone).

Within habitats mentioned in Appendix of Bern Convention (habitats encompassed by EMERALD and NATURA 2000), habitats with Beech *Fagetum* and Macedonian Oak *Quercetum trojanae* are the most important ones.

In addition to diversified and complex composition of deciduous trees, with dominant thermophilic forests, forests in the area of the motorway is featured by specific fauna, as well. Flora communities are developed in lower and warmer and, hence, more accessible terrains. One of the consequences of intense destructing of these forests is intensified erosion, which is also a factor of further degradation of these communities and habitats of many animal species.

The mountain and forest parts of the planned motorway route are still inhabited by the biggest mammal species of the local fauna. Wolf (*Canis lupus*) is not a protected species and the population of wolves is quite largely present in that area. Also, wild boar (*Sus scrofa*) can be found in the area, as well as fox, marten, badger, rabbit and squirrel, and the fauna of small mammals, such as small forest rodents and bats (genus Chiroptera – bats are included by the list of protected species in Montenegro). The most dominant bird species are forest songbirds and woodpeckers, an important link in preserving forest health.

Karstic area is well known by its rare and endemic species of lizards, such as: *Algyroides nigropunctatus*, *Podarcis melisellensis*, *Lacerta trilineata* and snakes: *Elaphe longissima*, *Coronella austriaca*, *Elaphe situla*, *Vipera ammodytes* and *Vipera berus*. The invertebrate fauna is also significant in this area. The fauna of insects is especially interesting, such as *Stenochoromus montenegrinus nivalis* and *Otiorrhynchus imitator*. Butterfly species include *Papilio machaon*, *Papilio alexanor*, *Parnassius apollo* and *Lucanus cervus*. The karstic area is known by its diversified and endemic cave-populated fauna (insects, snails, spiders) and particularly fauna of underground waters.

About 150 bird species have been registered up to now in the area of Bjelasica. Bjelasica is habitat of a large number of internationally distinctive birds, which provided Bjelasica the IBA status (Important Bird Area) in 2000. Representatives of ornithofauna include Sombre Tit *Parus lugubris*, White-backed Woodpecker *Dendrocopus lilfordi* and Collared Flycatcher *Ficedula albicollis*.

Habitat is a very complex natural system, very sensitive to different impacts and changes contributing to migrating of animal species. Results of previous research indicate that the wider area of the planned motorway is becoming habitat for some protected species, such as:

Class *Insecta*: Red *Lepidoptera*: Familia *Papilionidae*: *Papilio machaon* L.; *Papilio alexanor* Esp.; *Parnassius apollo* L.; Red *Coleoptera*: Familia *Lucanidae: Lucanus cervus* L.

Class *Reptilia*: Genus *Lacertilia*: Familia *Lacertidae*: *Algyroides nigropunctatus* D.& B.; *Podarcis melisellensis* Wern.; *Lacerta trilineata* Schr.

Genus *Serpentes*: Familia *Colubridae*: *Elaphe longissima* Laur.; *Coronella austriaca* Laur.; *Elaphe situla* L.

Significant forest complexes appear in the Opasanica basin and Drcko basin (the upper basin of the Tara River) and in the area from Andrijevica to Bubanja on the southeast and eastern slopes of Bjelasica (the upper basin of the Lim River).

4.2.1 Protected Areas - International

Montenegro contains several internationally significant areas protected by legislation:

- Skadar Lake (Ramsar List of Wetlands of International Significance), two-thirds of which is located in Montenegro and the rest in Albania;

- Durmitor National Park with part of the Tara Canyon (UNESCO List of World Natural Heritage), the Tara River watershed is recognised as a World Biosphere Reserve;

- Kotor and Risan Bay (UNESCO List of Cultural and Natural Heritage);

- Tara Canyon (UNESCO Man and Biosphere Programme).

Skadar Lake and the Tara River watershed fall within the area potentially affected by the project. Skadar Lake, Ćemovsko Polje and Bjelasica (tbc) have been identified as Important Bird Areas and Skadar Lake, together with the Tara River Canyon[8] and Lim River Canyon have been identified as Important Plant Areas.

4.2.2 Skadar Lake

Covering an area ranging from 370 to 530 square kilometres, depending on the water level, Skadar Lake is the largest lake in the Balkans. Its favourable geographical location and sub-Mediterranean climate have made it one of Europe's most important habitats of marsh birds, second only to the River Danube delta. Around 280 bird species breed and nest on the lake, including the rare curly (Dalmation) pelican, which became the symbol of the national park and the lake itself. Two-thirds of Lake Skadar belong to Montenegro and one third to the Republic of Albania. The Montenegrin part of the lake, with 40,000 hectares of shore land, was proclaimed a national park in 1983[9].

4-12 shows the location of Skadar Lake. The Montenegrin part of the lake was declared a National Park in 1983 and in 1996 was added to the World List of Wetlands of the Ramsar Convention. The Albanian part of the lake has also been protected as a Ramsar site since 2006. The lake has been identified as a site for inclusion in the Natura 2000 network in the event that Montenegro accedes to the European Union.

The lake is a crypto-depression, which means that in some parts the bottom of the lake is below sea level. These places are sub-lacustrine springs or eyes ('oka'). Around 30 such 'eyes' have been identified. The deepest eye, called Radus, is about 60 m deep. Other 'eyes' are Karuc (28 m deep), Volac (24 m deep) and Krnijcko (24 m deep).

[8] Not directly affected by the SEETO Route 4 proposal
[9] Source: Montenegro Facts Government Guide Series: Fact sheet December 2010

Skadar Lake, as it appears today, is a relatively new phenomenon. Before 1856, there were three smaller lakes in the area. In 1856, two rivers coalesced and another river deposited a large volume of sediment, which closed the flow of the Bojana River and led to the valley being flooded. The Bojana River, located on the Montenegrin/Albanian border, is the only river to flow out of the lake to the sea.

The extent and depth of the lake fluctuates considerably throughout the year and from year to year. The average depth of the lake is 6 m. Around 62% of water is delivered to the lake by the Morača River and its smaller arms Zeta and Cijevnom, which contain large amounts of sediment. Underground springs supply a further 30% of its water. The average summer water temperature is 22^{o}C and the winter temperature is rarely below 11^{o}C.

Skadar Lake is thought to be a refuge for many species surviving the glaciations. The lake and its vicinity are rich in relict and endemic animal and plant species. Large areas of the park are wetlands with floating plants, reeds and rushes, and seasonally there are varying areas of flooded meadows and flooded forests.

Skadar Lake is a relatively shallow water body. Dominant plant species include: Common Reed *Phragmites communis*, White Waterlily *Nymphea alba*, Yellow Waterlily *Nuphar luteum* and Water Calltrop *Trapa natans*. In some areas near to the northern lake shore there are still fragments of Skadar Oak *Quercus robur scutariensis* forest. The southern coast and islets are steep, rocky, with sparse sub-Mediterranean pseudomacquis (Oriental Hornbeam*Carpinus orientalis*, Pomegranate *Punica granatum*, Jerusalem Thorn *Paliurus spina-christi*, Fig *Ficus carica*, *Phillyrea* sp.). The lake hosts contains unusual flora such as algae from the families of Chara and Nitelopsis, the carnivorous Bladderwort *Utricularia* spp. and various species of Orchids.

Over 270 species of birds have been recorded from the site, which supports large populations of breeding and wintering waterbirds, including the largest population of Pygmy Cormorant *Phalacrocorax pygmeus* in Montenegro as well as the globally threatened Dalmatian Pelican *Pelecanus crispus*. It is also an important 'stop-over' for migrating birds travelling along the Adriatic Flyway from breeding areas in Central Europe to their wintering station further south and east in the Mediterranean and Africa. In addition, the lake supports over 40 species of fish (economically the most valuable ones are Carp *Cyprinus carpio* and Bleak *Alburnus alburnus*).

Figure 4-12: Skadar Lake National Park and Ramsar Site

Basemap: Montenegro map (Freytag & Berndt)

In terms of biodiversity 'hotspots' within Montenegro and the region:

• Skadar Lake and the northern slopes of Rumija mountain are a centre of diversity for vascular flora;

• Skadar Lake is a biodiversity centre for birds (and is designated an Important Bird Area and Ramsar site);

• The coastal region of Montenegro and its hinterland (including Skadar Lake) is considered the most significant centre of biodiversity for reptiles and amphibians on the Balkan Peninsula and in Europe.

The Global Environment Fund (GEF)/World Bank project Integrated Management of the Skadar Lake Ecosystem (for Montenengro and Albania) started in 2006. The initial joint transboundary study of environmental conditions in and around the lake was completed in 2006 and a strategic action plan developed. The implementation phase of the project aims to:

• Reduce and prevent pollution;

• Improve ecological and biodiversity monitoring;

• Promote environmentally sustainable economic use of biological resources and manage protected areas;

• Promote environmentally-sustainable tourism development with an emphasis on local community participation and benefits.

4.2.3 Tara River Canyon and Biosphere Reserve

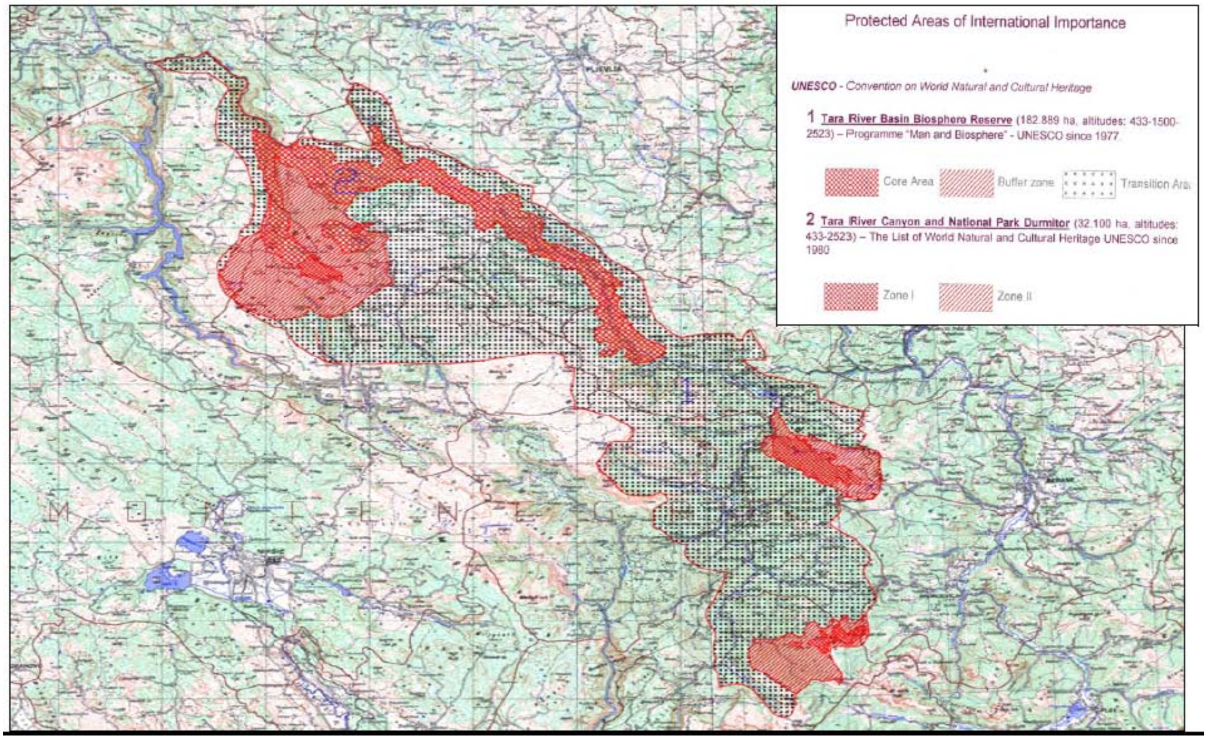
The Tara River Canyon and National Park Durmitor is a Protected Area of International Importance covering 32,100 ha, which has been on the UNESCO List of World Natural and Cultural Heritage since 1980. The easternmost boundary of the protected area is located at Bistrica.

The Tara River Canyon and NP Durmitor, together with the Biogradska Gora National Park and Komovi mountain, lie within a more extensive Protected Area of International Importance, the Tara River Biosphere Reserve. The Biosphere Reserve, designated in 1976 under the UNESCO Man and Biosphere Programme, covers an area of 182,889 ha. According to the Statutory Framework of the World Network of Biosphere Reserves, biosphere reserves are created 'to promote and demonstrate a balanced relationship between humans and the biosphere'. The design of the reserve must include a legally protected core area, a buffer zone where non-conservation activities are prohibited, and a transition zone where approved practices are permitted. The design is done with regard for the sustainable use of natural resources for the benefit of local communities.[10] The boundaries of the two areas are shown in Figure 10-1.[11]

The Tara River is created by the confluence of the Veruša and Opasanica Rivers. From its beginning up to Streljički krš, the Tara receives water from several intermittent and minor streams, and the Drcko, Skrbuša Velika, Mala Pješčanica and Pčinja Rivers. The mouth of Drcko River is located at Mateševo.

[10] http://durmitorcg.wordpress.com/national-park/biosphere-reserve/
[11] D Polleto (2007) Territorial Diagnostic of the Tara River Basin Biosphere Reserve and the Durmitor World Heritage Site in Montenegro. UNESCO, Italy, 2007

Figure 4-13 Zoning Map of Tara River Basin Biosphere Reserve and Tara River Canyon-National Park of Durmitor World Heritage Site



4.2.4 Protected Areas - Local

Natural areas in and around Podgorica protected by either existing or proposed local regulations listed in Table 4-3.

Table 4-3: Protected natural areas in Podgorica

Code	Type	Location
Existing protected area		
3	Natural monument	Tološi district
Proposed protected area		
5	Area with special natural features	Velje Brdo, Tološi and Beri districts
6	Natural monument	Cijevna River valley
8	Prominent viewpoints	Gorica hill and other highpoints in Rogami, Dajbebe, Velje Brdo and Beri districts
9	Botanical-horticultural objects	Areas including Gorica hill, area north of Zagoric and Malo Brdo

Other areas of environmental and cultural interest recommended for protection by the Institute of Nature Protection (1986)[12] are:

- Pécina Magara, the only cave within area covered by the General Urban Plan;
- Komova mountains east of Podgorica;
- Morača River and tributaries;
- Morača, Male Rijeke and Cijevne river canyons where rare endemic animals and plants may be found;
- Springs around Rikavačko lake;
- Areas of geological interest around Morača;
- Rikavačko lake ‘natural aquarium’, Žijova and the springs of the Mareze River;
- Karst around Žijova where there are many caves and other karst features, and the local groundwater is of very high quality;
- The scenic area of riverine vegetation between Veljeg hill and the springs of the Mareze River, and also an area near Danilovgrad;
- Bukumirsko lake on Žijovu mountain and Crni žar on Lake Skadar, where there are rare and endangered animal and plant species;
- Park-woodlands at Zagoriča, Maloga hill, Gorice hill, Ljubovića, Dajbapske hill and Kruševca.

[12] Republic Institute of Nature Protection (1986) Area Plan and Revision of the General Urban Plan (April 1986)

4.3 Geology and Soils

4.3.1 Geology

Figures 4-14 to 4-19, from the Spatial Plan to 2020, provide a wide range of information relating to the lithology and stratigraphy, engineering geology, soil type, erosion potential and seismic characteristics of different areas within Montenegro.

Terrain in the SEETO 4 Road Route corridor is of complex geological structure with rocks and rock masses dating from the Paleozoic (sedimentary rocks from the Carboniferous and Permian periods), Mesozoic (sedimentary rocks from the Triassic, Jurassic and Cretaceous periods and igneous rocks from the Triassic and Jurassic periods) and Cenozoic eras (sediments from the Paleogene, Neogene and Quaternary periods). Spectacular faulting and folding of the rocks can be seen, particularly in the Morača valley.

The rock masses have different physical and geotechnical characteristics. Tight-stiff, well petrified rock masses such as limestones, dolomites and igneous rocks form stable load bearing areas in which steep cuts, side cuts and other excavations can be made. Tight, poorly petrified rocks and rock complexes such as mudstones, marls, sandstones and limestones are stratified and tectonically complex. Disturbance of these rocks can lead to rockfalls and landslides. Unconnected granular rocks such as the Quaternary sediments of the Morača and Mala Rijeka river terraces have variable stability.

The present appearance of terrain in Montenegro has been largely shaped by tectonic movements of the south east Dinarides. Seismic activity continues to date with periodic earthquakes. Other geomorphological process have and continue to include karstification (particularly where the geology is partly limestone and partly dolomite), fluvial erosion (such as Moraca River canyon and Mala Rijeka) and glacial erosion of mountain slopes.

4.3.2 Agricultural Soils

Given the extensive areas of mountains within Montenegro, there is a shortage of land suitable for agriculture and horticulture. There are 514,000 ha of agricultural land, of which 189,000 is arable land. Much of this land is held in smallholdings. Agricultural activities include: farm livestock and poultry; citrus fruit orchards, olive groves and vineyards; greenhouses; flower production; fish breeding; beehives and honey production.

The Bar-Boljare SEA indicates that food is produced primarily for personal use, with little surplus to be exported to markets and free sale (e.g. at the roadside): the small parcels of land are large enough to grow food for personal use, but not large enough to provide an adequate income for households.

According to Podgorica Municipality, agricultural land with high soil fertility (Category I and II) extends along the rim of Ćemovsko Polje at Doljani, Momišići, Tološi, Donja and Gornja Gorica, Farmaci, Beri, Lekic, Grbavci, Botun, Dajbabe, a narrow belt from the Mahale to Podhum, and in the transition from Ćemovsko Polje to the coast of Skadar Lake. When well irrigated, it is the most abundant fruit-vegetable and wine growing land. This type of soil provides for the production of top quality wine and tobacco, and many kinds of fruits (peach and cherry), as well as medicinal and aromatic plants.

Medium-fertility soil (Category II and IV), together with the high fertility soil, form a major part of agricultural areas with relatively intensive production: arable land, gardens, orchards and vineyards. Medium-fertility soils are found in the valleys and plains, the coastal area of Lake Skadar, and the Zetsko-Bjelopavlicka and Lješanska Nahija areas.

Figure 4-14 Montenegro - Lithology and Stratigraphy

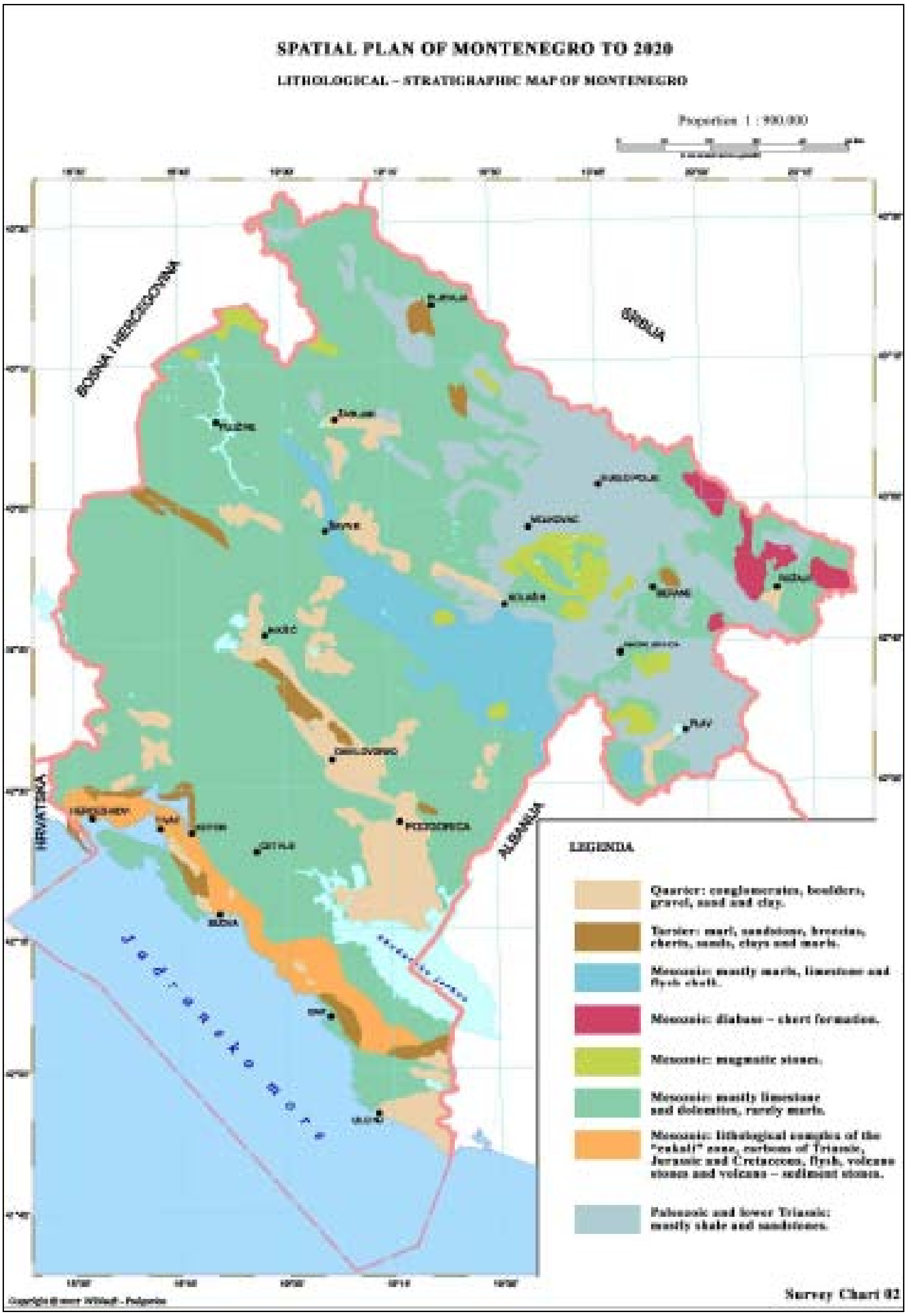


Figure 4-15 Montenegro - Engineering Geology

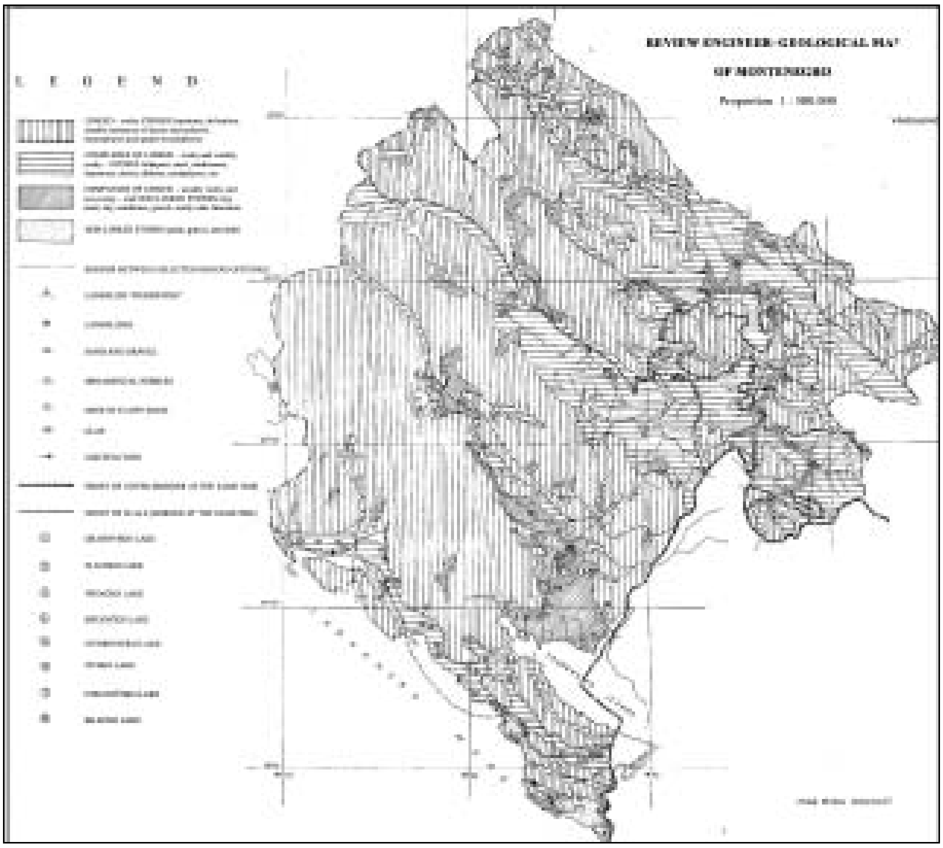


Figure 4-16 Montenegro - Groundwater Resource and Karst Regions

Figure 4-17 Montenegro - Soil Types

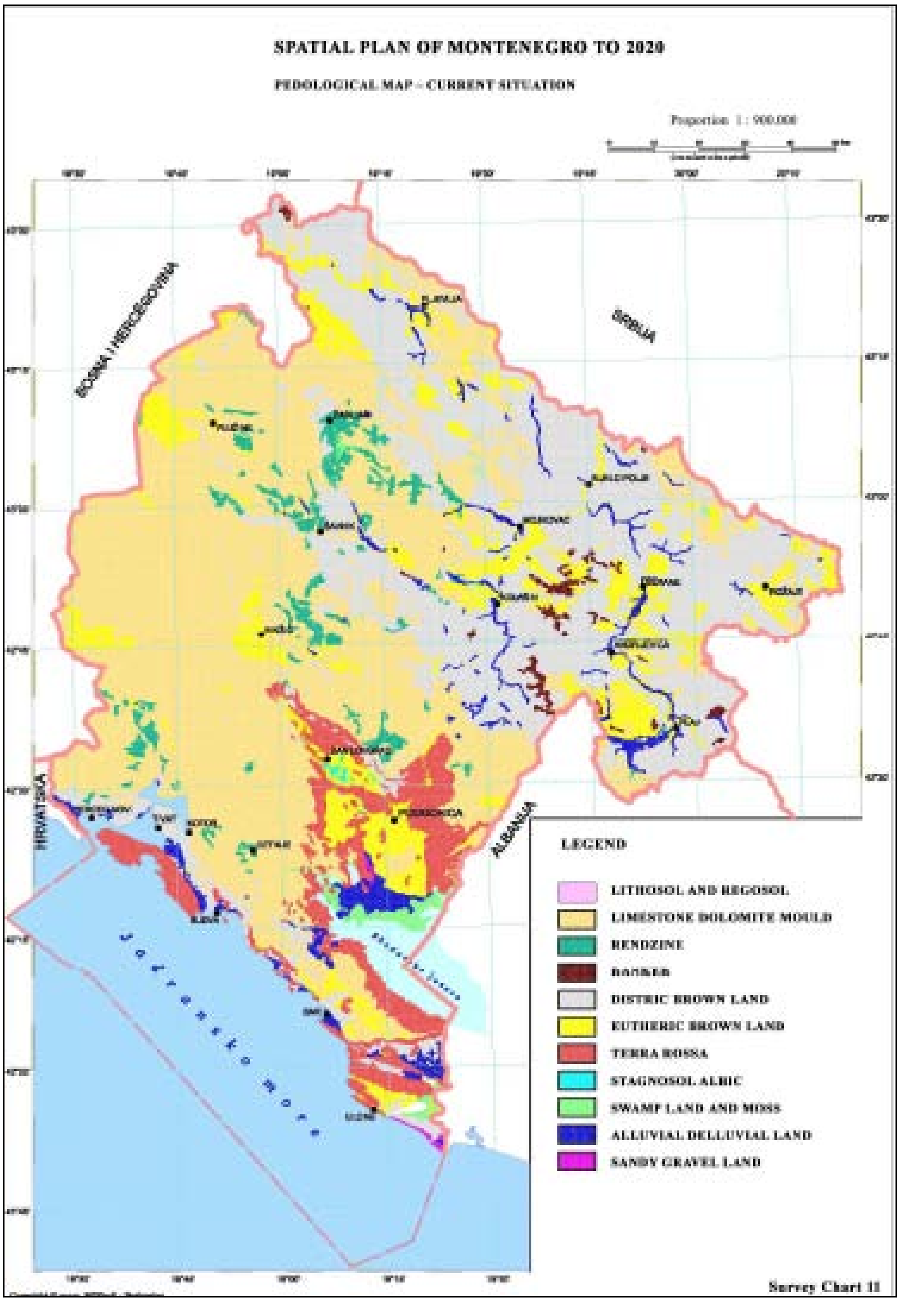


Figure 4-18 Montenegro - Erosion Hazard

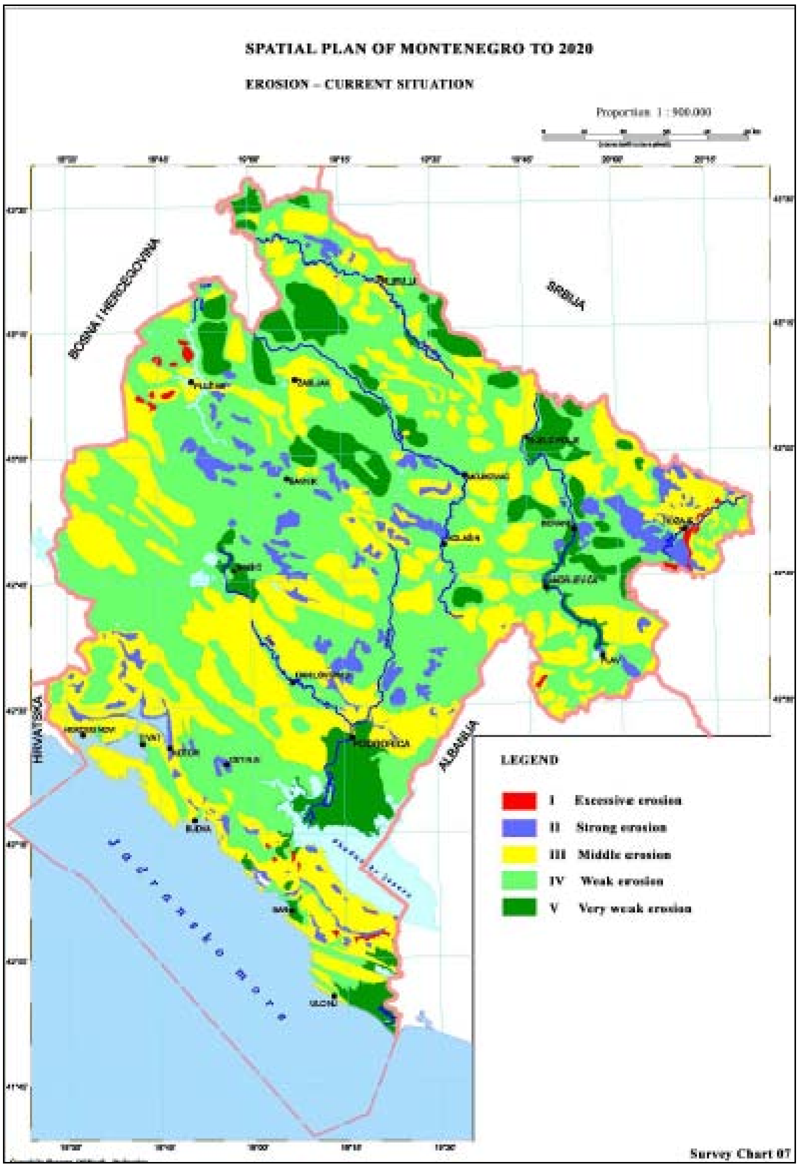
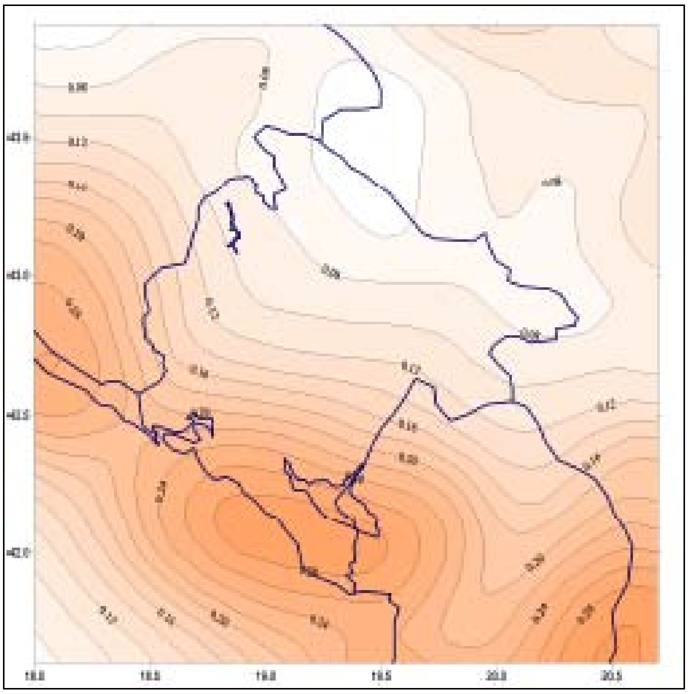


Figure 4-19 is map of seismic hazard of Montenegro and the surroundings (showing expected maximum horizontal ground acceleration in gravity parts) within the return period of 100 years with a 70% possibility of not overcoming the events (B Glavatović (2004) quoted in the Spatial Plan of Montenegro until 2020). There is a decreasing hazard from the coastal regions towards the Serbian border.

Figure 4-19 Montenegro - Seismic Hazard



4.4 Water Resources

4.4.1 Hydrology and Hydrogeology

Montenegro's water courses flow either to the Adriatic Sea basin via the Morača River or into the Black Sea basin via the Tara River and Lim River.

The Morača River is the largest tributary of Skadar Lake. The Morača River and its smaller arms (the Zeta and the Cijevnom) provides around 62% of the water of Skadar Lake: much of the remainder is provided by underground springs within the lake. The Morača River receives water from the intermittent tributaries Mala Rijeka near Bioča, Ribnica through Podgorica, Zeta and Sitnica.

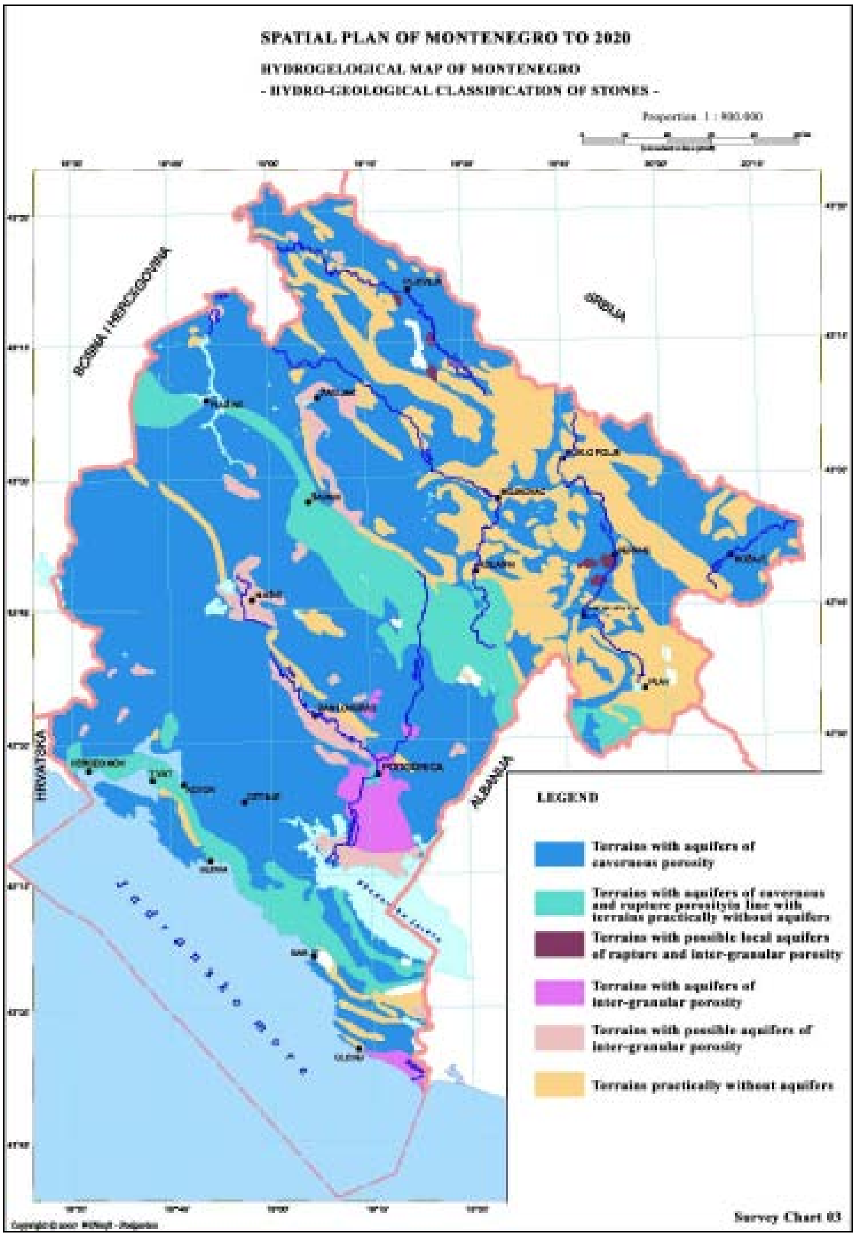
The physical features and biological significance of Skadar Lake are described in some detail in Section 4.2. The extent and depth of the lake fluctuates considerably throughout the year and from year to year, with an average depth of the lake of 6 m. The lake drains to the Adriatic Sea through the Ada Bojana River on the Montenegro/ Albania border.

As described in Section 4-2, the Tara River is created by the confluence of the Veruša and Opasanica Rivers. From its beginning up to Streljički krš, the Tara receives water from several intermittent and minor streams, and the Drcko, Skrbuša Velika, Mala Pješčanica and Pčinja Rivers. The mouth of Drcko River is located at Mateševo.

The Lim River receives water from a variety of major tributaries including the Šekularska, Kaludarska, Dapsićka, Lješnica and Crnča, Zlorečica, Kraštica, Trepačka, Ševarinska, Vinicka and Bistrica Rivers.

Figure 4-20 provides an overview of the karst regions and hydrogeological resouces of Montenegro.

Figure 4-20 Montenegro - Hydrogeology



4.4.2 Water Supply Sources

Over 90% of the population of Montenegro have piped water supplied to their homes or yards. The municipalities reporting the best water quality are the large cities, including Podgorica, where there are more financial resources to operate and maintain water supply systems. Almost all drinking water is supplied from groundwater resources - springs.

The following water sources supply major settlements along the route of the proposed motorway between Bar and Boljare:

Water sources 'Velje around' on the edge of Crmničko Polje and 'Orahovštica' provide water to consumers in Bar. The source 'Orahovštica' servesr Virpazar;

Water source 'Lisica' serves Lješanska Nahija;

Water sources 'Mareza', 'Zagoričko Polje', and 'Ćemovsko Polje' serve consumers in Podgorica;

Water source 'Bioče' serves Bioča;

Water source 'Duga' serves settlements in the area of village Duga;

Water source 'Lijeva Rijeka' serves Lijeva Rijeka;

Water source 'Mateševo' serves Mateševo;

Water source 'Krkor' serves Andrijevica;

'Water sources 'Lubnice' (Merica vrelo) and 'Manastirsko vrelo' serve Berane.

In addition, there are several smaller sources which supply the rural population in the Veruša and Brskut valleys.

4.4.3 Water Quality

Water quality issues in Podgorica include: pollution of the main Morača River; inadequate waste management; inadequate sewage collection, treatment and disposal facilities; buildings unconnected to the existing sewerage system; the KAP aluminium plant; agriculture; traffic, and direct pollution.

Only 60% of Montenegro’s population have access to a public sewerage system, the rest use septic tanks and absorbing wells (wells previously used for drinking water converted to disposal sites) for disposal of wastewater; tanks collecting wastewater and sludge from septic tanks dump their contents into rivers or onto the ground. No urban area in Montenegro is fully covered by a sewerage system. Poor sanitation, leakage from domestic septic tanks and discharges of un- or semi-treated wastewaters from industrial and municipal areas adversely impact on local and downstream water quality.

Podgorica is located to the north of Lake Skadar. Eutrophication (nutrient enrichment often indicated by algal blooms) has been noted in the north-west part of Lake Skadar, due to excessive flows of nutrients from untreated industrial and municipal wastewaters from Podgorica, agriculture, pollutants from waste disposal sites transported by groundwater, and sediment runoff resulting from deforestation and overgrazing in the catchment area.

Projects to install/upgrade wastewater collection and treatment facilities in several urban centres, including Podgorica, are currently being implemented.

4.5 Air Quality and Climate

4.5.1 Air Quality

According to the Bar-Boljare SEA, air quality in Montenegro in terms of global indicators (sulphur dioxide (SO_2) and total nitrogen oxides (NO_x) content) is generally satisfactory or of very good quality. In urban areas, elevated levels of PAHs[****] and dust particles are noted, related to the exhaust emissions from motor vehicles, many of which are old and lack catalytic convertors, and poor quality fuel. Elevated levels of smoke and soot during winter months can be related to the traditional use of solid fuels for heating.

4.5.2 Climate

As illustrated in Figure 4-21, the climatic zones in Montenegro are very diverse. Each region has its own normal and extreme climatic conditions. The coastal region has a Mediterranean climate characterised by high volumes of rainfall during the autumn and spring. This area is also subject to strong gusts of wind with speeds of around 40 m/s. Between Virpazar and Smokovac, the climate is more continental with summer air temperatures of 40^{o}C being quite common. Winter snowfall, temperatures between zero and frost are also possible in this area. Gusts of strong winds from the north may also occur. In the mountainous regions, extreme weather conditions can occur in winter, with low temperatures and snowfall. During the summer months, weather conditions are favourable in terms of temperatures and levels of precipitation. The pattern of precipitation (rainfall and snowfall) over the country is shown in Figure 4-21.

[****] Polyaromatic hydrocarbons

Figure 4-21: Montenegro - Climatic Zones

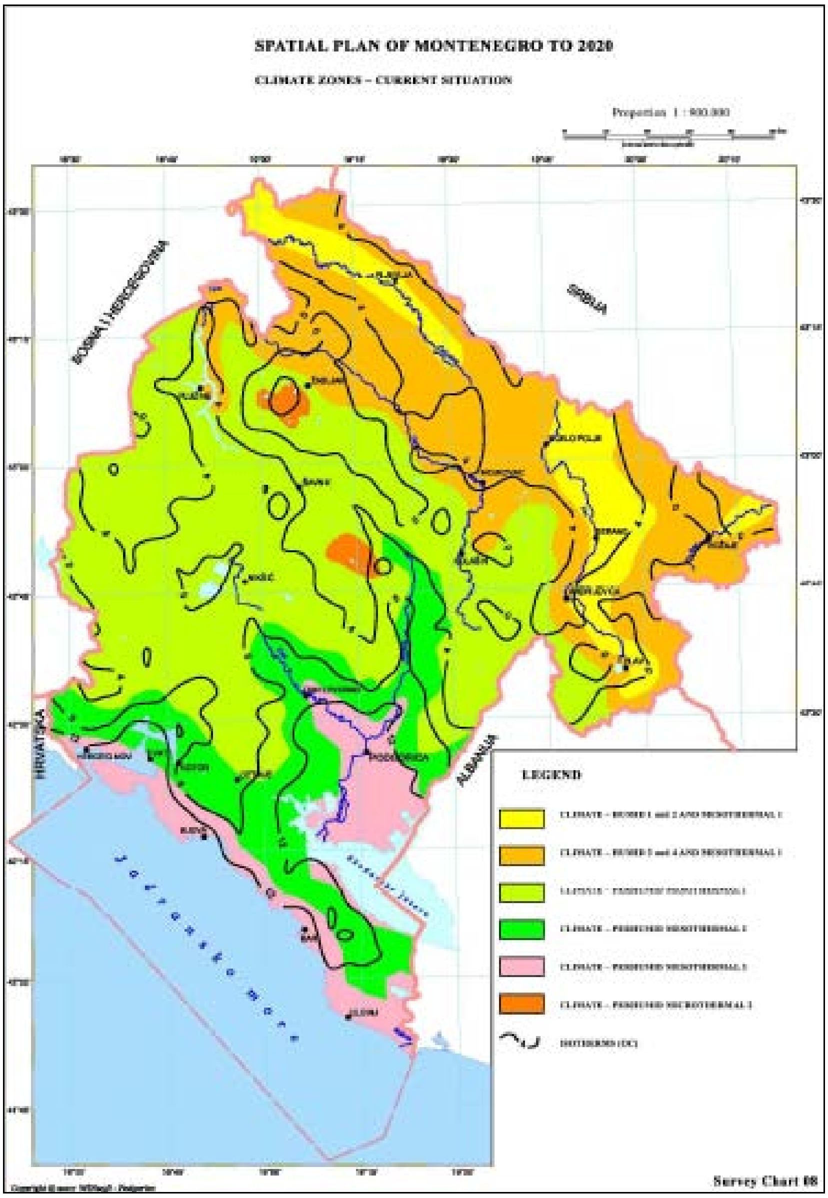
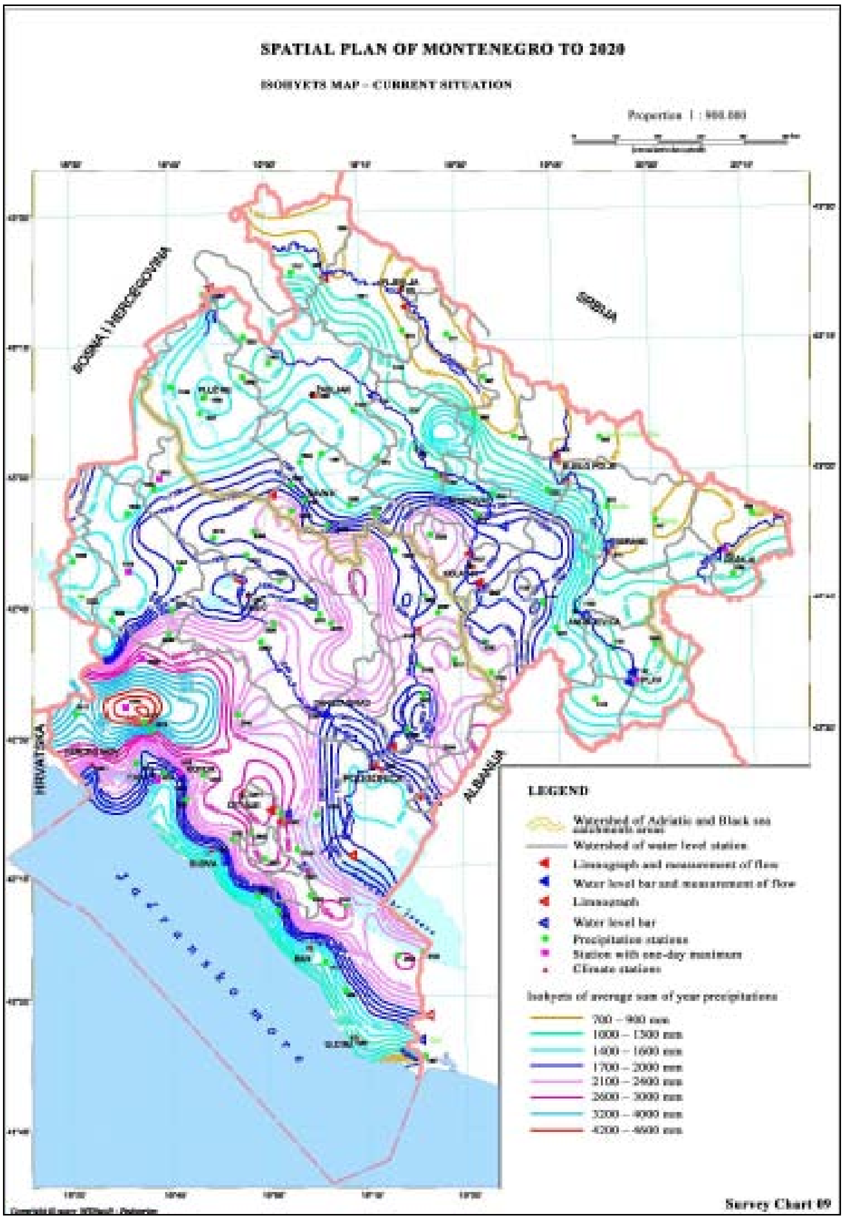


Figure 4-22: Montenegro - Isohyets



4.6 Cultural Heritage and Protected Areas

4.6.1 Categories of Protection

The cultural heritage of Montenegro consists of over 300 archaeological, historical, artistic, architectural, ethnological and technical monuments, which are classified in three categories of protection:

- **Category I** - consists of 35 monuments of great importance with 4 in the area covered by the Bar-Boljare Detailed Spatial Plan[††††];

- **Category II** - monuments of great importance (135 monuments) with 9 in the area covered by the Plan;

- **Category III** - monuments with local importance (187 monuments) with 29 in the area covered by the Bar-Boljare Motorway Plan.

4.6.2 Overview of Cultural Monuments in Bar-Boljare Plan

Below is an overview of 'protected immovable cultural monuments' in the area covered by the Plan listed per category and municipality:

- **Category I** – Žabljak, Rijeka Crnojevića and Kom Monastery on Skadar Lake in Cetinje municipalities;

- Duklja, an archaeological site in the Municipality of Podgorica;

- Monastery Đurđevi Stupovi with the Church of St. George in Berane municipality.

- **Category II** – Church of St. Anastasius in Sotonići;

- Church of St. Demetrius - Nehaj; Monastery Orahovo in the municipality of Bar;

- Church of Blagovještenja Jeksa, Čukojevici in Cetinje municipality;

- Archaeological site Doljani-Zlatica, Dajbabe Monastery, the church of St. Djordje under Gorica in the municipality of Podgorica;

- Building of elementary school - Polimski Museum and Roman Castrum - Dolac in Berane municipality.

- **Category III** – Church of St. John, Archangel Michael and St. Petka in Sotonići, fortifications Besac and Grmožur on Skadar Lake in the Municipality of Bar;

- Fort Lesendro near Vranjina; Monastery Duga - Bioče, Balšića Grad in Ponari, Ribnica fortress, the Old Bridge at the mouth of Ribnica River, Osmanagića mosque in Stara Varoš, Church of St. Trinity and Fort Oblun in Vukovci, Fort Planinica in Dodoši, church of St. George in Srpska;

- Church Pahomije in Komani-Orahovac, Vranjina Monastery with its church of St. Nicholas and the fishing village of Vranjina, Church of Our Lady in Čepurci, Church of Assumption of

[††††] That is, 1 km either side of the 2008 Bar-Boljare Motorway alignment

Christ in Lijeva Rijeka, house of Čubranović, Jusovača dungeon in Stara Varoš, the church of St. George in Blizni, church of Ascension-Ubli; church of St. John the Baptist in Kosor;

- the building of the Republic Institute for Protection of Nature and Starodoganjska mosque in Stara Varoš in the municipality of Podgorica, Šudikova Monastery and the Church of the Presentation of the Virgin Mary and the ruins of the church in Budimlje in Berane.

Note, according to the Smokovac-Mateševo EIA, that churches and mosques and graveyards are not automatically protected sites in Montenegro although they are of cultural importance.

4.7 Landscape

4.7.1 Skadar Lake

The Bar-Boljare SEA describes the landscape unit of Skadar Lake as follows:

'The area stands out as a special landscape units due to the distinctive look and an exceptional harmony of natural and cultural heritage. The characteristic appearance of the landscape comes from: spacious surface of the lake, jagged coastlines with numerous bays, peninsulas and promontories, rocky islands, the rich wetland vegetation with vast marsh reeds and field of water lilies and water caltrop, lush flooded meadows and riparian forests.'

4.7.2 Zeta-Bjelopavlićka Plain

The Bar-Boljare SEA describes the Zeta-Bjelopavlićka plain as follows:

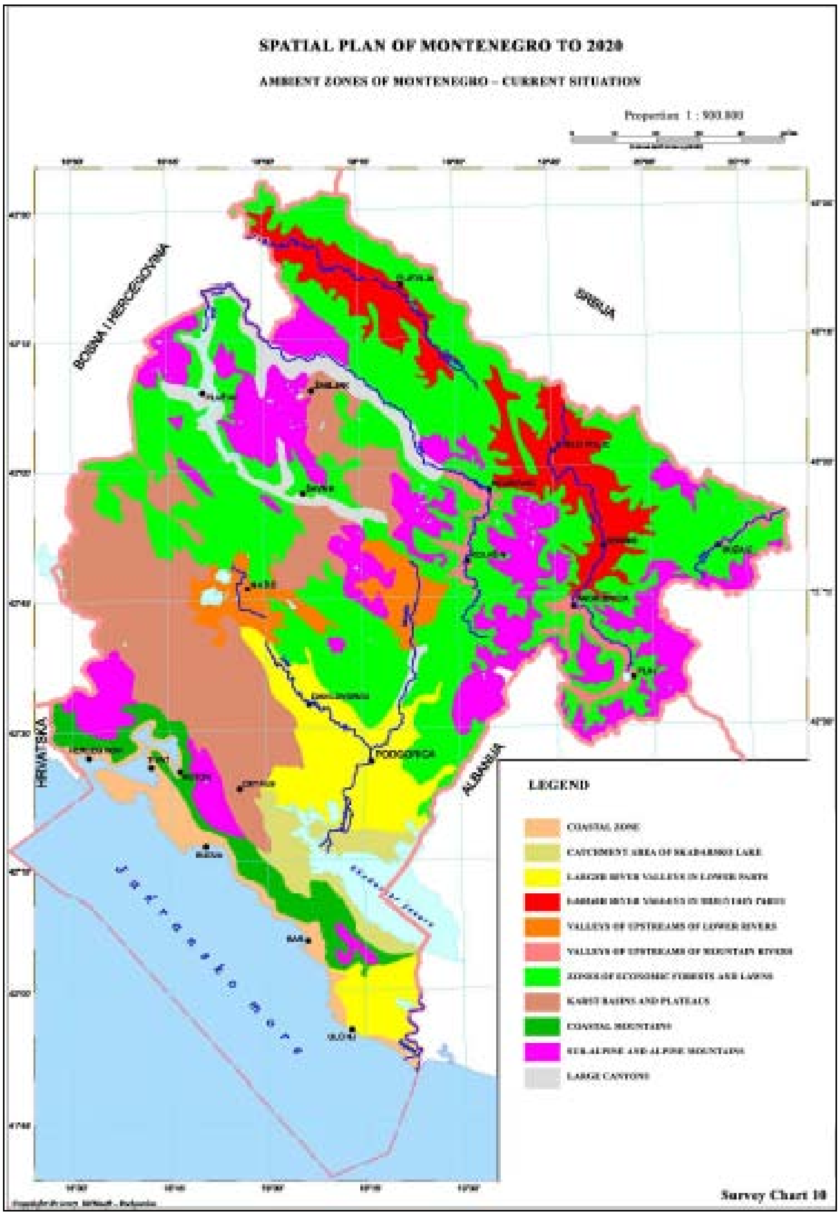
'This is a typical depression which is an extension of Niksić field and which separates the Karst plateau of western Montenegro from the high mountains. The plain is dotted with the valleys of Zeta, Morača, Cijevna and Ribnica. Peripheral low hills are covered with xerothermal degraded oak forests and thickets of Oriental Hornbeam with a mixture of evergreen species. It is necessary to preserve the remaining communities of Macedonian Oak due to its limited distribution and rarity. Also, in the valley, all the individual trees and groups of Skadar Oak trees that are remaining at the edge of the Ćemovsko field and in the Bjelopavlićka plain, and which represent a botanical curiosity, should be protected. Dry semi-desert habitats in the Ćemovsko field are in the extinction phase due to conversion of land into other land uses (orchards, vineyards, vegetable gardens, village forest plantations, industrial facilities). With the exception of Podgorica, as the largest urban agglomeration, the area is cultivated with a predominantly rural landscape structure. It is uniform in composition and has a low aesthetic value.'

4.7.3 Morača River Canyons

The Bar-Boljare SEA describes the canyons in the basin of the Morača as follows:

'The high aesthetic quality, representativeness and impressiveness of this landscape expression distinguished the catchment area of Morača River from the landscape of high mountains. A special feature of this landscape unit is reflected in a dramatic contrast between certain elements of nature: the blue surface of Morača and the surrounding rugged ridges (Moračka kapa, Maganik, Prekornica, Žijevo). Attractive micro-landscapes of the Mrtvica and Male Canyons complement the visual dynamics of this area. Platije mountain which rises almost vertically above the bed of Morača, is the most impressive part of the canyon. In terms of flora, it is possible to set out a mosaic landscape of small units - bare rocky surface with individual Whitebark Pine and yew trees, vegetation of rocks and rock creep, areas covered with Macedonian Oak and dense forests of White and Turkey Oak.'

Figure 4-23: Montenegro - Landscape Units



4.7.4 Tara River Valley

The Bar-Boljare SEA describes the Tara River Valley as follows:

'The valley of the River Tara canyon with its canyon, spacious massive of Bjelasica and impressive Komovi, is a typical structural element of of this landscape units that give it a distinctive look. Viewed from a remote position, this macro-landscape can be seen as a harmonious composition of rivers, forests, pastures and bare mountain peaks. Emerging from the confluence of the Opasnica and Veruša Rivers at Podkomovlje, the Tara runs through a narrow valley along the western rim of Bjelasica which, over wooded Jelovice and Trešnjevik, conects to mountains Komovi in the South. The mountain ranges of Komovi and Bjelasica are rich in pastures and forests and hydrological facilities which provide special visual dynamism. ….

Mountain ranges are also characterized by a number of peaks above 2000 m which offer impressive views (Kučki Kom - 2484 m; Vasojevićki Kom - 2460, Black Head - 2137 m; Zekova Head - 2116 m). In the area of Kolašin and Mojkovačka valley, the landscape is somewhat altered into the built-up landscape.

The extraordinary value of the area is a wealth of endemic and relict plant and animal species and ecosystems. In particular, forest ecosystems are well preserved. The catchment area of the Tara River is protected as a Biosphere Reserve….'

4.7.5 Bjelasica and Komovi

The Bar-Boljare SEA descriptions of Bjelasica and Komovi include the following text:

' The environment of Bjelasica consists of the aesthetic visual mosaic of wild clear streams, forest vegetation aligned in nearly lawful vertical zonation (alder, beech, pine, spruce, with a touch of maple and microlocations of Whitebark Pine, subalpine beech, Juniper Nana and Mugo Pine) up to its peaks. Mountain meadows are positioned as made forest clearings created in the lower positions and as high mountain meadows, depending on exposure, above 1,650 m asl. The high mountain pastures are dominated by grasses, and on northern exposures, by blueberries as well….. On the slopes of Bjelasica, picturesque rural settlements formed which complement the beauty of nature.

Kučki Kom (2,484 m) and Vasojevićki Kom (2,460 m) are orogenetic bridge and barrier between Bjelasica and Komovi…. The basins of Drcko and Mojanske Rivers are the example of pristine purity of watercourses, but also the force of the flow when conditions are right.

The villages Kraljske bare in the northwest, Kralje in the northeast and Konjuhe in the east are settlements fully incorporated into the local environment of visual aesthetics.'

4.7.6 Lim River

The Bar-Boljare SEA describes the Lim River area (Polimlje) as follows:

'This landscape unit includes the valley of Lim River, from Plavsko Lake up to the entrance in Kumaračka gorge. The main structural elements of the landscape: Lim valley, gorges and extensions in the form of valleys along the river course. The Lim valley is composite in character, it has emphasized morphology, in which bigger and smaller valleys alternate (Plav, Murinjska, Andrijevačka, Beranska, Zatonska, Bjelopoljska) with cliffs (Sutjeska, Tifran). Beranska Valley (the area around Berane) is the largest expansion in the valley of Lim.

North of Berane, an imposing Tifranska gorge is formed. Downstream, the Lim enters the Bijelopoljska valley (the area around Bijelo Polje). Relatively low hills and plateaus rise on the rims of the valley. The terrain is intersected by numerous narrow, and relatively deep valleys of small rivers and streams that make up a dense network of valleys. The landscape is completed with vegetation of floodplain forests and shrubs. There are mostly shrubs of willow, poplar, black and gray willow, which stretch in the form of a narrow strip along the watercourse. Communities of False Tamarisk (Myricaria germanica) are especially interesting because they give the landscape specific appeal, especially during flowering. Brushland floodplains should be protected from further degradation due to their background environmental and reclamation function. This picturesque and dynamic landscape is cultivated landscape with a predominantly rural character.

In the area of Bijelo Polje and Berane, due to urbanization, the landscape has completely changed and has the character of the built-up landscape.'

4.7.7 Pešter

The Bar-Boljare SEA describes the Pešter area as follows:

'Montenegrin Pešter with average altitude of between 1,000 and 1,300 m above sea level, is part of the Pešter plateau in the wider geographical sense. The space between Bjelopoljska Bistrica in the northwest, Rožaje in the west, Lim in the south and the northern Serbian Pešter, is largely covered with mountain meadows.

This rounded morphology has the characteristics of a flowery meadow from May through July, after which it gets a predominantly yellow color of faded grass from early November. During the winter, the area is dominated by snow, with all the characteristics of such seasonal microclimate: the whiteness of snow, blizzard, snow, snowdrifts, and also the rural idyll characteristic for this kind of atmosphere….

Forest mosaics are related to the narrow basins of the Bistrica, Crnča, Tronoša and Lješnica Rivers. In this forest mini-ecosystems, dominant species are oak, beech and fir, depending on altitude and terrain exposure.'

5 ASSESSMENT OF OPTIONS

5.1 Purpose of Options Assessment

The main purpose of this report is to document an initial strategic level review of the route options where they involve new construction (e.g. new carriageway, bridges, tunnels), particularly in relation to environmental and cultural heritage aspects. The environmental impacts of minor maintenance works to existing roads (e.g. installation/replacement of safety barriers, minor slope stabilisation works) have not been reviewed.

The TEM design standards referred to earlier indicate that the new motorway:

will not be designed to serve the properties bordering it;

will have restricted access both in terms of the number of physical access points (interchanges) and the types of vehicles allowed to use the motorway;

will not cross at level with any road, railway or tramway track, or footpath;

will be fenced (to prevent access by people, vehicles, livestock and wildlife).

This means that the people directly affected by construction of the new motorway may, in many cases, be unlikely to benefit from its operation.

This environmental review of options is based on the drawings, which are overlaid on a variety of base maps and images, with additional information (e.g. national park boundaries, locations of monuments, churches and mosques, place names) from the following maps:

Montenegro Road and Leisure Map 1:150,000 Freytag & Berndt (Austria)

Montenegro Mountain Touristic Map 1:50.000 Bjelasica & Komovi (Austria) 2008. This map was developed by the regional tourism organisation Bjesica & Komovi in cooperation with the municipalities of Andrijevica, Berane, Bijelo Polje, Kolašin and Mojkovac.

Note: the sections presented in the drawings have been numbered from south (Djurmani, Ch. 0+870 km) to north (Boljare, Ch. 52+785 km or existing border, Ch. 32+650 km) as indicated in Figure 1-1. This means that, depending on the location, the 'left' hand cuts, slopes and other features may be the eastern, southern or northern side of the road; the 'right' hand cuts, slopes and other features may be the western, northern or southern side of the road. Description of the location of various environmental features within this report, e.g. settlements, lakes, rivers, is consistent with the direction indicated on the drawings.

Note: there appears to be considerable variation between place names and river/stream names given on different maps; consequently there may be multiple names for a location. It is not always clear what is the name for an area/district and what is the name of the settlement itself. In addition, the maps do not show new residential, tourism-related and commercial buildings which appear to have been constructed in several areas - particularly between Podgarica-Bioče in the Morača valley, along the existing road between Bioče- Mateševo and Mateševo-Andrijevica between the site visits in September 2008 and April 2012. The maps also do not show the apparently new churches and mosques that have been constructed in several locations between Berane and Biljelo Polje. These apparent inconsistencies will require clarification during more detailed feasibility stage ESIA studies.

Note: distances given in the following text are approximate.

5.2 Options - Section 1: DJURMANI-VIRPAZAR

5.2.1 Existing Road

The area is very hilly with small settlements and scattered houses. Whilst many homesteads have their own small gardens and vines, the most extensive areas of agricultural land occur in Crmnička Polje valley which drains towards Skadar Lake.

The Montenegrin part of the Skadar Lake was added to the World List of Wetlands of the Ramsar Convention in 1996 and the Albanian part of the lake has also been protected as a Ramsar site since 2006. The lake has been identified as a site for inclusion in the Natura 2000 network in the event that Montenegro accedes to the European Union.

The landscape unit of Skadar Lake is described in Chapter 4.7. The area has extensive scenic views over the hills and the lake towards Albania. The existing road network (comprising the new Sozina tunnel between Djurmani and Jasen, the old Podgorica-coast road between Zukovica and Sotonići and minor village roads linking settlements) are dwarfed by the scale of the hills and lake.

The recently constructed Bar-Sozina tunnel-Virpazar road passes close to many existing settlements including: Brezani (<250 m right), Djurmani (<250 m right), Srednja Maha (<250 m right), Jasen (250-500 m right), Reljići (<250 m left), Suvodo (<250 m right) and Besac (250-500 m right). Some of the settlements are located in the hills above the existing road, others are situated at lower altitudes than the road. Any road upgrading/construction in this area would pass within a similar distance of these settlements.

Cultural/religious buildings and monuments identified in the area include: Sotonići (1.5 km right) - church, Besac (250-500 m right) - fortifications and Orahovo (1 km right) - church/ monastery. As for all areas along the alignment, there may well be other important sites (e.g. religious buildings, graveyards and monuments) which are not marked on the maps reviewed.

The nearest point to Skadar Lake National Park lies at Virpazar at the northern end of this section, about 1 km from park boundary. All water courses in the area flow ultimately into Skadar Lake.

5.2.2 Alternative I-0 - Do minimum/Alternative I-1 - Upgrade existing single 2 lane road

Few details of the 'do minimum' and 'upgrade existing road' options have been made available for review, but they are likely to include: improved signage, improved safety barriers and minor repairs to the road surface and to existing slopes (both cut slopes and embankments).

Assuming that good site practice is observed in regard to equipment noise and air emission control and waste management, the environmental impacts associated within these works are expected to be negligible.

5.2.3 Alternative I-2 - Construct 2nd 2 lane carriageway

This alternative would involve widening the existing 2 lane road and addition of a second carriageway (9.23 km).

Because of the terrain throughout the Bar-Boljare Corridor and the concentration of settlements and agricultural land on valley floors and slopes, extensive use of tunnels, reinforced and high embankments and high cuts for a constructed road on almost any new alignment - or the improvement/widening of almost any existing road - is inevitable.

Around half of the new carriageway would be in tunnel and 430 m length of steep (2 vertical: 3 horizontal) reinforced and high embankments would be required. The design engineers estimate that the scale of surplus excavated materials would be small-medium. Bridges and underpasses would be constructed to maintain the existing road and drainage networks.

5.2.4 Alternative 1-3 - Construct 2nd 2 lane carriageway on different alignment

This alternative, which would be less expensive to construct than Alternative 1-2, would be shorter (9 km), have two fewer bridges and a marginally shorter tunnel (110 m less). However, it would require longer stretches of reinforced and high embankments (2V:3H and 1V;1H) and 1,765 m of high cuts (3V:1H),with an estimated small surplus of excavated materials. In addition, some expropriation of agricultural land: the precise area and indicative cost of expropriation has yet to be determined. Bridges, under- and overpasses would be constructed to maintain the existing road and drainage networks.

5.2.5 Discussion

In environmental terms, there seems little to choose between the two options: both will require major construction works and affect a similar number of environmentally sensitive receptors (e.g. villages, streams). However, Alternative 1-3 would require the loss of some agricultural land, which is to be avoided if possible.

5.3 Options - Section 2: Virpazar-Farmaci

5.3.1 Existing Road

The existing route follows the valley between hills then existing road/rail route across Skadar Lake to Vranjina hill and adjacent Lesendro fortress, with extensive views of the lake and surrounding hills. The route crosses flat, low-lying marshland/agricultural land through villages and increasingly semi-urban and urban areas, with residential and commercial properties close to existing road, to Podgorica itself. The landscape unit of the Zeta-Bjelopavlićka plain is described in Chapter 4.7.

The road network currently comprises the new Bar-Sozina tunnel and old Petrovac-Sotonići route which meet at Sotonići. There is a junction at Virpazar with local roads to Gornja Seoca, Cetinje and villages. The existing route crosses Skadar Lake to Vranjina then crosses marshy and agricultural lands east of Morača River via Bistrice, Bijelo Polje, Goričani, Mojanoviči, Mahala, Lajkoviči to Podgorica.

The extent and depth of Skadar Lake varies throughout the year. The road part of the existing road/rail embankment between Virpazar and Vranjina is subject to occasional flooding and associated traffic disruption.

The existing road passes close to many settlements. Some of these are located in hills above the existing road, whilst others are at a lower altitude. Villages in close proximity to the existing route include: Suvo - scattered buildings (<250 m right and left), Virpazar (<250 m left), Vranjina (<250 m left), Bistrice (<250 m left), Bijelo Polje (<250 m left), Goričani (<250 m left), Mojanoviči (<250 m left), Mahala (<250 m right), Lajkoviči (<250 m right), Farmaci and Podgorica itself.

The existing route runs for 6.5 km across Skadar Lake National Park and Ramsar site between Virpazar and Vranjina, then a further 5 km to the boundary of the national park. In total the existing route crosses the marshlands and open lake areas of the park for around 11.5 km.

Protected cultural monuments include Lesendro fortress (500 m right), adjacent to the existing road/rail causeway between Virpazar and Vranjina, Orahovštika and Skadar Lake itself.

The Morača River is the largest tributary of Skadar Lake. The Morača River and its smaller arms (the Zeta and the Cijevnom) provides around 62% of the water of Skadar Lake: much of the remainder is provided by underground springs within the lake. The Morača River receives water from the intermittent tributaries Mala Rijeka near Bioča, Ribnica through Podgorica, Zeta and Sitnica.

The route of the existing Bar-Podgorica road crosses two branches of Morača and runs within 300 m of a tributary of the Morača for several km. Two branches of the Morača enter Skadar Lake either side of Vranjina hill. Between Suvo and Ponari, the route drains directly into Skadar Lake for around 14 km.

5.3.2 Alternative II-0 - Do minimum

No details of the do minimum road option have been made available for review but they are likely to include: improved signage, improved safety barriers and minor repairs to the road surface.

Assuming that good site practice is observed in regard to equipment noise and air emission control and waste management, particularly the handling of oils and other chemicals, the environmental impacts associated within these works are expected to be limited.

However, with the existing road remaining as the main cross-country route for transit traffic, the potential for major traffic-related water pollution incidents such as oil tanker spillages on the cross-lake bridge and causeway are of concern.

5.3.3 Alternative II-1- Construct new 2 lane road in new alignment across Skadar Lake; could prepare for 4 lanes

This route follows the valley then the existing road/rail route across Skadar Lake to Vranjina hill and adjacent Lesendro fortress, with extensive views of lake and surrounding hills. The route then crosses low-lying marshland to hills near Ponari before taking a new alignment across the hills to join the existing Podgorica-Cetinje road near Farmaci, thus reducing the potential impact on the built up areas on flat land towards Podgorica.

This alternative (also known as the east route) involves the construction of a new interchange near Virpazar in the marshy area close to the boundary of Skadar Lake NP. Following four tunnels, the route crosses the existing road/rail link and Skadar Lake to Vranjina, on a 1,300 m long bridge, followed by a tunnel through Vranjina Mountain. The route would then cross several kilometres of marshland within the national park before crossing the Morača River on a 160 m long bridge.

Following a new route, the road would pass through the hilly area west of the Morača River. Construction of the new road would require 3 km of reinforced and high embankments (2V:1H and 2V:3H) and 3.1 km of high cuts (3V:1H). In addition, a very long and high bridge (dimensions not yet defined) would have to be constructed at Ch.18+400.

Between Suvo and Ponari, the route is essentially the same as the existing one. The attractive settlements of Virpazar and Vranjina, which both lie within 250 m of the new route, and the nearby Lesendro fortress, are likely to be significantly impacted by the new road, particularly in terms of visual impact.

Settlements closest to the new route include: Ponari (500 m left), Grbava (500 m left), Kokoti (500 m left) with a few buildings <250 m from alignment and G. Kokoti/Selista (500 m right).

The proposed route runs for 6.5 km across Skadar Lake National Park between Virpazar and Vranjina, then a further 5 km to the boundary of the national park: in total around 11.5 km.

As for the existing route, this alternative repeatedly crosses the Morača River, a major source of water for Skadar Lake. Between Suvo and Ponari, the route drains directly into Skadar Lake for around 14 km. Ponari is on the Karatuna River, a distributary of the Morača. Over the following 4 km, the route drains westward into Gorije Malo Brdo (part of Skadar Lake), then for around 7 km drains eastward to the Morača, or to the Sitnica, a tributary of the Morača. The importance of avoiding water pollution from construction and operation of the proposed route cannot be over-emphasised.

This option would cross urban residential areas and require extensive expropriation of expensive land – for example km 8.5 – 9.6. Medium quanitities of borrow materials would be required for embankment formation and small-medium amounts of surplus excavated materials would be generated.

5.3.4 Alternative II-2 - Construct new 2 lane road on new alignment avoiding Skadar Lake (II-a) and upgrade existing 2 lane road Farmaci-Cetinje (II-2b)

By branching northwards from Virpazar rather than eastwards towards Vranjina, alternative II-2 avoids construction activities within the Skadar Lake NP as far as possible.

The route follows the valley between hills then crosses marshy Orahova valley to hills, from where there are extensive views eastward of lake and surrounding hills. The route crosses the Rijeka Crnojevića on a long bridge, several kilometres downstream of the historic settlement of Rijeka Crnojevića. The route then enters a hilly area with scattered settlements to meet Podgorica-Cetinje road; land either side of Podgorica-Cetinje road appears quite rocky and barren.

The existing road network includes the new Bar-Sozina tunnel and old Petrovac-Sotonići route whichmeet at Sotonići; the junction at Virpazar with local roads to Gornja Seoca, Cetinje and villages; local roads to villages in hills. The new route will join existing Podgorica-Cetinje road near Grubani and measures to upgrade the stretch between Grubani and Podgorica are proposed.

Existing settlements along the proposed route include: Virpazar (<250 m left); Jabukova (<250 m right); Grado (<250 m right); Crnohijva and Komarno (500 m right of the proposed tunnel alignment); Bakljanci (<250 m left); Zaškek (<250 m right); Poselan (<250 m left); Donje salo (250 m right); Zavratno (500 m right); Burger (<250 m left); Mihajloić (<250 m left) a larger settlement; Gagosi (250-500 m right); Rijecani (500 m right); Drušići (250-500 m right) a larger settlement; Doljane (750 m left) and Grubani (500 m left).

The following settlements are close to the existing Podgarica-Cetinje road: Brežine (<250 m) a larger settlement; Barutana (500 m left); Bigor (500 m right); Liješug (500m right), G. Kokoti (500 m left) and Farmaci.

Around 15% of the route would be in tunnel. Between a 1,400 m tunnel and a 465 m tunnel, the alignment runs for around 2 km alongside the Skadar Lake National Park in parts within 250 m of the lakeside. The route crosses around 3 km of Skadar Lake NP between Rijicani and Drušaci, with 800 m bridge up to Rudinsk lug (bay) over Rijeka Crnojevica. All watercourses crossed by the route flow into Skadar Lake.

Land acquisition impacts would be felt at various locations – for example km 8.5 and 18-19 – agricultural land/terraces and scattered housing. Properties at Farmaci (including Farmaci Interchange) are potentially of high value.

In relation to cultural monuments and religious sites, the route avoids Lesendro fortress (2 km left) and passes within 500 m of the following: Komarno church (500 m right, NB road in tunnel here); Donje salo church (250 m right); Rijiecani church (500 m right); Brezine church (<250 m right) on existing road.

5.3.5 Discussion

Alternative II-2 is the preferred option in environmental terms, primarily because it seeks to minimise potential direct and indirect environmental impacts on the internationally important Skadar Lake National Park and Ramsar site. The route bypasses Skadar Lake in an optimal way, avoids construction in marshy areas, would result in less impacts on existing land uses and activities and utilises an 8.20 km long section of the existing Farmaci-Cetinje road. It would not require extensive expropriation of expensive land and the volume of surplus excavated materials is expected to be medium.

Alternative II-2 will divert transit traffic away from built up areas along the existing road from the coast to Podgorica, improving the traffic related congestion and environmental nuisance currently experienced by these communities.

5.4 Options - Section 3: Farmaci-Smokovac

5.4.1 Existing Road

The existing route follows a flat plain crossed by Moraca and Zeta Rivers, which intersect at Podgorica, surrounded by hills. There are extensive areas of agriculture/horticulture around Farmaci and northwest of Podgorica. Elsewhere, there are mixed residential/ commercial/ industrial uses associated with the urban/suburban areas of the capital city; development is less dense on urban fringes.

The road network in the area comprises the Podgorica-Cetinje road, the existing bypass, and existing urban and rural roads. There are no easy routes around Podgorica and traffic is affected by congestion and delays of varying severity, particularly within the urban areas, on a daily basis.

According to Podgorica Municipality the network is heavily congested by transit traffic in the high season (June-September) when the traffic levels - particularly tourists - are said to increase up to 20 times. Transit traffic goes through the urban areas on local roads, which reduces the quality and continuity of traffic on main routes. The mini bypass constructed in 2011 with a length of 7 km on the road running in north–south direction, greatly improved the flow of local and transit traffic, and pointed to future optimal solutions.

5.4.2 Alternative III-0 - Do minimum

As indicated above, the existing road network does not allow for unhindered transit of passenger and commercial vehicles within and around Podgorica. The lack of free flow traffic conditions in close proximity to residential blocks and pedestrian walkways means that large numbers of people are potentially subject to traffic noise and exhaust emissions.

5.4.3 Alternative III-1 - Construct new 4 lane road in new alignment and interchange with Adriatic-Ionic motorway at Strganica (NB Alt III-1 and III-2 identical for first 12,409 m (Strganica I/C))

The proposed alternative would involve construction of a new road and interchange to the north of Podgorica. This alternative takes into account the preferences of Podgorical Municipality.

The following settlements are within 500 m of the proposed alignment: Cafa (<500 m left); Tološi (<250 m left) - quite dense; Luzani (250 m left); Vranicke Njive (500 m left); Kucice (500 m left); Vukovic (<250 m right); Baci (<250 m right); Potpeca (500 m right); Zavala (<250 m right) and Gornje (500 m right).

Tološi district is a protected natural monument, possibly due to its scenic natural qualities. The area has been subject to extensive illegal construction. The only site of cultural importance identified close to the alignment is Tološi church (250-500 m left).

This alternative avoids the need for road construction across Licine Hill, which would be clearly visible from Podgorica. It also avoids the need for additional road construction at the entrance of the spectacular Morača valley.

In a meeting with Podgorica Municipality, the following observations were made:

'The construction of the interchange in Strganica instead of Smokovac should render it possible to avoid tunneling three hills: Gradiška (l = 1103m), Velji peak (l = 1104m) and Suka (l = 717). The motorway would run through geologically stable fields without landslides and rockfalls, and the construction itself would be much easier, because it would have no impact on the existing motorway M2, at which traffic would often need to be interrupted in the event of developing an interchange in Smokovac. It would lead to a longer duration of the already demanding work on the tunnels, which in turn would have an impact on the economic aspects of implementation.

Furthermore, the fact that Strganica is separated by hills from the urban areas, while in contrast the village Smokovac is visible to the city and exposed to the dominant north-east winds, from the aspect of environmental protection this has great and immeasurable importance reflected in the reduction of negative impacts on the city and environment during construction and operation of the motorway. The Smokovac area, which is populated unlike Strganica, represents a land of great value that could be optimally used in accordance with the natural environmental attributes and resources. The Strganica area consists of mostly non-arable land of lesser value, which would lead to the final cost of expropriation being significantly smaller.'

As well as reducing the amount of land resumption required in the urban fringe areas, the route avoids the important Dukla archaeological site to the north of Podgorica. Acquisition of agricultural land will be required. However, as indicated above, it is mainly non-arable land.

5.4.4 Alternative III-2 - Construct new 4 lane road in new alignment and interchange with Adriatic-Ionic motorway at Smokovac

For the first 12 km, this route follows the same route as Alternative III-1, i.e. the flat plain crossed by Moraca and Zeta Rivers, which intersect at Podgorica, surrounded by hills; the extensive agriculture/horticultural areas around Farmaci and northwest of Podgorica.

As this alternative involves construction of an interchange at Smokovac, it has greater impacts on the mixed residential/ commercial/ industrial uses in northern Podgorica (particularly around km63-66, which are high-value, including vineyards). In addition, it will require construction across Licine Hill, which result in a visual scar which is visible from extensive areas in and around Podgorica. From Smokovac, the alignment enters the narrow , congested entrance of Morača valley, resulting in physical and visual disturbance in this area.

Settlements close to the alignment include: Cafa (<500 m left); Tološi (<250 m left) - quite dense; Luzani (250 m left); Vranicke Njive (500 m left); Krugori (250 m left)/Dukla (500 m left); Stralic (<250 m left); Priboj (<250 m right); Vladiste (250 m left); Rasi (<250 m right) and Smokovac.

Sites of cultural and archaeological importance in the area include: Tološi church (250-500 m left); Dukla archaeological site and Zlatica archaeological site.

5.4.5 Discussion

As indicated above, Alternative III-1 (with an interchange located at Strganica) is the strongly preferred option for a variety of environmental and socio-economic reasons, including minimising the potential visual impact of the proposed motorway on Podgorica's residents and visitors.

Alternative III-1 will divert transit traffic away from built up areas along the existing road network, improving the traffic flows and reducing the traffic-related environmental nuisance currently experienced by the population of Podgorica.

5.5 Options - Section 4: Strganica (Smokovac)-Mateševo

5.5.1 Existing Road

The landscape of this section is a dramatic combination of mountains and valleys, with extensive views, as described in Chapter 4.7.

The purpose of Bar-Boljare motorway is primarily to improve the existing transit times and safety for long distance traffic through Montenegro. The main road between Podgorica (Smokovac) and Bioče is a two lane road (one in each direction) up the Morača valley with steep gradients, many tunnels and bridges, and steep drops to the river. This road links eventually to the regional centre of Kolašin.

Between Bioče and Mateševo, where a new route is proposed, the existing road is a narrow tarred road with steep gradients and tight hairpin bends, with minor tracks to small settlements scattered in the valleys. The road is only wide enough for two small vehicles to pass each other with caution. Settlements in this area are widely scattered. There was still snow on the road in late April and evidence of landslides. There is very little traffic.

The Smokovac-Mateševo EIA notes that all settlements in this section mainly villages, usually composed of several small hamlets, which are not registered by censuses. The settlements are connected to the public electric power network, all settlements are supplied with water from their own local water supply networks and none of the settlements have sewerage networks for wastewater, sewage and other wastewater being conveyed into the soil or the nearest water course.

The road in Veruša/Tara valley between Cucevica and Mateševo falls within the transition zone of the Tara River Basin Biosphere Reserve; Mateševo is around 40 km upstream of boundary of Tara River Canyon and NP Durmitor.

5.5.2 Alternative IV-0 - Do minimum

The existing road network is described above. It links the urban/suburban fringe of Podgorica to the guesthouses, residences, commercial/industrial up Morača valley. Between Bioče and Mateševo the area is one of small settlements and farmsteads in rugged topography. This second section is not one at present which would attract commercial vehicles or other types of transit traffic.

5.5.3 Alternative IV-1 - Construct new 2 lane road in a new alignment (IV-1a); could be prepared for 4 lanes (IV-1b); compatible with interchange with Adriatic-Ionic motorway at Smokovac

The starting points of Alternatives IV-I and IV-2 are highly dependent on the alignment of the Adriatic-Ionic Motorway and on the location of is major interchange in the Strganica-Smokovac area.

Alternative IV-I is almost 46 km long and runs along the southern slopes of Vezenik hill, following a route parallel to the Morača River, the railway and the Old National Road. This section includes three long tunnels, a major interchange at Smokovac, and a 370 m long/70 m high bridge over the Morača River near Bioče. Both alternatives IV-1 and IV-2 have the same bridge.

The route then traverses mountainous territory with altitudes of 250 m-1,170 m: about 44% of the route will be elevations exceeding 1,000 m. A very long tunnel (4.2 km) will be required as well as 5 smaller tunnels and 5 large span bridges. The final section of the route includes two tunnels of 970 m length and several bridges.

Construction of a new road, as proposed, would affect the following areas:

suburban fringe of Podgorica; Smokovac - other side of Morača River; Velo Luka - other side of river; Vezista (<250 m left); Gornje (500 m right); Pocic (750 m left) - other side of river; Zagrade (500 m right); Bioče (<250m-500 m left); Potkraj - other side of river; Moracica Bridge passes directly over Jeli Dub; Pavlic (<250 m right); Brat (<250 m right); Tirmojevica (250-500 m right);

Gusic (<250 m right); bridge passes over Mocijta (<250 m left) and access road; Ptic (<250 m right); Kami (500 m left); Lijeka Rijeka (500 m left) - larger settlement; Zagrade (<250 m right); Lopate (<250 m right); Kovacica (<250 m left) - Cucevica?; Cesto (<250 m right); Pajkov Vir; Jabuka (<250 m left); Zauglina (<250 m right); Jasen (passes over); Pešića Luka (250 m-500 m left); Lazi Raderica (250 m-500 m left) and Mateševo.

The road in Veruša/Tara valley between Cucevica and Mateševo falls within Tara River Basin Biosphere Reserve; Mateševo is located around 40 km upstream of the boundary of Tara River Canyon and NP Durmitor.

Cultural buildings in the area include: Bioče - church (500 m left); Klopot - church; Vilac/Pelev Brijeg - fortress and church; Lijeva Rijeka - church and monument (<250 m left).

Rivers in the area include: the Morača itself, Suvovare, Suvoa Bube, Veruša and Opasanica which merge around 1 km upstream of Han Garanšića to form the Tara River. Between Cesto and Jasen (6 km), alignment one bridge over tributary (Cestogaz) and crosses and re-crosses Tara River on 8 bridges.

This option will require occupation/expropriation of expensive land. In total, around 21% of the route will be in tunnel and 10% on bridges. The scale of surplus excavated materials is expected to be very large.

5.5.4 Alternative IV-2 - Construct new 2 lane road in new alignment (IV-2a); could be prepared for 4 lanes (IV-2b); includes interchange with Adriatic-Ionic motorway at Strganica and eastern branch to link with existing road and Podgorica road network at Smokovac

This alignment is 1.8 km shorter than Alternative IV-1 and has one tunnel (3.2 km) in the first section, instead of 3 tunnels.

The alignment essentially affects the same settlements, road network and water courses as indicated above. However, it provides a better linkage to the existing and proposed road network (i.e. Adriatic-Ionic Motorway) and potentially causes less environmental and social impacts, by avoiding extensive works in the congested urban area of Smokovac, the Old National Road, the railway and the entrance to the Morača valley. Both alternatives have the same bridge over the Morača valley near Bioče.

This option will not require occupation/expropriation of expensive land. In total, around 20% of the route will be in tunnel and 10% on bridges. The scale of surplus excavated materials is expected to be very large.

5.5.5 Alternative IV-1+III-2 - Includes branch road interconnecting to local road network at Smokovac

This alternative locates the main interchange at Strganica, with a tunnel through the mountains to the Morača valley as described above, but also includes a minor road link to the local road network at Smokovac.

5.5.6 Discussion

As indicated above, Alternative IV-2 (with an interchange located at Strganica) is the strongly preferred option for a variety of environmental and socio-economic reasons.

Between Bioče and Mateševo, both alternatives essentially follow the same route. The road in Veruša/Tara valley between Cucevica and Mateševo falls within Tara River Basin Biosphere Reserve (note that Mateševo is located around 40 km upstream of the boundary of Tara River Canyon and NP Durmitor). Effective measures to avoid adverse impacts on natural drainage and water quality in this area are essential.

Podgorica Municipality has strongly suggested siting the Strganica Interchange approximately 0.5km to the East of the current-proposed alignment for the Strganica Interchange option for reasons of technical feasibility and reducing the scale of land acquisition.

5.6 Options - Section 5: Mateševo-Andrijevica

5.6.1 Existing Road

This area is extremely rugged country, with distant and close views of mountains. There are scattered small settlements, farmsteads and holiday chalets along the route. Much farmland in this region is upland pasture. The landscape in the Bjelasica and Komovi areas is described in Chapter 4.7.

The existing Matesevo-Andrijevica road is narrow tarred road with hairpin bends and minor tracks to settlements. There is very little traffic.

The road between Mateševo-Trešnejevik falls within the transition zone of the Tara River Basin Biosphere Reserve; Mateševo is around 40 km upstream of boundary of Tara River Canyon and NP Durmitor; 3.5 km from border of Komovi mountain. The road forms the border between two regions: Bjelasica and Komovi.

5.6.2 Alternative V-0 - Do minimum

Between the site visits in September 2008 and April 2012, the some repairs and improvements to the road have been undertaken, e.g. repair of bridges, installation of some safety barriers.

5.6.3 Alternative V-1 - Construct new 2 lane road in a new alignment (V-1a); could be prepared for 4 lanes (V-1b)

Given the difficult geomorphological conditions at high elevations, both alternatives require long tunnels (around 20% of the route), many bridges (around 8% of the route), high embankments and high cuts. In both cases the works are expected to generate large amounts of surplus excavated materials and require medium amounts of borrow materials.

This alternative is 24.05 km long. After Mateševo Interchange, the first tunnel (690 m long) is located at about Ch.1+300 and there are 4 shorter tunnels and 6 bridges before a very long tunnel (3.6 km long) under the highest point (around 1,200 m altitude). Between the highest point and Andrijevica there are 2 shorter tunnels, 4 relatively low bridges and 6 relatively high bridges.

Existing settlements along the proposed alignment include the following: Pešica Luka (<250 m left); Radevica (<250 m left); Doline (500 m left); Jasenova Klada (500 m left); Han Drndarski (left); Kralje (<250 m left); Peovac (500 m left); Salevići (250-500 m right); Prisoja (500 m right) and Andrijevica (>500 m left).

Cultural structures include: Bare Kraljeske - monument (500 m left); Kralje church (500 m left); Sjenozeta church on old road; Andrijevica church and monument (500 m left).

5.6.4 Alternative V-2 - Variation of new 2 lane road of Alt V-1 with reduced construction cost

This alternative is 24 km long. After Mateševo Interchange, the first tunnel is 530 m long and there are 2 short tunnels, 4 sections with high cuts (tunnels may be required if geological conditions are adverse), 1 bridge and several high embankments. There is a very long tunnel (3.5 km long) under the highest point (around 1,200 m altitude). Between the highest point and Andrijevica there are 3 sections with high cuts, a low bridge and 5 relatively high bridges.

The settlements and cultural monuments affected by this variation are the same as above.

5.6.5 Discussion

The selection of alternatives will be dependent on reliable topographical and geotechnical data, which will only be available during a later design stage. As for all sections, effective measures to avoid adverse impacts on natural drainage and water quality are essential.

5.7 Options - Section 6: Andrijevica-Berane-Poda

5.7.1 Existing Road

Andrijevica is located on the narrow plateau of Radunova above the banks of the Lim River. The town was founded during the Nemajici Dynasty (12th century). The church of the St Archangel Michael is located in the town centre. Important buildings within 500 m of the existing Matesevo-Andrijevica-Berane road include a chapel and a secondary mixed school.

First settlements in the Berane municipality date back to the Middle Ages. Traces of earlier civilisations date back to the Illyrian, Celtic and Roman civilisations. Đurđevi Stupovi monastery was built in the 12th and 13th century. The Budimljan episcopacy was established in 1219, and it remains the spiritual and cultural centre of the area.

The area comprises the wide valley of Lim River with residential and agricultural development to Berane; industry and commercial activity concentrated in Andrijevica, Berane and Biljelo Polje; narrow gorge north of Berane opening to wider valley with villages either side;

residential and other development either side of existing road from Bijelo Polge to border. There is an airport at Berane. The landscape of the area is described in Chapter 4.7.

The main roads from Mojkovac and Berane follow the available valleys, link south of Biljelo Polje and go to the existing Montenegro/Serbia border crossing. A network of rural roads and tracks link to small settlements in the valleys and remote hills.

5.7.2 Alternative VI-0 - Upgrade existing 2 lane road

The existing road could be upgraded with installation or replacement of safety rails at the roadside and on bridges, slope protection works, improved slope/surface drainage and construction of an emergency lane.

The length of the existing road and all proposed alternatives are similar: approximately 26 km.

5.7.3 Alternative VI-1 - Construct new 2 lane road in a new alignment (VI-2a); will be prepared for 4 lanes (VI-2b)

The proposed alternative, which essentially follows the existing road, will affect the following settlements:

Slatina (<250 m right) - scattered houses; Rasoje (250-500 m right); Tresnjevo (<250 m right); Sitna Luka (<250 m left); Crvene prie (<250 m left); Čoveča Glava (<250 m right); Lukin Vir (250-500 m left, other side of river); Trepča (<250 m right); Trebacki (<250 m right); Marsenika Rijeka (500 m left, other side of river) mid tunnel; Zabreda (<250 m right) - scattered buildings; Vinicka (500 m right); Navotina (500 m left, other side of river);

Buče (<250m right); G. Lužac (<250 m right)/D. Lužac (<250 m left); Dolac; Baren Selo - route crosses; Donje Zaostro (250 m from tunnel route?); Skakavac (<250 m left, other side of river); Crvljevine (250 m right?); Gorje/Krlje? (<250 m right); Raspori (<250 m left, other side of river); Do Stitari (<250 m right); Lukavica (<250 m right); Bioča (500 m left, other side of river); Radulska (<250 m left); Poda (250-500 m left); Srdevac (250-500 m left) ; Ivanje (<250 m left); Slatina (<250 m left) and Sipovica (<250 m right).

Sites of cultural and archaeological importance close to the alignment include: Dolac - archaeological site(<250 m right); Đurđevi Stupovi monastery (< 250 m right); Monastery Šudikovo - recently rebuilt close to ruins by the Lim River. The route intersects the runway of Berane airport.

From Andrijevica, the route runs alongside the major Lim River for over 4 km, crossing it in 4 locations. The alignment would require 4 bridges over the river together with extensive protection works for the motorway and revetment of the river. In addition, considerable improvements to the existing road would be required. In total, this option would involve the construction of 28 bridges compared with the two or four required by the other alternatives.

Tributaries of the Lim River include: Šekularska, Kaludarska, Dapsićka River, Lješnica and Crnča; Zlorečica, Kraštica, Trepačka, Ševarinska, Vinicka and Bistrica. The route crosses a number of water courses and, beyond Berane, runs along the Lim River for over 13 km, within a narrow gorge which then widens. Over all this stretch, the route is within 500 m of the Lim River and within gorge is within 250 m.

According to Berane Municipality, the alignment passes close to the Manastrisko vrelo water source which used to be the main source for Berane: now 30-40% of water from this source goes into the municipality supply.

Berane Municipality has suggested that the alignment is moved 500 m to 1 km towards the west. This alteration would mean that the route avoids Berane airport. Rather than potentially affecting 30% of the municipality, the new variation would traverse the periphery of Vinicka, Buča and Lužac villages.

5.7.4 Alternative VI-2 - Variation of new 2 land road of Alt VI-1 that will have reduced construction cost; could be prepared for 4 lanes (VI-3b)

The settlements, rivers and other features are similar to those described above. However, given that the alignment is located beween the river and the existing road, the improvements to the existing road required in the preceding option would no longer be necessary. Whilst a 750 m tunnel would be required between Ch.4+200 and Ch.5+500, this would avoid the need to demolish buildings in this area.

5.7.5 Alternative VI-3 - Variation of new alignment of Alt VI-2 from Ch.3+800 to Ch.6+500

This varation improves the motorway geometry and minimises interference with the existing road and the river. The settlements, rivers and other features are similar to those described above.

5.7.6 Alternative VI-4 - Variation of new alignment of Alt V1-2 from Ch.13+200 to Ch.17+500

This variation removes the requirement for high bridges, reduces the visual impacts, improves the motorway geometry and avoids the need for high cuts and high embankments. The settlements, rivers and other features are similar to those described above.

5.7.7 Discussion

As indicated above, all the alternatives are a similar length, around 26 km, and will generate medium quantities of surplus excavated materials. All will involve disturbance of urban areas and occupation/expropriation of expensive land, particularly in and around Berane. Measures to minimise direct and indirect impacts on the important Đurđevi Stupovi monastery and water source and existing communities should be implemented, preferably by maximising the distance between the motorway and sensitive areas.

5.8 Options - Section 7A: Poda-Boljare

5.8.1 Existing Road

There is no existing road between Poda and Boljare where a new Serbian Border checkpoint is planned. The area is characterised by mountains with wide valleys and scattered houses, and a sparse network of minor roads. The landscape of the area is described in Chapter 4.7. There is considerable difference in elevation between Poda (at around +620 m) and Boljare (at around 1,270 m).

5.8.2 Alternative VII-1 - Construct new 2 lane road in new alignment with reduced construction cost; could be prepared for 4 lane

This alternative is 25.3 km long and includes several tunnels (700 m, 450 m) and bridges (up to 100 m long). There will be many sections with high cuts and embankments. The volume of surplus excavated materials is likely to be small and the scale of borrow materials required is likely to be medium.

Settlements adjacent to the proposed route include: Slatina (<250 m right); Crnča (<250 m both sides); Cepice (<250 m both sides); Ivanje (250-500 m left); Sipovici (<250 m right); Mekići (<250 m left) and Duplajci (<250 m left) before meeting the Serbian border.

The only cultural building identified is Ivanje church > 500 m.

5.8.3 Alternative VII-2 - Variation of alignment of Alt VII-1 from Ch.34+000 to Ch.47+000

This alternative is 30.62 km long and includes a similar number and scale of tunnels, bridges, high cuts and embankments as Alternative VII-1. The volumes of surplus excavated materials and borrow materials required is likely to be similar to Alternative VII-1.

Settlements on this route are essentially the same as above: Slatina (<250 m right); Crnča (<250 m both sides); Cepice (<250 m both sides); Ivanje (250-500 m left) and following tunnels/bridges Ivanje (<250 m left); Godijevo (<250 m either side); Kradrnik (<250 m left); Rrascevine (<250 m left); Mekići (<250 m left) and Duplajci (<250 m left).

Ivanje church lies more than 500 m from the route.

The main differences between this and the preceding alternative are the length (it is 5.33 km shorter) and the gradient (it has a better longitudinal profile).

5.8.4 Alternative VII-3 - Variation of alignment of Alt VII-1 from Ch.27+500 to Ch.47+000

This alternative, a variation of Alternative VII-1 from Ch. 27+500 to Ch 47+000, is 25.2 km long. However, it involves many more tunnels and bridges than the preceding options and the gradients are worse. In addition, the scale of surplus excavated materials is anticipated to be high.

Settlements within 500 m of the route include only: Slatina (<250 m right); Crnča (<250 m both sides) and Duplajci (<250 m left).

5.8.5 Discussion

Construction of any of these three alternatives would be a major engineering feat. Alternative VII-2 would appear the preferred option in both environmental and road engineering terms, although would appear to have greater resettlement impacts than VII-1 or VII-3 with more houses/structures potentially affected.

5.9 Options - Section 7B: Poda-Bijelo Polje-Serbian Borders

If construction of the new Poda-Boljare section is delayed, it is proposed that the new motorway could meet the border at the existing Serbian Border checkpoint, north of Bijelo Polje.

Bijelo Polje is the cultural, financial and administrative centre of the northern part of Montenegro. It is the third largest city in the country. The town was founded in the 12th century. Archaeological relics found in the Bijedici area date back to the Neolithic period; traces of the Illyrian and Roman legions have also been found.

A number of alternatives are proposed which follow the existing road or which 'cut the corner', following a shorter route to/from Bijelo Polje via a tunnel.

5.9.1 Existing Road

The existing area comprises mountains and the current main road along the Lim valley. There are houses, gardens, agriculture, industry and commercial activities both sides of existing road especially at Bijelo Polje, where the railway lies to the right. The main roads from Mojkovac and Berane link south of Biljelo Polje before going to the existing Montenegro-Serbia border crossing point. A bypass has recently been constructed around part of Bijelo Polje.

Nearby settlements along the existing roads include: Slatina (<250 m left); Brestovik (<250 m left); Brazava (500 m right, other side of river); Pasića Polje (<250 m left); Kamina (<250 m either side of road); Zaton (<250 m left); Sakate (<250 m either side of road); Nova Selo (250-500 m left); Grudevica (250-500 m right, other side of river); Ljubovida (<250 m right, other side of river); Kruševo (<250 m either side of road); Bijelo Polje (<250 m either side of road); Džastica Brdo (<250 m right); Nedakusi (<250 m either side of road); Slijepašnica (500 m right); Potkrajci (<250 m either side of road); Prestreke (<250 m either side of road); Sutivan (<250 m right); Unevine (<250 m right) and Metanjaci (<250 m both sides).

Existing cultural and religious buildings include: Zaton mosque (250 m left); St. Jovan monastery/fortress, Zaton (<250 m left); St. Nikola (<250 m left other side of river) - place of particular interest; St. Petar i Pavao (<250 m right); Church at Obrov (500 m, other side of river); Church in Biljelo Polje (<250 m right) and Sutivan mosque (<250 m left).

The church of St. Petar i Pavao, built in the 12th century, is the most significant cultural monument. The church, which has been the Bishop's seat since 1321, contains one of the oldest and most beautiful manuscripts written in Cyrillic on parchment. The church of St. Nikola, in Nikolajac on the opposite side of the Lim River to the main road, was built in the 14th century. This church has a library with 84 manuscripts and 97 printed books

The route follows Lim River from Poda to existing border crossing – about 33 km – for most of route within 500 m of river channel. Many water courses crossed by existing road, e.g. Lim River and Liešnica river.

5.9.2 Alternative VII-4-0 - Upgrade existing 2 lane road

There is scope for upgrading along the existing road, such as installation or replacement of safety rails in appropriate locations at the roadside and on bridges, slope protection works, improved slope/surface drainage. In many areas, construction of an emergency lane is constrained by the presence of residential and other buildings and electricity poles being located close to the edgelines of the road.

5.9.3 Alternative VII-4-1 - New alignment between two sections of existing road (Ch.7+102 existing road to Ch.21+000 - end of Biljelo Polje Bypass)

This route, which reduces the distance between Poda and Biljelo Polje by 8.25 km, runs through a landscape of mountains along the existing road along valley. It includes a new route through a 1,200 m tunnel in mountains with scattered houses, then enters an area of houses, gardens, agriculture, industry and commercial activities both sides of existing road: a situation especially prevalent at Bijelo Polje.

Settlements affected by the route are as follows: Zaton; Krusev Do (<250 m left); Cerovac (500 m left); Grabovi (<250 m left); Reznik (<250 m left) and Bijelo Polje. After this point, the route lies along the existing road.

Cultural buildings include: Zaton mosque (250 m left); St. Jovan monastery/fortress, Zaton (<250 m left) and Reznik mosque (<250 m left).

The main advantages of this alternative is that the tunnel is 800 m shorter than Alternative VII-4-2 and that there are less potential impacts on the built environment.

5.9.4 Alternative VII-4-2 - New alignment between two sections of existing road (Ch.6+419 existing road to Ch.12+516 existing road linking to end of Bijelo Polje Bypass)

This route, which also 'cuts the corner' between Poda and Biljelo Polje, runs through a landscape of mountains along the existing road along valley. It includes a new route through a 2,000 m tunnel in mountains with scattered houses, then enters an area of houses, gardens, agriculture, industry and commercial activities both sides of existing road especially at Bijelo Polje.

Settlements affected by the route are as follows: Zaton; Brdo (250 m left); Votrila (<250 m right); Crn (<250 m right); Plani (<250 m right); ?ica Mala (<250 m left) and Bijelo Polje. After this point, the route lies along the existing road.

Cultural buildings identified are: Zaton mosque (250 m left) and St. Jovan monastery/fortress, Zaton (<250 m left).

The main disadvantages of this alternative, compared with Alternative VII-4-1, is that the tunnel is 800 m longer than Alternative VII-4-2 and that there are more potential impacts on the built environment.

5.9.5 Discussion

Of these three options, Alternative VII-4-1 is preferable in environmental terms. However, a comparison between Alternatives VII-1to VII-3 and Alternatives VII-4-1 to VII-4-3 is more complex because of the widely different scales of construction work, and associated environmental impacts, required.

6 IMPACT ASSESSMENT AND MITIGATION - OVERVIEW

6.1 Introduction

This impact assessment is a broad overview of potential issues associated with construction of the new motorway and/or improvements to the existing road network. Further detailed environmental and social impact assessment studies to meet the requirements of Montenegrin and any international financial institutions will be required at a later stage in development of the design.

The Detailed Spatial Plan (DSP) for Bar-Boljare emphasises the obligation to protect natural resources, primarily the highest quality agricultural land, from the irrational use of water and pollution. According to the Bar-Boljare SEA, the DSP also:

'…*elaborates in detail long-term goals and measures for protection of the soil, groundwater and surface water; improvement of the current condition of vegetation, wildlife protection, protection from polluted area, aesthetic arrangement of the corridor, protection against noise and vibration, solid waste management, prevention of traffic accidents involving vehicles transporting hazardous and toxic chemicals, control of environmental conditions during operation of the motorway as well as additional environmental protection measures on functional and support facilities of the motorway*'.

To date, no detailed environmental impact assessment of the SEETO Route 4 has been undertaken, apart from the Smokovac-Mateševo EIA (2008) which focussed on the noise, vibration and air quality impacts of blasting for cut and tunnel construction, road traffic emissions and tunnel ventilation.

However, as presented in Chapter 3, TEM Standards and Recommended Practice (2002) contain a wide range of practical measures to avoid and reduce potential environmental impacts in relation to:

Aesthetics and landscape;

Landscaping;

Drainage control and pollution prevention;

Erosion prevention;

Animal (livestock and wild animal) control;

Anti-noise measures;

Anti-vibration measures;

Anti-air pollution measures;

Road lighting;

Tunnels

Safety barriers.

6.2 Population and Economy

6.2.1 Construction Phase - Impacts

Impact: Resettlement

In 2007, the Government of Montenegro adopted a Decision to prepare a Detailed Spatial Plan for the Bar-Boljare Corridor. Restrictions were placed on any new development within a corridor measuring 1 km either side of the Bar-Boljare Motorway alignment being promoted at the time. Construction of any section of the proposed SEETO Route 4 is likely to involve land resumption and resettlement of people with properties within the declared corridor, or those who have occupied land or constructed buildings without authorisation in the intervening period. It is anticipated that all structures within motorway footprint and within 40 m of the edge of the motorway will be demolished, in accordance with the Law on Public Roads_14-11-2005_101-05 'width of road protection zone for public roads'.

Although the alignment alternatives have been designed to limit direct impacts on the local population, that is to minimise resumption and demolition of property, some demolition of residential and associated property will be unavoidable. Care will need to be taken to ensure that those more vulnerable to resettlement impacts are identified and provided with appropriate support and assistance, including, where necessary, in terms of livelihood restoration and improvement.

Resettlement impacts will be dealt with under a separate Resettlement Action Plan, prepared according to the provisions of applicable Montengrin Legislation and in line with International Best Practice (including EIB environmental and social safeguards and IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement), and building on the Resettlement Study prepared as part of the present study (see Appendix B).

Resettlement planning and implementation may be phased according to different stages of construction, but for each stage it must always be complete before construction begins.

Impact: Infrastructure

Material assets include properties and infrastructure services, such as gas and water supply, district heating, drainage, telecommunications and street lighting. Whilst most if not all communities in Montenegro are likely to be connected to the public electricity supply, water supply is often from local sources and wastewater disposal, particularly in rural communities, is often into the soil or local water course. Waste management is generally centralised in major urban centres and informal in rural areas.

Impact: Disruption of Access

Severance refers to disruption or restriction of access due, for example, to the construction of a new road with restricted crossing or entry points (such as the proposed motorway) or upgrading of an existing road which leads to increased speed of traffic. This restriction of access means that it is no longer so easy or safe for pedestrians or non-motorised vehicles to reach their agricultural or pasture lands, or neighbours, local facilities (such as shops, schools, religious buildings, health or sports facilities) and local businesses.

Restriction of access can impact on different groups of people in different ways: the requirements of the elderly and disabled, mothers with young children and school children, and elderly farm workers grazing their livestock in particular need to be taken into consideration.

Impact: Construction-related Nuisance

Construction of the SEETO 4 Road Route will inevitably have major, though 'temporary', impacts on the population living, working and travelling in the vicinity of the works sites and access routes.

Typical construction impacts might include a localised increase in noise, vibration, dust and dirt, and a loss of amenity due to the presence of heavy construction traffic. Construction of cuttings and tunnels is likely to involve the use of explosives. Blasting and the movement of plant such as bulldozers, scrapers and dump trucks may cause vibration which can be felt in nearby buildings. Piling can cause periods of intense noise and vibration nuisance.

Careful consideration of practicable measures to minimise the potential nuisance related to construction works will be an essential part of project development.

Impact: Construction-related Traffic Disruption

Impacts on vehicle travellers due to construction activities may consist of longer journey times due to queues and delays at roadworks; traffic diversions can lead to temporary increases in the number of vehicles on local roads. Movement of heavy construction plant and trucks may also disrupt the local movement of traffic.

In addition to movement of considerable quantities of borrow and spoil material, other vehicle movements relating to the transportation of site staff, importation and deployment of plant, delivery of materials and concrete and so on will be required. Good traffic management planning for transport movements along existing public roads will be essential.

Impact: Construction-related Air Quality

Construction-related air quality impacts are mainly associated with the movement of vehicles on unpaved haul roads. Other sources of air pollution nuisance include the transportation of aggregates and other fine-grained materials in uncovered trucks, loading/unloading of materials, wind erosion of stored aggregates and operation of cement batching/asphalt plants. Dust from construction sites may accumulate on roads and buildings, dirtying windows and laundry drying on washing lines, and can contribute to respiratory problems for local people.

Impact: Construction-related Noise

Construction-related noise impacts include the operation of plant and vehicles, percussive piling and blasting. Sudden or continuous noise early in the morning or late at night, on rest days and holidays, during school examination periods, religious services and entertainment performances, can be particularly annoying to local residents.

Impact: Environmental and Social Disruption from Workers

Montenegro has severe and on-going problems of un- and under-employment; inter-ethnic tensions and conflicts occur. An influx of 'outside' construction workers could lead to disruption of local communities.

Depending on the numbers of workers employed, the workforce may be accommodated locally in hotels and guesthouses or within work camps. Poor sanitation and waste management in work camps and on site can lead to the physical and visual pollution of the local area.

Poor personnel management can lead to disorderly behaviour both on and off site. Construction workers may also contribute to the spread of HIV/AIDS and other diseases among the local population.

Impact: Economic Activities

Construction of various sections of the SEETO Route 4 and/or improvement of the existing road network may provide direct employment opportunities for both skilled and unskilled local labour over a period of several years. The extent to which opportunities are made available to the local community is likely to depend on the types of construction contract let. Provision of international financing for projects is, almost without exception, tied to the requirement for international competitive tendering for the works involved. International construction firms are likely to have their own preferred reams for construction management and supervision.

Impact: Human Health and Safety

Safety of construction workers and members of the public is a key issue to be considered when planning and implementing construction works.

6.2.2 Operation and Maintenance Phase - Impacts

Impact: Economic Activities

Construction of the new motorway and/or improvement works to the existing road network may have secondary impacts on the local population and economy, including encouraging new commercial activities and employment opportunities. Land and property values in the vicinity of interchanges may increase.

Impact: Severance

See under 'Construction'.

Impact: Human Health and Safety

Higher road speeds and traffic volumes could have implications for human health and safety. The safety of both vehicle travellers and the local population needs to be taken into account in the design.

6.2.3 Construction Phase - Mitigation

Mitigation: Public Relations

Effective and responsive communication is the key to achieving a good relationship with the 'neighbours' of any construction site. If people are informed about what is going on, know that they can comment on/complain about site activities and that their comments/complaints will be acted on, they are much more likely to accept the minor and sometimes major inconveniences which are associated with proximity to construction works.

Inform the public in advance of project implementation;

Keep the public informed of phasing/activities;

Install 24-hour comments/complaints hotline direct to the Engineer's office: complaint to be logged and responded to quickly.

Mitigation: Permanent Loss of Property and Land

Measures include:

Avoid resumption/demolition of residential and other properties as far as possible;

Provide information to owners of un-registered properties regarding how to apply for property registration;

Appropriate levels of compensation for expropriated property to be disbursed;

Safe demolition works;

Prompt replacement/reinstatement to an equivalent or better standard of boundary walls, fences and accesses affected during site clearance.

Mitigation: Severance

Measures include:

Avoid damage to existing infrastructure and interference with planned infrastructure, for example, high voltage electricity cables, sewerage;

All works within the vicinity of existing/planned infrastructure to be undertaken in agreement with, and conformity with, the requirements of the relevant utility operators and authorities.

Mitigation: Construction-related Nuisance

A variety of practicable measures to avoid or reduce potential air and noise pollution are identified later in this chapter.

Mitigation: Construction-related Traffic Disruption

Measures include:

Plan operations involving disruption to traffic on public roads in cooperation with the police and other relevant authorities;

Maintain safe movement of traffic flows using appropriate safety measures, such as traffic lights and clear warning signals;

Avoid movement of slow-moving plant/trucks on public roads during the rush hour;

Operate designated haul roads and minimise/regulate construction traffic movements through residential areas.

Mitigation: Environmental and Social Disruption from Construction Camps

Measures include:

Hire as many local people and possible and train them;

Site, construct and manage any work camps to minimise adverse impacts by appropriate layout, housing provision, sanitary and waste management facilities.

Implement HIV/AIDS education schemes;

Plan and carry out post construction site clean up.

Mitigation: Human Health and Safety

Measures include:

Have a designated Health & Safety Officer on site;

Health & safety awareness training for all site staff, for example, safe operation of machinery, first aid;

Clear emergency procedures for accidents, fire, chemical spillages;

Site security measures to avoid casual/deliberate entry and vandalism/theft/accidents, particularly by children.

6.2.4 Operation and Maintenance Phase - Mitigation

Mitigation: Economic Activities

Measures include:

Actively encourage economic enterprise;

Plan economic zones in consultation with local communities and entrepreneurs;

Monitor/regulate development of economic activities.

Mitigation: Severance

Measures include:

Maintenance of local roads, footpaths and access to community facilities as far as practicable during the construction period and operation and maintenance phase;

Provision of safe alternative routes where existing access is disrupted.

Mitigation: Health and Safety

Measures include:

Fencing of motorway;

Clear and properly positioned signage and motorway markings;

Provide equipment and establish clear procedures to deal with accidents, snowfall, flooding, poor visibility;

Ensure adequate provision of drainage.

6.3 Flora and Fauna (including Biodiversity)

6.3.1 Construction Phase - Impacts

Impact: Loss/Disturbance of Habitat

Wildlife habitat loss, alteration and fragmentation is one of the major impacts of motorway construction projects.

In order to calculate the maximum amount of land lost due to motorway construction (excluding other temporary or permanent land take), the alternatives with the greatest areas of open road have been selected: I-3, II-2, III-1, IV1+III-2, V-2, VI-3 and VII-1. These alternatives give a total road length of 129.5 km, an area of permanent land loss under road of 635.26 ha and an area of permanent/temporary land loss under bridges (depending on their size, construction and what they are being built over) of 298.48 ha.

No assessment has yet been made on the extent of different habitats lost or altered by construction of different sections of motorway.

Impact: Loss/Disturbance of Fauna

Impacts can include:

disruption of bird nesting sites;

creation of barriers to wildlife movement;

visual and auditory disturbance due to the presence of machinery and construction workers.

6.3.2 Operation and Maintenance Phase - Impacts

Impacts can include:

creation of barriers to wildlife movement;

death and injury due to vehicle impact.

6.3.3 Construction Phase - Mitigation

Mitigation: Loss/Disturbance of Habitat

Extensive lengths of tunnels are proposed: although there will be permanent and/or temporary loss of habitat at the portals and spoil dumps, the habitats above the tunnels will remain largely undisturbed. In addition, a considerable number of bridges, underpasses and culverts are proposed to maintain existing drainage, roads and paths.

In addition, a new route (Alternative II-2) has been proposed that diverts traffic away from the existing and previously promoted additional motorway route across Skadar Lake National Park and Ramsar site. Although the new route would lead to the loss of areas of pseudo-maquis, it would protect the wetland habitats associated with Skadar Lake which have a higher national and international protection and conservation priority.

Other measures include:

Protection of existing areas of habitat equivalent to or larger than those being destroyed by motorway construction;

Revegetation of areas such as embankments and establishment of shelter belts and landscaped areas using native species appropriate to the local environment;

Clearing and grubbing of vegetation, particularly areas of woodland, should be reduced to the minimum practical extent required for the construction of the works;

Where possible, arrangements should be made for suitable topsoil material to be stored and reused for landscaping works, such as provision of vegetation cover for the embankments;

Avoid unnecessary disturbance to natural river banks and channels during bridge construction and drainage works;

Practicable measures to minimise disturbance to the hydrology and quality of water courses are outlined elsewhere in this report.

Mitigation: Loss/Disturbance of Fauna

Measures include:

Best practice requires that site clearance, particularly of forest areas, and resulting destruction of habitat should be scheduled to ensure that nesting birds are not disturbed;

Where feasible, construction activities during the breeding season and other sensitive seasons or times of day should be avoided or modified to reduce adverse impacts.

6.3.4 Operation and Maintenance Phase - Mitigation

The motorway will be fenced to restrict vehicular access to designated interchanges, and to prevent unauthorised access of pedestrians, livestock and wild animals.

The Smokovac-Mateševo EIA comments that:

'as seen from the design, the Smokovac-Mateševo section has a large number of road facilities, bridges and tunnels. The motorway route has a safety barrier. However, the migration routes of wild animals are most probably cut in some sections. Given the large number of bridges and tunnels, the areas below the bridges and above tunnels are free areas and the fauna species will adapt to the new circumstances.'

All sections have a considerable number of bridges, underpasses and culverts to accommodate the requirements of the topography, drainage patterns and access routes. However, construction of additional animal crossings/underpasses in strategic locations may be required.

6.4 Geology and Soils

6.4.1 Construction Phase - Impacts

The main impacts on geology and soils will occur during the construction phase. These relate to removal of topsoil during site clearance, extraction of materials for motorway construction, physical works such as tunnelling, cuts, embankment construction and underpass excavation, and disposal of materials surplus to/unsuitable for reuse within the works.

Impact: Loss of Agricultural Land

Given that the SEETO Route 4 is around 130 km long and has a footprint of around 765 ha (around 635 ha of permanent loss under open road and around 130 ha of permanent/ temporary loss under bridges) some landtake of agricultural areas (small holdings as well as more extensive farms and grazing areas) is inevitable.

Impact: Loss of Topsoil

Up to 764 ha of topsoil of varying quality will be removed from the footprint of open road sections and bridges as a result of the proposed motorway construction works. This figure excludes additional temporary and permanent landtake required for the works.

Impact: Extraction/Disposal of Construction Materials/Spoil

Motorway construction will have a permanent impact on the geomorphology of the area. Physical works, including extraction of borrow materials, tunnelling, cuts, embankment construction, underpass excavation, road bed/road base filling and dumping of excess materials from cuts, is required.

Quarries, borrow pits and materials disposal sites may have permanent visual and physical impacts on the environment, including changes in geomorphology and loss of vegetation.

Impact: Erosion/Instability of Cuts and Embankments

Engineering-geology characteristics of rocks along the route vary considerably. Tight-stiff, well petrified rock masses such as limestones, dolomites and igneous rocks form stable load bearing areas in which steep cuts, side cuts and other excavations can be made. Other types of rock are less stable and construction works may result in landslides, rockfalls or subsidence. Cut faces, quarries and borrow pits must be designed and worked with the short- and long-term safety of the construction workers and members of the public in mind.

Impact: Erosion of Land Downstream of Drainage Structures

Over-wetting of slopes and embankment materials can lead to instability and ponding of water on the motorway surface represents a hazard to traffic. Appropriate facilities to safely collect, divert and dispose of motorway surface drainage are required, with energy dissipating structures installed if necessary to reduce the likelihood of erosion downstream.

Impact: Ground Contamination

During construction, careless handling and storage of oil, grease and bitumen can lead to accidental or deliberate spillages. This wastage of materials may in turn lead to pollution of the underlying soil and possibly to contamination of groundwater and/or watercourses. As well as being a cause of complaints by the local population, this may lead to contravention of local regulations and fines being imposed on the Contractor.

6.4.2 Construction Phase - Mitigation

Mitigation: Loss of Agricultural Land

Measures include:

Avoid unnecessary loss of/damage to agricultural land;

Avoid siting temporary work sites, borrow pits or disposing of spoil on agricultural land: if essential, rehabilitate and return to productive use;

Compensate land owners by financial means or provision of alternative land.

Mitigation: Loss of Topsoil

Where possible, arrangements should be made for suitable topsoil material to be stored and reused for landscaping works, such as provision of vegetation cover for the embankments.

Mitigation: Extraction/Disposal of Construction Materials/Spoil

Measures include:

Balance cut and fill quantities as far as possible;

Avoid excavating quarries or borrow pits in protected areas or agricultural land;

Avoid tipping cut spoil directly into gullies or water courses or over the edge of the motorway;

Avoid locating spoil dumps in protected areas or agricultural land; dispose of spoil in borrow pits or quarries; rehabilitate spoil dumps by terracing and re-vegetate with native species.

The permanent visual and physical impacts of quarries, borrow pits and spoil dumps can be mitigated by site management and remedial works, such as landscaping.

Mitigation: Erosion/Instability of Cuts and Embankments

Cut faces, quarries, borrow pits and tunnels in particular must be designed and worked with the short- and long-term safety of the construction workers and members of the public in mind. Measures include:

Design/construct slopes to minimise instability;

Minimise major earthworks during periods of rainstorms;

Install appropriate slope protection works and drainage structures;

Foundation design appropriate to local geotechnical conditions.

Mitigation: Erosion of Land Downstream of Drainage Structures

Appropriate facilities to safely collect, divert and dispose of motorway surface drainage are required, with energy dissipating structures installed if necessary to reduce the likelihood of erosion downstream. Measures include:

Include adequate number of drainage structures;

Include adequate energy dissipation facilities in drainage structures;

Where appropriate, line receiving surface with riprap and/or concrete.

Mitigation: Ground Contamination

Measures include:

Collect, store, handle and dispose of solid and liquid materials in accordance with local laws/standard acceptable practice;

Oil, grease, fuel, etc. should be stored on a secure, sealed, bunded surface with an oil/grease trap at the outlet, away from rivers and streams;

Provide spill containment and cleanup equipment and train workers in correct procedures for fluid handling, spill prevention and emergency clean up procedures.

6.5 Water Resources

6.5.1 Construction Phase - Impacts

Impact: Changes to Local Hydrology

Construction activities including bridge works could adversely impact on surface drainage in the area, leading to changes in runoff, peak flows or low flows. Any dewatering works could also temporarily impact on local flow regimes. Temporary or permanent restriction or obstruction of water courses or surface water drainage systems could lead to flooding.

Controlled drainage is required not only to protect the surface and groundwater quality and maintain existing drainage patterns, but also to avoid over-wetting of the materials from which the embankments are constructed, which could lead to slope instability.

Impact: Surface and Groundwater Pollution

During construction, careless handling and storage of fuels, oil, grease, bitumen, paint and other chemicals, bridge deck waterproofing agents and concrete can lead to accidental or deliberate spillages. This wastage of materials may in turn lead to pollution of groundwater and/or watercourses; some may have serious impacts on freshwater fauna. Uncontrolled discharges of sewage effluent from any construction camps may also pollute local water resources. As well as being a cause of complaints by the local population, this may lead to contravention of local regulations and fines being imposed on the Contractor.

Impact: Extraction/Disposal of Construction Materials/Spoil

Construction will involve earthworks including tunnelling, cuts, embankment construction, underpass excavation, road bed/road base filling and dumping of excess materials from cuts and underpass excavation. The locations of sites for quarries, borrow pits and spoil disposal have not been identified. The installation of practicable drainage measures for works areas, borrow pits and spoil dumps should be considered in order to prevent runoff containing high volumes of suspended solids and other contaminants from entering nearby watercourses.

6.5.2 Operation and Maintenance Phase - Impacts

Impact: Changes to Local Water Quality

The uncontrolled discharge of motorway runoff has the potential to impact on water resources in terms of increased local and downstream flooding and pollution. Pollution from motorway drainage can arise from accidents (for example, tankers carrying hazardous products), general vehicle and road degradation, incomplete fuel combustion and oil or fuel leaks.

The chemical nature of road surface runoff is variable, but typical potential pollutants are:

Suspended solids – from mud, corrosion, metal particles, grit, tyre and motorway surface wear;

Lead – from petrol;

Zinc and cadmium – from deterioration of exhaust pipes and brakes;

Organics – including rubber, bitumen, grease and oil;

Iron – from corrosion;

De-icing agents – such as salts;

Herbicides and pesticides – if used for maintenance of motorway verges.

Given the low AADTs predicted for the motorway, only minor impacts from motorway runoff are anticipated.

6.5.3 Construction Phase - Mitigation

Mitigation: Changes to Local Hydrology

Measures include:

Design and implement temporary drainage works for construction sites to avoid damming, flooding or contamination of adjacent land and water courses;

Temporary drainage works near to water courses should include appropriate sediment traps and oil interceptors, which should be regularly maintained;

Include soil and slope stabilisation strategies in design documentation as above;

Include adequate design of bridges and culverts to ensure that drainage is not impeded;

Include design features to ensure that runoff is conveyed at controlled velocities.

Mitigation: Surface and Groundwater Pollution

Measures include:

Collect, store and dispose of solid and liquid materials on site in accordance with local laws/standard acceptable practice;

Oil, grease, fuel, etc. should be stored on a sealed, bunded surface with an oil/grease trap at the outlet, away from rivers and streams;

Provide covered storage for materials such as cement with potential to impact on water courses; provide designated concrete wash-out areas for controlled disposal of concrete, comprising a suitably lined and contained area remote from drainage channels;

Restrict refuelling and other liquid transfer to areas covered with impervious surfacing;

Avoid accidental spills and have agreed fire and spill containment/clear up emergency procedures in place;

Provide appropriate sanitary facilities for the construction workforce;

Ensure that springs have adequate physical protection.

Mitigation: Extraction/Disposal of Construction Materials/Spoil

Measures include:

Carefully control any extraction of construction materials directly from river channel;

Rock or gravel won from a river should not disrupt river flow or damage or undermine riverbanks.

6.5.4 Operation and Maintenance Phase - Mitigation

Impact: Changes to Local Water Quality

Measures include:

Ensure that water collected from motorway surface is treated, for example by oil/water separators and settlement, prior to discharge in accordance with regulations;

Personnel and equipment available to contain and clean up accidental spillages of chemicals, etc.;

Ensure that springs are adequately protected.

Careful consideration should be given to the design of all motorway surface, slope and bridge deck drainage to ensure that:

safe driving conditions are maintained;

damage to the motorway surface, tunnels, cuts, embankments and structures from flooding and/or erosion is avoided;

the road and associated structures do not cause flooding of adjacent land;

any further deterioration of the quality of waters in the drainage channels and water courses crossed by the motorway is avoided.

Provide appropriate facilities for treatment of motorway surface drainage with oil/water separators as a minimum.

6.6 Air Quality and Climate

6.6.1 Construction Phase - Impacts

Impact: Dust

Construction-related air quality impacts are mainly associated with the excavation and handling of potentially dusty materials and the movement of vehicles on unpaved haul roads. Mud tracked onto public roads will dry out to generate dust. Other potential sources of dust emissions include:

the transportation of aggregates and other fine-grained materials in uncovered trucks;

loading/unloading of materials;

wind erosion of stockpiles;

blasting of cuts and tunnels;

tunnel ventilation.

Impact: Blasting

Dust and gas emission during blasting depends on the drilling method and chemical composition of the explosive used and the speed, the blast hole diameter and the mechanical features of the rock. Blast gases include carbon monoxide (CO), nitrogen oxides (NO_x) and sulphur dioxide (SO_2).

Impact: Vehicle and Equipment Emissions

The main pollutants associated with vehicle emissions are nitrogen dioxide (NO_2) and fine particles (PM_{10}). In addition, carbon monoxide (CO) and a range of hydrocarbons are produced. Fuel can also contain sulphur (SO_2) and lead (Pb).

The concentration of pollutants at the roadside or at a sensitive receptor, is influenced by a number of factors including traffic flow, traffic composition and speed.

6.6.2 Operation and Maintenance Phase - Impacts

Impact: Vehicle Emissions

Pollutants include: nitrogen dioxide, fine particles, carbon monoxide, sulphur dioxide, lead and a range of hydrocarbons.

6.6.3 Construction Phase - Mitigation

Mitigation: Dust

Measures include:

Restrict the speed of vehicles on the site, access road and local roads;

Clean vehicle wheels before joining the public road;

Sweep/clean any mud and debris resulting from the works from the public road;

Cover loads of dust-generating materials being transported to and from the site;

Implement dust suppression techniques such as regular application of water to unpaved haul roads in dry and windy conditions;

Minimise dust from open area sources, including soil stockpiles, by using practicable control measures such as installing enclosures and covers, and increasing the moisture content;

Minimise the drop height of materials on site;

Locate storage away from the site boundary and sensitive receptors, such as site offices and the local population;

Best practice operation of concrete and asphalt batching plants.

Mitigation: Blasting

Safe blasting practices include:

Protection against flying pieces of rock;

Protection against ground vibration;

Protection against air blast;

Protection against blasting gases and dust.

Appropriate tunnel ventilation will be installed to extract dust and gases generated by blasting and allow safe working conditions.

Mitigation: Vehicle and Equipment Emissions

Measures include:

Keep vehicles and equipment used on site well maintained and regularly serviced;

Ensure that all vehicles used by Contractors comply with vehicle emissions standards at all times;

Train workers in safe driving practices that reduce both the risk of accidents and fuel consumption, include driving within safe speed limit;

Designate transport routes to minimise the distance travelled and overall fuel use and emissions;

Control deliveries to site to minimise queuing;

Turn off engines when not in use.

6.6.4 Operation and Maintenance Phase - Mitigation

Mitigation: Vehicle Emissions

Measures to reduce air quality impacts are integral to the SEETO Route 4 project:

Select route alignment to divert traffic, particularly HGVs, away from urban areas and other centres of population;

Site interchanges away from residential areas and pollution-sensitive locations such as schools and hospitals;

Design and operate route to facilitate free-flow traffic conditions.

Appropriate tunnel ventilation will be installed in longer tunnels (exceeding 500 m length) to extract vehicle emissions, maintain adequate air quality at maximum traffic flow, and provide smoke-free conditions for pedestrians in the event of a fire.

6.7 Noise and Vibration

6.7.1 Construction Phase - Impacts

Impacts - Construction Noise and Vibration

Construction-related noise impacts including the operation of plant and vehicles e.g. during earth moving and concrete pours, percussive piling and blasting. Excessive noise levels on site represent a major hazard to site workers. Sudden or continuous noise early in the morning or late at night, on rest days and holidays, during school examination periods and entertainment performances, can be particularly annoying to local residents.

6.7.2 Operation and Maintenance Phase - Impacts

Impact - Traffic Noise

The main impact during the operation and maintenance phase will be from traffic noise. Noise from a flow of road traffic is generated by vehicles' engines and the interaction of tyres with the road surface. The traffic noise level at a receptor, such as an observer at the roadside or residents within a property, is influenced by a number of factors including traffic flow, speed, composition (% HGV), gradient, type of road surface, distance from the road and the presence of any obstructions between the road and the receptor.

Impact - Tunnel Ventilation Noise

Appropriate tunnel ventilation will be installed in longer tunnels (exceeding 500 m length) to extract vehicle emissions, maintain adequate air quality at maximum traffic flow, and provide smoke-free conditions for pedestrians in the event of a fire. Tunnel ventilation equipment may generate noise in the form of a constant hum which may be noticeable to sensitive receptors in the vicinity of tunnel portals.

6.7.3 Construction Phase - Mitigation

Mitigation - Construction Noise and Blasting

Measures include:

Noisy construction work in or near to residential areas or noise sensitive sites (such as hospitals, schools) should be limited to daylight hours and to the normal working week;

Blasting should take place at a set time each day and drivers on existing roads and the local population should be informed in advance;

Proper scheduling and use of mechanical plant with respect to minimising noise emissions (avoid the simultaneous operation of noisy equipment);

All vehicles and plant should be fitted with exhaust silencers and maintained in good efficient working order (for example, adequate lubrication, tightening of loose nuts and bolts);

All major compressors should be 'sound reduced' models where possible fitted with properly lined and sealed acoustic covers, which should be kept closed whenever the machines are in use;

Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum;

Materials should be delivered during normal working hours and handled with care, not dropped;

All ancillary plant such as generators, compressors and pumps should be positioned so as to cause minimum disturbance, as far as possible from sensitive receptors or behind noise barriers. If necessary, acoustic enclosures and/or shielding should be provided;

The use of white noise reversing alarms can considerably reduce the noise impact of mobile plant items;

High noise levels can lead to permanent hearing loss. Noisy areas should be well defined with sign boards recommending the use of hearing protection. Where appropriate, site staff should be issued with, trained in the proper use of, and use suitable hearing protection equipment.

Train workers in safe driving practices that reduce both the risk of accidents and fuel consumption, include driving within safe speed limit.

6.7.4 Operation and Maintenance Phase - Mitigation

Mitigation -Traffic Noise

Measures to reduce noise impacts are integral to the SEETO Route 4 project:

Select route alignment to divert traffic, particularly HGVs, away from urban areas and other centres of population;

Keep route low within the natural topography and tunnels, where practicable;

Select location of tunnel portals and ventilation shafts to minimise noise impacts;

Site interchanges away from residential areas and noise-sensitive locations such as schools and hospitals;

Design and operate route to facilitate free-flow traffic conditions;

Install noise reduction measures, such as embankments and noise screens, at particularly noise sensitive locations;

Maintain road surface in a good state of repair.

Impact - Tunnel Ventilation Noise

Tunnel ventilation equipment will be selected and site to work effectively whilst minimising noise nuisance.

6.8 Landscape Assessment

6.8.1 Construction Phase - Impacts

Impacts - Views of Construction Works

Construction works will inevitably cause visual impact, the scale of which depends on the distance between the visual receptor and the activities viewed. Intrusions into the existing landscape will include: site clearance including removal of trees and other vegetation; establishment of borrow pits, quarries and spoil disposal area, site offices, equipment and materials storage areas; construction of tunnels, high cuts and embankments; operation of asphalt concrete batching plant and movement of vehicles.

Evening and night-time working, if permitted, will require the use of lighting: security lighting may also be required around site offices and equipment yards. The careless handling and disposal of construction waste – from surplus and damaged materials to chemicals and ‘domestic’ waste – can create a visual nuisance

6.8.2 Operation and Maintenance Phase - Impacts

Impacts - Views of Permanent Works

The visual impact of the motorway will depend on the proximity of the viewer to the carriageway, interchanges, bridges, embankments and cuts, tunnels and underpasses.

The glow of motorway lighting and illuminated signage during the night-time will become a permanent feature of the landscape. Headlight glare from vehicles on elevated structures may cause a nuisance to nearby houses.

6.8.3 Construction Phase - Mitigation

Mitigation - Views of Construction Works

Visual impacts of major construction works are inevitable. However, the nuisance value of these visual disturbances can be reduced by good site management, in particular by storing equipment and materials in an organised way and in the removal of litter and waste in the vicinity of the site. Measures include:

Good site management: keeping a tidy site;

Regular surface cleaning of roads adjacent to site;

Regular removal of litter and waste adjacent to site even if not works-related;

Restrict clearing and grubbing of shrub- and woodland to minimum practical extent.

6.8.4 Operation and Maintenance Phase - Mitigation

Mitigation - Views of Permanent Works

The route alignment selected for SEETO Route 4, the design of major structures and the distance between the motorway and the observer will influence the visual impact of the permanent works. For example, selection of Alternative III-1 with an interchange with the Adriatic-Ionic motorway at Strganica would mean that this section is hidden from Podgorica by a series of hills.

Night-time lighting arrangements should be designed so that illumination is directed to the road pavement rather than to any nearby residential areas. Signage should be clear so as to inform vehicle drivers but ideally the number of road signs should kept to the minimum required.

Where appropriate, landscaping with re-vegetation of embankment slopes and tree-planting using native species is recommended: this would have the dual benefit of improving the appearance of the motorway and compensating for any shrubs and trees removed and destroyed during site clearance.

6.9 Waste Management

6.9.1 Construction Phase - Impacts

Potential impacts include soil, water and visual pollution from improper management and disposal of solid and liquid wastes.

Considerable volumes of soils and rock will require handling during construction of the motorway. Blasting of high cuts and tunnels will be required, as will borrow of materials for embankment construction. Although cut/fill quantities will be balanced as far as possible within each section, considerable excess of spoil materials will be generated in some areas, which will require appropriate use (for example, in landscaping) or disposal.

Other wastes may include:

Vegetation from site clearance;

Surplus/sub-specification construction materials;

Hazardous wastes including paints and other chemicals, bridge sealant, oils and grease;

'Domestic' and sanitary waste from work camps and sites;

Illegally dumped waste.

6.9.2 Operation and Maintenance Phase - Impacts

Potential impacts include pollution and hazards generated by improper management and disposal of solid and liquid wastes, including:

Sediment and sludges from stormwater drainage systems (including sediment traps and oil/water separation systems);

Road litter and illegally dumped waste;

Wrecked vehicles and vehicle parts;

Hazardous and non-hazardous materials spilled from vehicles;

Animal carcases;

Paint waste from road and bridge maintenance;

Road surfacing wastes from maintenance activities.

6.9.3 Construction Phase - Mitigation

Measures should be taken to manage wastes on site with an appropriate waste management plan which:

Identifies major waste streams (such as soil, rock, concrete, vegetation, metal, demolition waste, chemicals, sanitary waste);

Identifies appropriate waste management (reuse, recycling, handling and disposal) methods.

6.9.4 Operation and Maintenance Phase - Mitigation

As for the construction phase, wastes should be managed and disposed of in accordance with an appropriate management plan.

6.10 Cultural Heritage

6.10.1 Construction Phase - Impacts

Potential impacts include:

Accidental or deliberate damage, destruction or removal of structures and artefacts discovered during construction works;

Accidental or deliberate damage, destruction or removal of existing structures and artefacts during construction works;

Visual or auditory disturbance to residents and users of, and visitors to, culturally important sites (whether protected or not) during construction works.

6.10.2 Operation and Maintenance Phase - Impacts

Impacts relate to the visual and auditory disturbance as above.

6.10.3 Construction Phase - Mitigation

Measures include:

Routing of motorway alignment and temporary works sites to avoid known culturally important site;

A chance finds procedure to halt works and investigate potentially important structures and artefacts discovered during construction works;

Measures to minimise noise and visual disturbance as outlined elsewhere in this section.

6.10.4 Operation and Maintenance Phase - Mitigation

Most effective measures involve routing of alignment away from (or in tunnel nesensitive sites.

7 PUBLIC CONSULTATION

7.1 Introduction

According to the EIB Environmental and Social Practices Handbook: “consultation is defined as a tool for managing culturally appropriate two-way communications between project sponsors and the public. Its goal is to improve decision-making and build understanding, by actively involving individuals, groups, and organizations with a stake in the project. This involvement increases a project’s long-term viability and enhances its benefits to locally affected people and other stakeholders.”

Disclosure and constutlation are requirements under the Montenegrin EIA process and the country has adopted the Aarhus Convention. According to the EU EIA Directive, it is the responsibility of the host country and its Competent Authorities to ensure that the "public concerned" are informed and consulted on the proposed project (Articles 6 and 9).

7.2 Stakeholder consultation for Preliminary ESIA

Consultation for the preparation of the preliminary involved meetings with all project-affected Municipalities and other key stakeholders, and semi-structured interviews with members of the public living in different locations along the proposed project route.

Questions sought to elicit anticipated economic, social and environmental impacts of the project on local areas (positive and negative). In some cases written responses were provided by Municipalities to questions asked. Project maps were displayed during meetings with Municipalities to facilitate discussion on the various alignment options.

The following key stakeholders were met:

- Representatives of Bar Municipality
- Representatives of Podgorica Municipality
- Representatives of Andrijevica Municility
- Representatives of Berane Municipality
- Representatives of Bjelo Polje Municipality
- Montenegrin Fund for Solidarity and Housing Development

All meetings were attended by senior representatives of their respective institutions (to the level of Mayor, Deputy Mayor or Director), reflecting the importance with which the Bar-Boljare Motorway project and its associated planning processes is regarded.

Key point from each of these stakeholder groups are summarized below.

7.2.1 Local People

A number of people (women, men and children) were spoken to at various locations along the route. The following themes emerged from dicussions:

- Livelihoods in rural areas are predominantly agricultural; in mountainous areas largely cattle and dairy. Production is generally small-scale. Many people seek additional employment to supplement (often meagre) agricultural incomes.
- Farmland is both owned and leased by users.

- The economic conditions in rural areas are harsh, with little trade of agricultural produce by smallholdings.
- Populations in rural areas are mostly elderly people (particularly in mountainous areas). Some settlements are literally dieing with young people moving away; schools are closing down.
- Forestry and wood processing (sawmills) appear to be growing sectors for investment and employment in some northern locations.
- There appears to be a high level of support felt for the motorway amongst the population and a general expectation that negative impacts (such as land acquisition, noise) will be offset by positive benefits to local economies.
- Some northern residents said that with an improved road they could commute daily to Podgorica for work rather than migrating, resulting in more activity in their place of origin.
- Some regard expropriation compensation as a good ‘boost’ for local economic activity.
- Some people anticipate positive benefits in terms of road safety – for example in reduced accidents on the Matesevo-Andrijevica road.
- Concerns in relation to the road felt by local people in some cases include reduced access to grazing lands and having to drive a long way to access the motorway. Some suggest maybe a main road rather than a motorway may therefore be appropriate in some locations, including regarding associated benefits of setting up shops and restaurants along the route, bringing more revenue into local areas.
- A concern expressed by one resident of Virpazar was in relation to visual impact of a possible new bridge crossing Skadar Lake.

7.2.2 Bar Municipality

Key points emerging from discussions with Bar Municipality include the following:

- 20km of road passes through Bar.
- The economic priority for Bar is tourism (coast and Skadar Lake, plus wine and health foods (eg honey).
- Mostly rural agriculture in project area (individual, private, small-scale), including vineyards and apiaries. The motorway will be very important in promoting local industries.
- There has been a recent trend of people returning to Virpazar to invest and reconstruct houses and tourism facilities (eg restaurants).
- There is concern regarding visual impacts of structures around the lake, for example a large bridge on one proposed alignment option.
- In terms of expropriation experience locally, there have been reports of discontent with compensation received for other projects. Vines can be very valuable.
- Care must be taken in terms of project impacts on vulnerable groups – for example those who will lose a significant portion of their income from loss of agricultural land.
- The mountain route should be given consideration in order to avoid impacts on Skadar lake. Properties in the uplands could include quarries.
- Care should be taken regarding possible impacts on the Orhhovistica River which is a main water supply for Bar.
- In case of any physical resettlement, there may be limited opportunity to provide replacement housing and as such cash compensation may be the most appropriate.

7.2.3 Podgorica Municipality

Key points emerging from discussions with Podgorica Municipality include the following:

- Traffic integration of economic and urban centers by the crossing of a large number of existing and planned primary roads and the integration of smaller settlements through which the planned motorway will passs, with specific measures and programs, will significantly contribute to faster economic and social development. This is because the motorway will provide fast, safe and comfortable transport in the gravitational zone, furnishing corridors with a variety of amenities, new opportunities for economic and other activities, and new jobs. Therefore, it is realistic to expect a reduction of the negative trend of depopulation and the consequent slowing down of the metropolitanization of Podgorica.
- The main source of GDP growth in Podgorica is the service sector, especially tourism, trade and activities related to financial services and real estate, we can expect these sectors to be generators of employment growth in the future.
- The agricultural sector in Podgorica also has large potential, particularly in vineyards.
- Podgorica City is an important transit point for traffic the coast.
- The Capital city, following the DPP Bar - Boljare adoption, has faced many problems in implementing the plan documentation since the establishment of a corridor width of 2.0 km and undefined locations of the traffic loops, which represents a major constraint to the development of Podgorica since it covers an area of 70.25 km2, or 12.92% of the area of Podgorica. The suspension of the implementation of many projects since 2008 impacted and is still impacting not only the development of a large area of the Capital City, but also prevents the realization of the primary infrastructure facilities.

- A major interchange at Strganica rather than Smokovac is the preference, in order to reduce land acquisition, valley air pollution impacts to the north of the city, reduce tunnel construction and be to construct more of the road on stable ground with reduced risk of landslides and rockfalls. The construction itself would be much easier, because it would have no impact on the existing highway M2, at which traffic would often need to be interrupted in the event of developing a loop in Smokovac. It would lead to a longer duration of the already demanding work on the tunnels, which in turn would have an impact on the economic aspects of implementation. Furthermore, the fact that Straganica is separated by hills from the urban areas, while in contrast the village Smokovac is open to the city and exposed to the dominant north-east winds, from the aspect of environmental protection this has great and immeasurable importance reflected in the reduction of negative impacts on the city and environment during construction and operation of the highway. Area of Smokovac, which is populated, unlike Straganica, represents a land of great value that could be optimally used in accordance with the natural environmental attributes and resources, while Straganice consists of mostly non-arable land of lesser value, which would lead to the final cost of expropriation being significantly smaller.
- In respect of a Strganica Interchange alignment option, there is a strong preference of a design that would see this sited some 0.5-1km to the East of the most ‘established’ option for a Strganica Bypass as it is claimed that this would be more technically feasible and would result in less land acquisition.

- In terms of potentially affected settlements, high soil fertility (Solvency I and II) extends along the rim of Ćemovsko polje at sites: Doljani, Momišići, Tolosi, Donja and Gornja

Gorica, Farmaci, Beri, Lekic, Grbavci, Botun, Dajbabe, and a narrow belt from the Mahale to Podhum, in the transition from Ćemovsko polje to the coast of Skadar lake. With good irrigation this is the most abundant fruit-vegetable and wine growing land. This type of soil provides for the production of top quality wine and tobacco, and many kinds of fruits (peach and cherry), as well as medicinal and aromatic plants.

- Medium-fertility soil (Solvency II and IV), together with the high fertility soil, forms a major part of agricultural areas with relatively intensive production: arable land, gardens, orchards and vineyards. These are present in the valleys, plains, the coastal area of Lake Skadar, Zetsko-Bjelopavlicka ravnica and Lješanska nahija. This land of forests is present in Opasanica and Lijeva Rijeka.
(NOTE: Underlined villages coincide with the Terms of Reference of the territorial coverage of the detailed spatial plan of the highway Bar-Boljari).
- On the territory of the Capital City approximately 40 million m2 of land has been usurped and 16,382 buildings illegally constructed with a total area of 1,285,665 m2 in foundation, which averages 78.48 m2 per building (data of the Real Estate Directorate of Montenegro in 2009). Illegal construction is most present in areas: Donja Gorica, Zabjelo, Tolosi, Mareza, Little Hill, Donji Kokoti, Farmaci, Park Suma, Zagorič, Momišići, Konik, Milješ, Zeta, and the Zagorič and Konik - Vrela Ribnička (settlement of refugees and displaced persons). The causes for the usurpation of land and illegal construction are: demographic trends, low living standards and inadequate inspection, inconsistent application of sanctions prescribed by law and the like.
(NOTE: Underlined villages coincide with the Terms of Reference of the territorial coverage of the detailed spatial plan of the highway Bar-Boljari).
- According to the available data, construction and operation of motorway Bar-Boljare could have direct impact on the following historic-cultural heritage of the Capital:
    - archeological sites Duklja and Doljani-Zlatica,
    - monasteries Dajbabe and Duga-Bioče
    - churches Sv. Đorđe pod Goricom, Sv.Trojice in Vukovci-Zeta
    - Balšića grad in Ponari-Zeta
    - Fortresses Ribnica, Oblun in Vukovci-Zeta, Planica in Dodoši
    - Old bridge on the confluence of river Ribnica
    - Osmanagića mosque in Stara varoš

- The following impact risks for the motorway were identified:

1. <u>Loss of biodiversity: loss of natural and semi-natural habitats and their fragmentation</u> – mostly in the construction phase
    - Direct distruction of species, natural and semi-natural habitats and their transformation into build-up areas (physicaly altered): road-pavement, embankments, cuts, retention walls, bridges, etc. Preliminary earthworks
    - Cutting and mowing of vegetation
    - Fragmentation of flora/ vegetation (including forest areas), areas populated with different animal species and their nesting places, interuption of watercourses where there is a lot of wild life Stvaranje barijera za kretanje životinja
    - Visual and audio disturbance due to the operation of construction machinery (in the construction phase) and vehicles

2. <u>Storm and waste water</u> – in the operation phase but also during the construction
    - Changes in runoff regime of atmospheric and other surface water / surface watercourses, including occurance of erosion, flooding, etc.
    - Pollution with oils and lubricants, residues from fuel combustion (including metals Zn, Cu, Cd, Ch, Ni ...), products for maintenance of road equipment (abrasives, paints, varnishes, etc.), anti-icing (CA and Mg chloride etc.)

3. Solid waste – in the construction phase and during the greater part of operational phase
    - Soil and rock which were dug during the preliminary earthworks, during the construction phase
    - Surplus of asphalt mass cast away during the construction, as well as discarded parts of asphalt, concrete, soil and rock during mainenance, in the operational phase
    - Waste thrown out from the vehicles, illegal formation of landfills, garbage in the zones of rest areas/ temporary stops
    - Sediment in the drainage and water treatment systems for surface waters from the road

4. Noise – in the operational phase but also during construction
    - Depending on the type, volume and velocity of traffic participants
    - Health problems – noise causes stress in children, increase of blood pressure, pulse, hormon levels, etc.
    - Level/intensity of noise changes and decreases due to distance, configuration of terrain, vegetation, natural and artificial barriers

5. Air pollution – in the operational phase, to a lesser extent during the construction
    - Raising dust during the construction phase
    - Exaustion gases from vehicles during the operational phase – calculation is based on estimated traffic volume, according to vehicles categories

6. Impact on landscape
    - Changes in character and landscape type
    - Changes (especially linear) landscape structures
    - Changes in colour
    - Interaction of natural and anthropogenic landscape

7. Physical and chemical hazard - in the operational phase but also during construction
    - Impact on human health and safety

7.2.4 Andrijevica Municipality

- Key points emerging from discussions with Andrijevica Municipality include the following:
- Settlements within the municipality in the corridor of the road include: Gnjili potok, Kralje, Sinožeta
- No cultural heritage monuments or archeological sites will be affected by the project in Andrejevica;
- Municipality of Andrijevica is one of the least developed municipalities in Montenegro – main issues are unemployment, pronounced emigration, over 2,000 people left this municipality in the past 4 years. People go towards Podgorica, coast, Serbia. It is not just the work force; they also suffer from 'brain-drain', people who could help develop the municipality. The new road could stop this because people could go to work in Podgorica but then come back to Andrijevica; also raw materials and natural resources from this municipality could be more accessible for further distribution – such as wood, forest fruit, medical herbs, decorative stone. There is also potential for hydropower development – this municipality is the richest in water in Montenegro.
- 100% of people in this municipality is for this project – they see it as a major chance for development.
- There are two possible alignments for which they have plans – lower and upper variant. The lower seems to be the one that is accepted – advantage is that they will have to rehabilitate the riverbed of the Lim River. A disadvantage however is that if this alignment is chosen they will have to give up on the possible project for construction of mini hydropower plants on river Lim. Also this alignment is more expensive because

there are more houses and the cost of expropriation would therefore be greater. The upper variant is less expensive and it is better from the environmental point of view – exaustion gases from the traffic will have lesser impact in the forest then in the valley with the lower variant.

- In the local community of Rijeka Marsenica there is a lot of houses, many people will have to move, also there is a church and a cemetary – the new road would go straight through this community.
- They feel that maybe a 'semi-motorway' would be a better option because they know that access to motorway is far (expensive) and they have no use of the motorway unless they have access to it – in maps junctions to the motorway are in Kralje and later near the border with Berane.
- The population is mainly engaged in agriculture: cattle-breeding and fruit-growing – mostly small estates; Directorate for forests is responsible for forests and woodlands in the municipality.
- Mostly elderly people live in the municipality – the highest level of education in the municipality is secondary technical education.
- During 1970's this municipality was very well developed – there was a factory for production of small electrical products, a water treatment plant and a tannery. Now most people work for local government (school, police and health center); there is very little industry – an exception is Boj komerc, a sawmill with around 50 employees.
- During the summer season people pick blueberies and mushrooms – last year they got the highest price ever for blueberries – 5.2 euro per kg, but it is just a one-off activity so people cannot live of it.
- They did expropriation before for power transmission poles and compensation was paid ok – even overpaid.
- 98% of land is private property.
- Category of land is 4,5 or 6. This doesn't affect compensation amounts which are calculated at market value.
- All the illegal structures build before 2008 can be legalised – 99% of illegal structures can be legalised – in order to legalise their structures they need – possession list, right of ownership and for the building to be constructed before 2008 and the new law.
- Plans for the development of the municipality include development of agrotourism, healthy food, cattle-breeding – all of these plans would benefit from the road.

7.2.5 Kolasin Municipality

Key points emerging from discussions with Kolasin Municipality include the following:

- Overall impact of the SEETO Route 4 project will be extremely positive; it would improve road safety, better road connection, also it would help decrease the depopulation in the area – Municipality of Kolašin lost over 40% of its inhabitants in the past 40 years. It would also help development of economy, tourism – better access to the local ski resort Bjelasica; the condition of the existing road is an obsticle to that development.

- In terms of effect on agriculture, the road cannot have detrimental effect – land quality is not good: mainly meadows, non-economical forests – class 5 and 6 of land. It cannot hurt local production – what they already „import" from other places they will continue to do; a better road can only help because they can obtain goods more easily, and local products will have a better chance because they will be able to be exported more easily – for example, local cheese and potatos are of very good quality but the condition of the existing road is an obstacle for distribution outside the municipality.

- Pajkov Vir – border with municipality of Podgorica – as far as they know the alignment goes on the side of the river Tara where there are no houses (only exception Miloševića house in Pajkov vir), mainly forest – around 80% is private land; remainer is state land.

- Trešnjevik – border with Municipality of Andrijevica. They are not aware of any particulary sensitive sites in the construction phase – land is not erosive, so no danger of landslides; disposal of excaved land should not be a problem in the construction phase – maybe it could be reused for embankments.

- Local businesses along the alignment won't suffer becase of the road – example of the opposite: there was a plan to build collection center in Mateševo for all agricultural products from that area but the condition of the existing road made it difficult and so project never came to life. The new road on the other hand could develop economy and improve quality of life – in Mateševo there isn't even a health station at the moment.

- Vranještica – during the winter there are 50-60 inhabitants: this year, because of the snow,they were blocked for more than 1.5 months.

- Population density in municipality of Kolašin is 9 people per km^2; in more remote areas, density is around 5 people per km$^{2.}$

- Wood is generally of very poor quality so it does make a big effect on the price of land.

- Private land is: 5% arable land, 25% meadows and grazing land, the rest are forests, mostly of lower quality.

- They had some problems with power transmission pilons in the municipality – people didn't get compensated for the use of their land.

- Office for urbanism of the Municipality is responsible for environmental protection.

- There should be access to the road in Mateševo, Kraljske bare, Pajkov vir and anywhere else where they estimate that it would be beneficial – they wouldn't have much use of the new road if they don't have good access to it.
- In case highway designers need some consultation with the local authorities and population they should contact Mayor and Directorate for property and office for urbanism and they can also be their liasons with the local people.

- The Mayor is the main person the local people contact when they have any problems.

7.2.6 Berane

Key points emerging from discussions with Berane Municipality include the following:

- All competent persons from the municipality were present at the meeting.

- There a strong feeling against the current proposed alignment for a number of reasons, and they are aggrieved that alternatives were not been incorporated during previous studies in relation to the Bar-Boljare Highway, despite these having been discussed during public consultation.

- The proposed Berane interchange is located in a densly populated area – Pešica and Lužac settlements. With the current alignment variant 30% of the municipality would have to be resettled. This alignement is from the 1970s when the population in this area was far less.

- From Gradinsko Polje the alignment goes through Buče, Pešica, Lužac, Dolac and Beranselo, all suburban areas.

- One of the access roads will pass right through the Berane Airport complex (the Municipality is trying to reactivate the airport).

- The alignment passes 100m from the Đurđevi Stupovi Monastery (13th century), which is also adjacent to the Manastrisko Vrelo water source, which used to be the main watersource for Berane before they constructed the water system (now 30-40% of water from here goes to water supply and it is still the emergency water supply).

- In Beranselo the alignment goes over the existing landfill, where the Municipality is planning to construct a recycling center there.

- Towards the north the alignment goes through the following settlements: Donje Zaostro, Crvljvine, Lukavica and Do Štitara.

- It would be preferable if the alingment could be moved 500m – 1km towards the west, passing along the edges of Vinicka, Buča and Lužac settlements.

- The alignment goes through Bjelasica and Komovi area of special purpose.

- Protentially-affected settlements were established before 2008, before the adoption of the law. However, because most are in the corridor they could not be legalised. Now that the adoption of the new law is under way, they expect they will be able to legalize their structures except those which are in the corridor of the roads, water supply system and electric power transmission system.

- Most owners of illegal structures live in these houses and they were built on their own land.

- There is not a single argument i favor of the existing variant – moving the alignment just 1km towards west would solve 99% of the problems.

- People are leaving the Municipality – there are 33,970 inhabitants today; 9,000 people have left in the last 30 years.

- It is expected that if the project road was built, many people could come home to Berane and work elsewhere.

- Berane used to be an industrial area (facilities for processing and production of cellulose, paper, leather, fur, coal mine, brickyard, wood processing, two large trading companies), with some agriculature. Very few of these earlier industrial facilities are still operational. A facilitiy for production of explosives is working (mixed ownership); the rest are mostly medium-sized companies, mini farms (cattle, some sheep). Cellulose production facility used to employ 2.000 people.

7.2.7 Bjelo Polje

Key points emerging from discussions with Andrijevica Municipality include the following:

- The project road is a major development opportunity.

- The highway will reduce the differences in the development between north and south.

- Economic effects can only be positive – strategic improvement of agriculture, tourism, water industry, wood processing industry.

- Environmental protection is a priority; construction of the road is not expected to have great adverse effects. Negative impacts will be outweighed by positive ones.

- In terms of expropriation, the motorway is expected to pass approximately 10 km away from Bijelo Polje, with limited physical resettlement – mostly agricultural and pasture land.
- Different variants don't make a big difference but the preference would for the road to be closer to the town.

- During the construction of old road dust did effect production of local berries.

- Phase 1 of the Bijelo Polje Bypass has constructed. The Municility is waiting for the masterplan to be adopted for Phase 2. Final routing of Bar-Boljare Highway may influence, depending on timing.

7.2.8 Montenegrin Fund for Solidarity and Housing Development

The Montenegrin Fund for Solidarity and Housing Development (CFSSI) was introduced to the study team as a possible provider of housing in the context of physical resettlement.

Key points emerging from discussions with CFSSI included the following (also with reference to CFSSI's printed publicity material):

- CFSSI is a limited company established in 2008 by three partners – the Government of Montenegro (represented by the Ministry of Sustainable Development and Tourism), the Confederation of Trade Unions of Montengro and the Montenegrin Employers Federation, for the purpose of cooperation on the affordable housing development for low-income households, and support to the implementation of state social housing policy.

- CFSSI's mission is to provide affordable housing of good quality at below-market prices to its members – companies, institutions, organisations (ie, their employees).
- The support of Municipalities is essential in the provision of land for housing projects.
- Housing development is financed by Municipalities, investment by CFSSI members and loans from international financial institutions.
- Occupants can have lease or ownership options over their CFSSI dwelling.
- CFSSI already has developments in the north – in locations where there is no real functioning property market at present as house prices are too low (below construction cost).
- CFSSI could operate as a cost-effective housing provider in the context of physical resettlement, with credit lines and access to international investors.
- Key would be to work together with the project in developing a workable strategy.
- CFSSI can be involved in negotiations with individual households.
- The EU model for social housing is now to work through funds like CFSSI (rather than governments providing housing themselves as such).

APPENDIX A - TERMS OF REFERENCE

Task 5 Undertake an Environmental Impact Assessment for the Investment Plan

The Consultant's work under this task shall be performed in accordance with Directive 85/337/EEC as amended, Directive 92/43/EEC (Habitats), Directive 2009/147 (Birds), national law, international conventions that Montenegro has subscribed to, as well as meet the standards applicable for international financial institutions including the EIB, EBRD, IFC and World Bank that may potentially finance investments identified under these Services.

The Consultant shall:

a) Document all applicable treaties, laws, rules, regulations or protocols;

b) Identify all environmentally or culturally sensitive receptors along the route;

c) Recommend and agree a disclosure and consultation plan which shall include a minimum of two rounds of public consultation, of which at least one round shall include alignment and design standard options;

d) Implement the disclosure and consultation plan (all costs associated with such plan are to be borne by the Consultant);

e) Prepare an initial environmental and social impact evaluation (see next task for details of social assessment) of each option and duly include the results in the technical options analysis. Include the cost of mitigation/ compensation measures in the cost of options.

For the recommended investment plan, the Consultant shall:

a) Undertake further detailed environmental analysis for the investment works under the recommended investment plan requiring an EIA under Directive 85/337/EEC (i.e. new alignment or dualling of existing alignment more than 10 km in length or where otherwise screened in by the Competent Authority)

b) Where necessary, perform an "appropriate assessment" (as defined under the Habitats Directive) of the impact of the recommended investment plan on protected areas and species;

c) Prepare cost estimates of environmental mitigation and/or compensation measures; and

d) If necessary, identify what additional environmental analysis may be required at the subsequent preliminary design stage in order to meet fully the requirements of domestic legislation and prepare terms of reference for such additional services.

On the basis of the analysis above, for the recommended investment plan, the Consultant shall prepare an Environmental Impact Statement and Non Technical Summary for subsequent submission to the relevant Competent Authority and final round of public consultations. The Employer shall be responsible for actual submission of the EIS to the Competent Authority and the final round of public consultation.

If necessary, the Consultant shall amend the documentation in the light of necessary revisions arising as part of the submission of the EIS to the Competent Authority/final round consultation.

Task 6 Undertake a Social Impact Assessment for the Investment Plan

The Consultant's work under this task shall be performed in accordance with national laws and relevant policies and standards applicable for international financial institutions including the EIB, EBRD, IFC and World Bank that may potentially finance investments identified under these Services.

The Consultant shall:

a) Review all existing legal and regulatory measures related to involuntary resettlement or harmful effects from public projects;

b) Prepare an initial social impact evaluation (simultaneously with environmental impact, see previous task) of each technical option and duly include the results in the technical options analysis. Include the cost of mitigation/compensation measure in the cost of options.

For the recommended investment plan, the Consultant shall:

a) Categorise the various types of project affected persons and identify the likely social impacts for each category;

b) Prepare a resettlement and compensation policy framework including an entitlement matrix, consultation plan, cut off date (or method of determination if not possible to determine such date at the time), grievance mechanism and generic resettlement action plan;

c) Prepare cost estimates of land acquisition, compensation and resettlement; and

d) Prepare a stakeholder engagement plan.

APPENDIX B RESETTLEMENT POLICY FRAMEWORK

Resettlement Policy Framework

Project Background

The Government of Montenegro intends to develop an Investment Plan for SEETO Road Route 4.

Scope of the Resettlement Framework

Final project alignments have not been determined and engineering designs have been carried out at General Design level which means the full extent and nature of land acquisition impacts cannot yet be determined. This Resettlement Framework (RF) will guide the resettlement planning process as the project develops in preparation of preparation of a full Resettlement Action Plan during the detailed design stage. In line with EIB requirements, this RF sets out, in brief form:

a) the resettlement principles;

b) organizational arrangements; and

c) legal framework, due process, entitlements, procedures.

Structure of Document

The following chapters are presented in this report:

1 Introduction

2 Resettlement Principles

3 Potential Impacts

4 Legal Framework

5 Institutional Framework

6 Stakeholder Engagement

7 Eligibility and Entitlements

8 Livelihood Restoration and Improvements

9 Implementation Programming

10 Cost and Budget

11 Monitoring and Evaluation

12 Steps for Preparation of a Full RAP

Resettlement Principles
Resettlement Objectives of the EIB

According to the EIB Environmental and Social Practice Handbook, project objectives in relation to involuntary resettlement should be as follows:

- To avoid or, at least minimize, project-induced displacement whenever feasible by exploring alternative project designs;
- To mitigate negative social impacts from asset loss and/or restrictions of land use, (a) through the provision of appropriate compensation and/or livelihood opportunities regardless of the legality of existing land tenure arrangements, and (b) ensuring that

resettlement measures are implemented with meaningful consultation and the informed participation of the affected people;

- To assist displaced persons to improve their living standards and improve, or at least restore, their former livelihoods.

The means by which these are achieved is to put in place a comprehensive Resettlement Plan which ensures that:

- There are clear steps and due process to follow – ie, a plan.
- All project-affected people and their resettlement impacts are identified.
- Physical resettlement is a managed process, ensuring that all rehousing needs are met.
- The process is participatory.
- Livelihood restoration and improvements are ensured, as appropriate.
- There are sufficient institutional capacity and resources to manage the resettlement process properly.
- There is a detailed implementation schedule.
- There are grievance mechanisms in place.
- There is provision for monitoring and evaluation.

This RF provides the basis upon which the full Resettlement Plan will be elaborated.

Potential impacts

The scale of resettlement impact is not yet precisely known, although it is possible to predict the likely type of impact resulting from land expropriation, according to a knowledge of the landscape, settlements, population and livelihoods along the route.

These impacts can be summarized as follows:

Physical Resettlement

Physical resettlement means loss of primary dwelling place, and includes the following:

- Loss of primary owned homes (and associated structures) with/without valid title
- Loss of primary owned homes (and associated structures) with no valid title (informal structures)
- Loss of combined owned primary homes and commercial with/without valid title
- Loss of rented accommodation

Economic Resettlement

Economic resettlement means loss of livelihood or means to pursue a particular livelihood or way of life, and for the Bar-Boljare Highway project would likely include the following:

- Loss of agricultural land
- Loss of pastureland
- Loss of urban construction land
- Loss of vineyards and orchards
- Loss of commercial buildings and associated structures with/without valid title
- Loss of access – for example to transport networks, forest and pasture areas
- Loss of cultural or community property, such as schools, churches, mosques and cemeteries.

Vulnerability

Some groups may be more adversely affected by resettlement impacts, and for this reason may be considered to be vulnerable – for example on the basis of poverty, age, disability, illness, ethnicity, status of land-holding, or extent of dependence on land-based livelihoods. The project will identify all at-risk individuals and groups and ensure adequate provision for them as well as monitoring impacts of resettlement and any resettlement assistance provided, in consultation with the Ministry for Health, Labour and Social Welfare and Municipality Governments[15].

LEGAL FRAMEWORK

This section summarises applicable Montenegrin Legislation and international best practice in the context of land acquisition and resettlement.

Montenegrin Legislation

Primary applicable Montenegrin legislation is the Law on Expropriation (OG, No. 55/00, 12/02, 2806). Also relevant in the context of illegal structures is the draft Law on Informal Structures.

The term “resettlement” as such is not used, as these instruments are solely concerned with compensation for lost assets and legalization of structures, respectively.

Law on Expropriation

Applicable sections of The Law on Expropriation can be abbreviated as follows:

Expropriation – Article 1
Expropriation means dispossession or limitation of the ownership right on immovable (land, buildings and other structures) when required so by the public interest, with a compensation based on the market value of immovables.

Expropriation can be complete (through change in ownership) and incomplete (through establishment of emporary easement or occupancy – for example for the establishment of borrow or works areas.

Expropriation of the Remaining Part – Article 8
If use of remaining part of the immovable property is significantly more difficult, that part of immovable property shall also be expropriated, at his request.

[15] The ESIA provides more detail on the issue if vulnerability, including how it is conceived and addressed by providers of social services in Montenegro.

Compensation – Article 9
Compensation for expropriated immovable property shall be determined in money, unless otherwise determined by this Law.

Compensation – Article 18
A legal entity, for whose benefit the performance of preparatory activities is allowed, shall be obliged to pay in return a compensation prescribed by this Law to the owner of immovable property.

Amount of Compensation - Article 35
The amount of compensation for expropriated immovable property shall be determined at the market price.

Compensation for Agricultural Land – Article 36
Compensation for expropriated agricultural land or facility for raising cattle or storing agricultural produce shall be determined in money in accordance with the market price of such a land. The compensation for the expropriated agricultural land or facility to a person whose livelihood depends on the revenue from that land or facility may be determined by giving into ownership another adequate land or facility of the same culture and class or adequate value.

Compensation for City-Building Land – Article 37
Compensation for expropriated building and city-building land shall be determined in money in accordance with the market price of such a land.

Compensation for Apartment and Business Premises – Article 38
Compensation for expropriated apartment building, apartment or business premises shall be determined in accordance with the market price of such immovable property. The expropriation user may give to the former owner of the expropriated apartment building or apartment or business premises that he used for performing the activity.

The expropriation user shall be obliged to provide the lessee of the apartment in the expropriated apartment building or apartment as a separate part of the building, before demolition of the building, with another adequate apartment for use, with the right to lease for indefinite period of time.

Compensation for Vineyard or Orchard – Article 40
Compensation for an expropriated vineyard or orchard that give fruits shall be determined by determining compensation for the land in accordance with Article 36 of this Law, and adding to that amount the market value of non-amortized investments in growing and maintaining such a vineyard or orchard and the amount of net return that would be provided by this vineyard, with respect to its age and fertility.

Compensation for Nursery – Article 41
Compensation for expropriated nursery shall be determined as in the case of agricultural land (Article 36), and the compensation determined in such a manner shall be increased for the market price of unused planting material.

Compensation for Forest – Article 42
Compensation for an expropriated mature forest represents the value of the forest products determined in accordance with the market prices.

Compensation for the expropriated young forest shall be determined in accordance with the costs of growing such a forest increased for the factor of location value by which the value of mature forest is reached.

Discretionary Provision – Article 46
In the procedure for determining the compensation, in accordance with the provisions of this Law, the compensation can be determined in the amount greater than the market price, taking into consideration material and other personal and family circumstances of the former owner, if those circumstances are of a substantial importance for his existence (big number of household members and number of members capable to earn their living or employees, health condition of members of the household, monthly revenues of the household, and similar).

Harvesting Crops – Article 47
The former owner shall be entitled to harvest crops and collect fruits from the expropriated land.

Compensation for Creating Easement - Article 48
In the case of creating easement, the compensation shall be determined in the amount for which, due to creation of easement, the market value of the land or buildings is reduced.

Compensation for Establishing the Lease and Temporary Occupancy - Article 49
In the case of establishing a lease or temporary occupancy of the land, the compensation shall be determined in the amount of lease on the market realized for the closest similar land.

Compensation for Damage - Article 51
The compensation referred to in Articles 49 and 50 of this Law shall not exclude the right to compensation of damage in accordance with the regulations on liability for damage.

Draft Law on Legalisation of Informal Structures

Informal Structure – Article 2
Informal structure is residential, residential-commercial and commercial building or reconstructed part of the existing building, which was constructed without or contrary to building permit.

Buildings intended for basic housing – Article 3
Residential building with a total area of up to 250 m2, occupied by the owner of the informal structure and members of his household, whose residence is in the settlement where the informal structure has been built, if the owner or members of family household do not own or co-own any other residential building i.e. residential unit in Montenegro, is according to this Law considered to be informal structure intended for basic housing.

Business building – Article 4

Commercial buildings i.e. parts of commercial buildings referred to in the Article 2 of this law are: tourist accommodations, facilities for preparation and serving food and beverages, hospitality facilities, commercial and shopping centers, exhibition centers, fairs, office buildings, management facilities, commercial facilities, manufacturing facilities, warehouses and storage facilities.

Application of the law – Article 5
This law applies to informal structures which showed on orthophoto made by the administrative authority for registration of properties in the cadastre (hereinafter: the administrative authority).

During the process of legalisation of informal structures, provisions of the law which relate to the general administrative procedure will be applied, if not otherwise regulated by this law.

Exceptions to the application – Article 6

This law does not apply to the informal structure built on the following locations:

- in the coastal zone
- in the national park zone
- in the road protection zone
- in railway protection zone and in the airport zone
- on cultural heritage and in the cultural heritage protection zone
- in the protected natural heritage zone
- in the energy facilities protection zone
- on water land and in the water source protection zones
- in the zones of forest parks, protected forests, green areas
- on landslides i.e. exploitation areas
- in the areas less than 400m away from military facilities used for storage of explosives and ammunition
- in the area set in the relevant planning documents for construction of infrastructure and other facilities of public i.e. general interest

Alternative housing – Article 34

Local self-government authority is obliged to, in case of issued decision on removal of informal structure intended for basic housing, provide the owner of the informal structure alternative housing suitable for the number of the household members.

Alternative housing referred to in the paragraph 1 of this Article is provided by leasing the apartment at minimal rates, assigning the land for construction of residential building, providing compensation in the amount of minimal rent and other suitable ways.

International Best Practice

IFC Performance Standard 5 thoroughly captures international best practice in relation to resettlement and can be summarised as follows:

- Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood1) as a result of project-related land acquisition and/or restrictions on land use.

- The objectives of Resettlement are:
  - To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.
  - To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
  - To improve, or restore, the livelihoods and standards of living of displaced persons.
  - To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

- A grievance mechanism should be established which will allow the client to receive and address specific concerns about compensation and relocation raised by displaced persons or members of host communities in a timely fashion, including a recourse mechanism designed to resolve disputes in an impartial manner.

- Procedures to monitor and evaluate the implementation of a Resettlement Action Plan should be established, with corrective action taken as necessary.

Gap Review

The Montenegrin Law on Expropriation is fairly robust in its basis and procedures for awarding and valuing compensation. However, best practice goes further by providing for the following, which will form the basis for managing resettlement for the Bar-Boljare project:

- A requirement for stakeholder engagement throughout resettlement implementation, including in determining resettlement options.
- Establishment of a project grievance mechanism.
- To improve living conditions of displaced people, including through offering improved housing, where appropriate.
- To put in place livelihood improvement opportunities for people, including participation in project benefits.

INSTITUTIONAL FRAMEWORK

Under the provisions of the Expropriation Law, the "expropriation user" is responsible for management of all aspects the land acquisition and compensation process associated with a project. The expropriation user for the SEETO IV Project is The Road Directorate, which is currently managing the expropriation in relation to the Smokovac – Bioce section of the present project.

In order to facilitate best practice in resettlement management for the remainder of the project, a Resettlement Committee will be established, as a sub-committee of the SEETO Route IV Project Steering Group.

The Resettlement Committee will be responsible for determining overall strategy for the management of land acquisition and resettlement, to ensure compliance with national laws and the requirements of best practice, and to ensure that all resettlement activities are in harmony with national sustainable development priorities in plans – for example in relation to development of the economies of the northern regions and rural areas, and to slow north-south migration.

The Resettlement Committee will include representation from the following institutions:

- Road Directorate
- Municipality Governments
- Ministry of Health, Labour and Social Affairs
- Environment Protection Agency
- Ministry of Sustainable Development and Tourism
- Ministry of Agriculture and Rural Development
- Real Estate Administration

The role and responsibilities of each of these institutions in the resettlement process are outlined below.

Road Directorate

Reporting directly to the Ministry of Transport and Maritime Affairs, the Road Directorate is responsible for implementation of project construction of the project as a whole, including land expropriation. In relation to expropriation, the Road Directorate will carry out the following:

- Surveys of land to be expropriated
- Issuance of expropriation notices to affected land users

- Valuation of Affected Land
- Compensation negotiations with affected land users
- Establishment of project grievance mechanism

Municipality Governments

The Municipality Governments have detailed understanding of their localities and populations. In addition they are currently in the process of preparing local Sustainable Development Action Plans, as required by law. Amongst other areas, these plans will consider local housing, livelihood and land-use priorities.

In relation to resettlement management the Municipalities will provide guidance in the following areas (amongst others as required):

- Refining and verifying resettlement impacts, including identification of vulnerable households
- Identification of resettlement areas
- Receiving and processing grievances
- Resettlement Monitoring

Ministry of Health, Labour and Social Affairs

The Ministry of Health, Labour and Social Affairs is represented on the steering committee for the SEETO IV Project, and will have an important role in identifying and ensuring that the needs of vulnerable people are met – for example households below the poverty line, female-headed households, households with members who receive social protection assistance, ethnic minority (such as Roma) households, households containing internally-displaced people or elderly members of the community amd households with disabled or sick members. Specifically the roles and responsibilities of this ministry will include:

- Ensuring identification of and consultation with vulnerable households, working with the Road Directorate, Municipality Governments and providers of social housing in particular;
- Ensuring that needs of vulnerable households are taken into account during resettlement planning and implementation, including in the design of any safety nets;
- Project monitoring, particularly in relation to impacts on vulnerable people.

Environment Protection Agency

In relation to resettlement, the Environment Protection Agency will be responsible for reviewing and ensuring good management (for example by contractor staff as part of a project EMP) of any environmental impacts associated with land acquisition and resettlement, for example:

- Easements;
- Borrow and spoil areas;
- Resettlement Areas.

Ministry of Sustainable Development and Tourism

The Ministry or Sustainable Development and Tourism (MSDT) is currently working closely with other relevant government agencies and the World Bank (through the Land Administration and Management Project (LAMP)[16]) in addressing the issue of informal structures in Montengro, both residential and commercial. This has relevance in the context of land acquisition for the SEETO Route IV project since related land acquisition will affect a

[16] http://www.lamp.gov.me/

large number of informal structures for which clear policies and procedures in terms of compensation entitlements are established.

The MSDT has been instrumental in preparing a Draft Law of Legalisation of Informal Structures (Draft Law) which at the time of writing (June 2012) was being considered by the Montenegrin Parliament.

The contents of the Draft Law are summarized above, a key aspect of which is the requirement to provide rehousing to residents of unregistered housing who will face physical resettlement in cases where their homes need to be demolished (as in the case of physical resettlement as a result of the SEETO Route IV Project).

Whilst not directly responsible for housing provision, the MSDT will have the following responsibilities in relation to rehousing:

- Guiding the project on blending relevant provisions of the Draft Law with the management of physical resettlement for the Seeto Route IV Project, in terms of establishment of resettlement areas, identification of suitable and cost-effective housing providers[17], and supporting such providers in securing innovative financing arrangements (such as from international capital markets), as appropriate.
- Supporting project monitoring and assessing implications for resettlement implementation for the development of local and national sustainable development planning (for example in terms of demographic changes, development of the tourism industry and associated supply chains, etc).

Ministry of Agriculture and Rural Development

The Ministry of Agriculture and Rural Development (MARD) will work with Municipality Government to ensure targeting of existing agricultural and livestock development and extension programmes to project affected people, with a particular emphasis on reaching vulnerable groups.

Examples of programmes may include initiatives under the Strategy for Food Production and Rural Development (2006 – 2013) and EU-funded National Programme for Food Production and Rural Development 2009 - 2013[18], such as the following:

- Support to livestock production
- Bee-keeping improvement
- Investments in processing on family holdings
- Improving the quality of agro-food production and products
- Organic production
- Sustainable use of mountain pastures
- Diversification of economic activities in rural areas
- Village renewal and infrastructure improvement
- Extension and communication services

Real Estate Administration

The involvement of the Real Estate Administration in the resettlement process, including the Cadastre Department, will be in relation to the resolution of land title issues, determining land valuation for the purposes of compensation (with reference to market prices), and registration of new title in cases of physical resettlement to ensure tenure security and clarity.

[17] One notable example is the Montenegrin Fund for Solidarity Housing Development (http://www.cfssi.me/) which is a limited liability company established to support the provision of affordable housing in Montenegro and the development and implementation of state social housing policy.

[18] http://www.mpr.gov.me/en/organization/agriculture-and-farming/103228/NATIONAL-PROGRAMME-FOR-FOOD-PRODUCTION-AND-RURAL-DEVELOPMENT-2009-2013.html

ELIGIBILITY AND ENTITLEMENTS

The following Table B1 is an Entitlements Matrix and sets out the elibibilty criteria and entitlements for all categories of displaced people (and institutions) to ensure both compliance with the Montenegrin Law on Expropriation and to meet the requirements of international best practice.

Table B1: Entitlement Matrix

Category of PAP	Type of Loss	Compensation for Loss of Assets	Moving/Reestablishment Allowance	Other Assistance
Property Owners of Registered Property	Loss of Agricultural Land, Land for Raising of Livestock or Land for Storage or Processing of Agricultural Products	• Cash or replacement at market value / equivalent quality and in the local area (according to owner's preference and provisions of Law on Expropriation). • In cases of partial loss of land-holding parcel, entitlement to compensation for loss of the whole where the use/value of the remaining land is reduced to render unviable.	• In cash and at cost.	• Additional payments or other social service provision and/or livelihood restoration support to vulnerable households.
	Loss of land for construction or other commercial use	• In cash at market value. • In cases of partial loss of land-holding parcel, entitlement to compensation for loss of the whole where the use/value of the remaining land is reduced to render unviable.	• In cash and at cost.	
	Loss of home or combined home and business structure	• Cash or replacement at market value / equivalent quality and in the local area (according to owner's preference and provisions of Law on Expropriation).	• In cash and at cost.	• Additional payments or other social service provision and/or livelihood restoration support to vulnerable households.

Category of PAP	Type of Loss	Compensation for Loss of Assets	Moving/Reestablishment Allowance	Other Assistance
	Loss of crops	• Former owner entitled to harvest crops and collect fruits from the expropriated land, or compensation in cash at market value (minus costs) in case works begin before harvest time.		• Livelihood restoration support to vulnerable households.
	Loss of Vineyard or Orchard	• Compensation in cash at the market value, determined according to investments made in growing and maintaining such a vineyard or orchard and the amount of net return that would be provided by this vineyard, with respect to its age and fertility. • Compensation for an expropriated young vineyard or orchard that do not give fruits shall be determined according to the amount of the investments made for its growing and the amount of net return that would be generated until the actual date of expropriation.	• In cash and at cost.	• Additional payments or other social service provision and/or livelihood restoration support to vulnerable households.
	Loss of nursery	• Compensation to be determined as in the case of agricultural land, plus compensation for unused planting material		• Additional payments or other social service provision and/or livelihood restoration

Category of PAP	Type of Loss	Compensation for Loss of Assets	Moving/Reestablishment Allowance	Other Assistance
		(seedlings and other material for reproduction) at local market prices.		support to vulnerable households.
	Loss of forest	• For mature forest – value of the forest assortments and other forest products at local market prices, less reasonable production (cutting, processing, transportation) costs. • For young forest – according to the costs of growing such a forest in the local area.		• Additional payments or other social service provision and/or livelihood restoration support to vulnerable households.
	Temporary Occupancy of Land (for site access, borrow/spoil areas, temporary works, etc)	• Compensation in cash in the amount of lease on the market realized for the closest similar land, payable monthly in arrears.		• Additional payments or other social service and/or livelihood restoration support to vulnerable households.
	Damage to Property	• Compensation in cash at current market replacement value, including reestablishment costs.		
Owners of 'Informal Structures'	Loss of home or combined home and business structure, where this is the household's primary residence and no other home is owned by the household in Montenegro.	• Cash for value of materials or provision of suitable replacement housing (in lease or ownership).	• In cash and at cost.	• Additional payments or other social service and/or livelihood restoration support to vulnerable households.
	Loss of Commercial/Business Structure	• Review by Commission of whether or not the structure	• In cash and at cost.	• Additional payments or other social service

Category of PAP	Type of Loss	Compensation for Loss of Assets	Moving/Reestablishment Allowance	Other Assistance
		would qualify for legalisation according to the Draft Law on Legalisation of Informal Structures.		and/or livelihood restoration support to vulnerable households.
	Loss of other structures for which planning permission and registration are required (including second or investment homes)	• Review by Commission of whether or not the structure would qualify for legalisation according to the Draft Law on Legalisation of Informal Structures.	• In cash and at cost.	
Tenants	Loss of agricultural land	• For tenancy of at least twelve months' duration, payment of equivalent three months' rent at prevailing local rates.		• Additional payments or other social service and/or livelihood restoration support to vulnerable households.
	Loss of housing / commercial structures	• Assistance in identification of a replacement unit with indefinite lease.		• Additional payments or other social service and/or livelihood restoration support to vulnerable households.
Owners of Community Infrastructure	Churches, Mosques	• Removal according to procedures established through consultation with applicable religious authorities and leaders at settlement-, municipality- and national level as appropriate, and according to applicable laws.		
	Cemeteries	• Removal according to procedures established through consultation with applicable		

Category of PAP	Type of Loss	Compensation for Loss of Assets	Moving/Reestablishment Allowance	Other Assistance
		religious authorities and leaders at settlement-, municipality- and national level as appropriate, and according to applicable laws.		
	Other properties of cultural heritage significance.	• Removal according to applicable laws.		
Owners of Public Infrastructure	Utilities infrastructure	• Removal according to applicable laws and agreements with utility providers.		
	Private telecommunications infrastructure and equipment	• Removal according to applicable laws and agreements with		

Stakeholder engagement

Engagement with people affected by land acquisition throughout the duration of a project is important to ensuring an efficient resettlement process that is equitable and transparent and will involve the following components:

- Census and socioeconomic survey
- Disclosure and Dissemination of project information
- Consultation and participation
- Grievance mechanism
- Ongoing reporting to affected communities.

In relation to the SEETO Route IV project, these are dealt with in more detail below.

Census and socioeconomic survey

As part of project detailed design and preparation of a comprehensive Resettlement Action Plan, a detailed census and socioeconomic survey will be carried out in order to establish the project-affected population and resettlement risks and impacts. As such the census and survey will capture the following (building on the Resettlement Framework):

- Households affected – ownership status and use of affected land, number of members, names, age, gender, ethnicity, religion, language, occupations, health, disability, etc.
- Resettlement impacts – whether physical or economic (or both), whether partial or whole or land parcel is to be acquired and in case case with what effects;
- Identification of groups who may be particularly vulnerable to certain resettlement impacts – for example in terms of employment status, poverty, age, ethnicity (including in relation to Roma people), origin (for example internally-displaced people), health and disability.
- Entitlements in terms of compensation and other resettlement assistance.

The census and socioeconomic survey will be carried by experienced social development and resettlement experts using primarily house-to-house methods and with reference to existing demographic and socioeconomic development information (for example from the Statistical Office of Montenegro) An electronic RAP database will be established and maintained.

Disclosure and Dissemination of Project Information

The following information will be posted prior to project commencement in Municipalities and Settlements along the route (as well as in the local press where appropriate) (amongst others):

- Final project alignment with description of land acquisition impacts;
- Legal basis and process of land acquisition, including associated surveys and consultation;
- Project cut-off date (date beyond which no new arrivals to the area will be eligible for resettlement compensation or assistance);
- Project grievance mechanism and contact information (notice)
- Project progress, including in relation to land expropriation.

According to the Law on Expropriation, all affected households and business owners will be served notice individually of required land expropriation in the appropriate form. This notice will include information regarding the land acquisition process (including surveys and consultation in relation to compensation), as well as the project grievance mechanism and any official appeals process.

Consultation and Participation

Effective consultation is a two-way process that (i) allows affected people to express their views on the resettlement process, impacts, compensation measures and any other assistance, including any grievances; and (ii) enables the project to respond as appropriate and in a coordinated manner.

Participation means the active involvement of projected-affected people in influencing project outcomes. In the case of resettlement management this typically means such things as the identification of different options for compensation and other resettlement assistance, to the extent that this is reasonable and appropriate.

Consultation and participation in relation to planning and implementation for the SEETO Route IV project will involve the following (amongst others):

- Household-level discussions regarding basis for assessing compensation, compensation negotiations and discussions regarding options (for example whether cash or in-kind replacement of lost assets);
- Targeted discussions with project-affected women to identify any potential gender-based differences in impacts;
- Discussions with vulnerable households in relation to resettlement assistance required;
- Discussions with affected households during project implementation to monitor and evaluate resettlement impacts, and to determine need for any associated additional support or corrective measures;
- Resolution of grievances.

All consultation will be documented with records maintained electronically in a central resettlement database.

Grievance mechanism

A grievance mechanism for the project will be established which will facilitate resolution of concerns or grievances project-affected people's may have in relation to environmental and social performance. The grievance mechanism should be transparent, efficient, free of coercion, confidential, and operate at no cost to the user. In addition it should operate without prejudice to any judicial or other 'formal' channels for complaint, but should also provide an efficient, cost-effective alternative, whilst operating according to the laws of Montenegro.

The mechanism will be as follows (to be further developed during preparation of a full project Environmental & Social Impact Assessment and Resettlement Action Plan):

1. Grievance submitted to designated officer at Municipality level (to ensure a local point of contact);

2. Grievance referred to appropriate channel for review or hearing, according to nature and severity of grievance:

   a. Project Contractor
   b. Appropriate Municipality Department
   c. Road Directorate
   d. Ministry of Health, Labour and Social Affairs
   e. Social Housing Provider

3. If grievance resolved and acted upon, no further action required.

4. If grievance not resolved, referred to Resettlement Committee or judicial system according to nature.

Ongoing reporting to affected communities

Disclosure and consultation will continue periodically (monthy, quarterly, annually as appropriate) throughout the duration of resettlement implementation, in particular in relation to the following:

- General project progress, including in relation to land acquisition (through public notice and press release);
- Publicising good practice and successes in terms resettlement assistance provided in addition to compensation, particularly for vulnerable groups (such as transition support, training or housing provision);
- Any updates or updates in project programming, particularly in relation to land acquisition and resettlement management;
- Any updates or changes in relevant legislation or project policies (for example operation of the project Grievance Mechanism).

LIVELIHOODS RESTORATION AND IMPROVEMENT

Resettlement should be conceived as an opportunity for sustainable development with livelihood restoration and (where possible) improvement measures put in place for project-affected people, in addition to simple compensation for lost assets.

Article 46 of the Expropriation Law provides that "compensation can be determined in the amount greater than the market price, taking into consideration material and other personal and family circumstances of the former owner, if those circumstances are of a substantial importance for his existence (big number of household members and number of members capable to earn their living or employees, health condition of members of the household, monthly revenues of the household, and similar)".

This is a clear indication of the spirit of the legislation, which is to meet the needs of vulnerable households that may be affected by resettlement.

Under the SEETO Route IV Project, livelihood improvement measures will include, as appropriate, extension of existing national- and municipality-level agricultural and rural development initiatives to project-affected people and communities, with particular targeting of vulnerable groups. Measures will be selected in consultation with beneficiaries and according specific project impacts and local socioeconomic development priorities (for example as captured in Local Sustainable Development Plans), and subject to technical and economic feasibility assessment as well as detailed planning, in each case.

The EU-funded National Programme for Food Production and Rural Development 2009 – 2013 (NP) sets out a useful framework and range of initiatives that could be applied to support livelihood improvements for project-affected people. Activities under this programme, in addition to providing support to rural socioeconomic development in Montenegro generally, has the additional benefit of doing so, where possible, according to EU standards (for example in relation to health and hygiene in food production).

A selection of initiatives under the NP can be summarised as follows (with detail for each that may be adopted to be determined during full RAP design and implementation).

Supporting Livestock Production

This activity would involve direct assistance to livestock farming consisting of:

- Subsidies per head of cows and heifers
- Slaughter subsidies for beef cattle
- Subsidies per head of sheep and goats

Supporting Dairy Production for Market

This activity would provide assistance is in the form of a subsidy per litre of delivered milk, under the condition that the quantity delivered meets an agreed minimum per month, per producer.

Supporting Arable Crop Production

Support would be available for arable crop production and seed production in the direct payments of subsidies per hectare of cultivated land surface for basic crops (cereals, potatoes, plants for animal feed, buckwheat and other crops (apart from tobacco) and seed production of the aforementioned crops, according to an agreed minimum production area.

Apiary Improvement

Support in apiary improvement could include the following:

- Selection and introduction of high quality queen bees
- Improvements in health of bee communities
- Improvements in production, hygiene, packaging and storage of bee products, including subsidising of modern equipment.
- Support to gaining professional bee-keeping qualifications.

Investment in Agricultural Equipment and Mechanisation

Support under this activity would involve co-financing of farm-equipment to improve production efficiency (such as hand tractors, ploughs and tilling machines).

Investments in Livestock Farms

Assistance under this measure would primarily be in the form of co-financing stabling, enclosures, equipment and heads of livestock.

Restructuring of Permanent Crop Plantations and Horticulture

Assistance under this measure could include co-financing in relation to the following:

- Improving or establishing orchards, vineyards and olive groves
- Seedlings production
- Greenhouse design and construction.

Irrigation Supply Improvements

Irrigation supply improvements could include co-financing installation of new infrastructure or upgrading existing infrastructure, as appropriate.

Investments in Processing on Family Holdings

Support under this area of assistance could include subsidies for investments in the processing, storage and marketing of farm produce and sustainably harvested wild products (such as medicinal herbs, mushrooms and forest fruit).

Sustainable Use of Mountain Pastures

Under this initiative a subsidy would be provided to agricultural holdings practising transhumance for at least two months in a year. The subsidy would be in the form of a payment per livestock head, according to type of livestock (ruminants, horse, etc), to an agreed minimum number of head of livestock.

Diversification of Economic Activities in Rural Areas

Support under this initiative would be would be available to project-affected individuals, households and non-agricultural enterprises and include:

- Provision of training (for example in tourism-related industries, handicraft production, enterprise management, etc)
- Subsidised construction of facilities (such as for food and accommodation).

IMPLEMENTATION SCHEDULE

A detailed implementation schedule will be developed during detailed RAP preparation. Resettlement can be phased with construction stages, but in all cases must be complete before construction begins on each stage.

COSTS AND BUDGET

Estimated Land Acquisition costs are contained in the Economics Report for the study.

Funding for land acquisition costs will be drawn from project finance funds for the SEETO Route IV Motorway. State and other donor support may be secured as appropriate for co-financing of livelihood restoration and improvement programmes.

In relation to replacement housing, it may be possible to secure investment funding through the international capital markets, depending on the model(s) of housing provision adopted.

All funds for land acquisition will be maintained in an escrow account under the Ministry of Finance and disbursed according to applicable covenants and legislation.

MONITORING AND EVALUATION

Monitoring of resettlement process and impacts will be the responsibility of the Resettlement Unit, according to performance targets and associated indicators that will be set out the detailed RAP, likely to include the following (amongst others):

Expropriation

- Number of people/households physically resettled
- Number of business premises physically resettled
- Amount of agricultural land expropriated
- Amount of forest land expropriated
- Area/number of vineyards and orchards expropriated

Compensation

- Number of households/entities compensated in cash
- Number of households/entitles compensated in kind
- Value of compensation disbursed

<u>Vulnerable Groups</u>

- Number of vulnerable project-affected people identified (by vulnerability category)
- Number of vulnerable project-affected people in receipt of targeted assistance and/or monitoring

<u>Livelihood Restoration and Improvement Programme</u>

- Number of livelihood restoration and improvement initiatives in place
- Number of beneficiaries per livelihood restoration and improvement initiative
- Number of beneficiaries of livelihood restoration and improvement programme reporting positive impacts

<u>Grievance Mechanism</u>

- Number of grievances reported (by type)
- Number of grievances resolved (by type / means of resolution)
- Any review of grievance procedure

<u>Stakeholder Engagement</u>

- Number of project notices/announcement posted (by type/subject/location)
- Number of household/group meetings held (by type/purpse)

In addition to internal M&E as part of routine project management, RAP preparation, implementation and reporting will likely be subject to external M&E, according to the requirements of the Government of Montenegro and partner financing agencies.

Steps required for preparation of full RAP

In order to convert this Resettlement Framework into a full RAP, the following will be required as a minumum:

- Comprehensive census and socioeconomic surveys of the project-affected population (with updates during review and implementation as required).

- Review and, where required, updating of legal framework, to capture any changes in respect of applicable legislation (for example anticipated adoption of the Draft Law on Legalisation of Informal Structures).

- Identification and review of resettlement sites, including with the participation of local people and in consultation with host communities (if applicable).

- Further detail in relation to livelihood restoration and restoration measures, particularly their relevance to local livelihoods, socioeconomic development priorities, linkage with existing programmes, and targeting vulnerable groups.

- Further detail in relation to institutional arrangements for RAP implementation, including agreed terms of reference for each staff position and institution involved,

- Detailed implementation schedule.

- Detailed stakeholder engagement plan outlining the process of consultation and participation of affected people during RAP preparation, implementation and monitoring, including in relation to disclosure of relevant project information.

- Further detail on grievance redress, including in relation to appeals.

- Further detail on Monitoring and Evaluation, including indicators, process, frequency, involvement of project-affected people and anticipated external monitoring requirements.

- Comprehensive budget, including financial responsibility and authority and itemized costs.

APPENDIX C LAW ON ENVIRONMENTAL IMPACT ASSESSMENT

GOVERNMENT OF THE REPUBLIC OF MONTENEGRO
MINISTRY OF ENVIRONMENTAL PROTECTION
AND PHYSICAL PLANNING
LAW
ON ENVIRONMENTAL IMPACT ASSESSMENT
Podgorica, November 2005

LAW
ON ENVIRONMENTAL IMPACT ASSESSMENT

I. GENERAL PROVISIONS

Scope

Article 1

This Law shall regulate the impact assessment procedure for projects that may have significant impact on the environment, contents of the Environmental Impact Assessment Study, participation of authorities, organisations, and the public concerned, evaluation and procedure of approval issuing, exchange of information on projects that may have significant impact on the environment in another state, supervision and other issues of relevance for the Environmental Impact Assessment (EIA).

Objective of EIA

Article 2

The EIA shall identify, describe and assess, in each individual case, the potential direct or indirect impact of an intended project on the following:
1) human life and health, flora and fauna;
2) land, water, air, climate and landscape;
3) material assets and cultural heritage;
4) mutual relations of elements listed under points 1) to 3) of this paragraph.

Subject of EIA

Article 3

EIA covers intended and ongoing projects that may have significant impact on the environment or human health.
Impact assessment shall also be undertaken for projects in industry, mining, energy, transport, tourism, agriculture, forestry, water management and utilities, as well as for all the projects that are planned on protected natural heritage sites and within the protected environment of immovable cultural heritage.
The provisions of this Law shall not apply to projects serving the national defence purposes or aimed at remediation of consequences of weather and natural disasters.

Competent Authority

Article 4

Competent authorities responsible for the implementation of the EIA procedure (hereinafter referred to as: Competent Authority) shall be:
1) a state authority responsible for environmental protection – for projects for which approvals, permits and licences are issued by other state authorities;
2) a local authority responsible for environmental protection – for other projects for which approvals, permits and licences are issued by other local authorities.

Projects Requiring EIA

Article 5

The Government of the Republic of Montenegro (hereinafter referred to as: the Government) shall pass the regulation prescribing:
1) List of projects for which EIA is mandatory;
2) List of projects for which EIA may be required.

The Competent Authority shall decide on the need for EIA for projects referred to in paragraph 1, bullet point 2 of this Article on the case by case basis.

Obligation to Have the EIA Approved

Article 6

A project developer may not commence with project implementation without having conducted EIA procedure and obtained the approval of the Competent Authority for the EIA Study.

Definition of Terms

Article 7

The terms used in this Law shall have the following meaning:

1) Project shall mean construction, reconstruction, installation, removal and disassembling of structures, plants or systems, remediation, other interventions in nature and natural environment, including exploitation of mineral ores;

2) Project Developer shall mean any domestic or foreign legal person or entrepreneur that applies for approval for project implementation;

3) Environmental Impact Assessment (hereinafter referred to as: EIA) shall mean the identification and evaluation of potentially significant impacts of projects and determination of modalities for prevention, elimination, mitigation, or remediation of harmful effects on the environment and human health;

4) Public shall include one or several physical or legal persons, associations and organisations;

5) Public Concerned shall include the public affected or likely to be affected by the project, including the non-governmental organisations dealing with environmental protection and registered with the authority responsible for environmental protection in compliance with the law;

6) Authorities and Organisations Concerned are public authorities and organisations, local authorities and other legal entities that are authorised by the law to set conditions and issue permits and approvals for construction of buildings, execution of works, physical planning, execution of activities and protection and use of natural and man-made assets.

II. ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURE

Stages in EIA Procedure

Article 8

The EIA procedure shall include:

1) decision on the need for conducting EIA;

2) defining the scope and contents of the EIA Study (hereinafter referred to as: the Study);

3) decision on approval of the Study.

The decision referred to in paragraph 1, bullet point 1 of this Article shall not be made for projects for which EIA is mandatory.

Collecting Data, Information and Documentation

Article 9

The Competent Authority and other authorities and organisations shall provide, at the request of the project developer, the necessary data, information and documentation of relevance for the identification and assessment of potential direct and indirect impact of the project on the environment.

Within 15 days from the receipt of such a request, the authorities and organisations referred to in paragraph 1 of this Article shall provide the project developer with the requested data, information and documentation they dispose with.

When the authority or organisation referred to in paragraph 1 of this Article does not dispose with the requested data, information and documentation, it shall inform in writing the project developer accordingly within the period referred to in paragraph 2 of this Article.

1. Decision on the Need for EIA

Application for Decision

Article 10

The project developer shall submit the application to the Competent Authority to decide on the need for EIA.

The project developer shall submit the following along with the application referred to in paragraph 1 of this Article:

1) Description of the site;

2) Description of the project;

3) Outline of potential impacts of the project on the environment;

4) Filled questionnaire relating to the impact of the project on the environment.

The contents of documentation referred to in paragraph 2 of this Article shall be further elaborated by the regulation enacted by the state authority responsible for environmental protection issues.

Consideration of the Application

Article 11

Upon the receipt of the application enquiring about the need for EIA, the Competent Authority shall check whether the prescribed documentation has been submitted along with it.

When the documentation accompanying the application referred to in paragraph 1 of this Article is incomplete, the Competent Authority shall request the additional data, information and documentation from the project developer and set the period for their submission.

Should the applicant fail to submit the additional data, information and documentation within the set period, the Competent Authority shall refuse the application as incomplete, except in the case referred to in Article 9, paragraph 3 of this Law.

Information Dissemination

Article 12

The Competent Authority shall inform the authorities and organisations and the public concerned of submitted application to decide on the need to conduct EIA within seven days from the receipt of a complete application.

The information referred to in paragraph 1 of this Article shall contain:

1) The name of the project developer;
2) Title of the project;
3) Place and time granted for examination of the documentation;
4) Name and address of the Competent Authority to which the opinion is to be submitted.

The authorities, organisations, and the public concerned can submit their opinions about the submitted application to the Competent Authority within ten days from the receipt, or publication of the notification referred to in paragraph 1 of this Article.

Decision-making

Article 13

The Competent Authority shall decide on the need for conducting EIA within ten days from expiry of the period set in Article 12, paragraph 3 of this Law.

In deciding thereupon, the Competent Authority shall take into account the submitted opinions referred to in Article 12, paragraph 3 of this Law.

Right to Appeal

Article 14

An appeal may be filed to the head administrator against the decision referred to in Article 13, paragraph 1 made by the Competent Authority referred to in Article 4, paragraph 1, bullet point 2.

2. Decision on the Contents and Scope of the EIA Study

Application for the Decision on the Scope and Contents

Article 15

The project developer is entitled to submit an application for the decision on the scope and contents of the Study.

The project developer shall submit the following along with the application referred to in paragraph 1 of this Article:

1) General information;
2) Description of the site;
3) Description of the project;
4) Outline of the main alternatives considered;
5) Description of environmental elements;
6) Description of potential significant impacts on the environment;
7) Description of measures planned for prevention, reduction and elimination of significant negative impacts;
8) Summary of data listed in bullet points 2) to 7) of this Paragraph;
9) Data on potential difficulties that the project developer has encountered in collecting information and documents;
10) Filled questionnaire for determination of the contents and scope of the Study.

The competent state authority responsible for environmental protection issues shall regulate more precisely the contents of documentation referred to in paragraph 2 of this Article.

Decision upon the Application

Article 16

The Competent Authority shall act in the way set forth in Article 11 of this Law upon the receipt of the application for the decision on the contents and scope of the Study.

The Competent Authority shall submit the complete application to the Commission referred to in Article 21 of this Law within five days.

The Commission shall consider the application and submit the proposal of the contents and scope of the Study to the Competent Authority within 15 days from the receipt of the application.

The Competent Authority shall inform the project developer, authorities, organisations, and the public concerned about the proposal of the Commission within seven days from the receipt of the proposal.

The authorities, organisations and the public concerned may submit their opinions to the Competent Authority within 15 days from the receipt of the Commission's proposal.

Within 20 days from the expiry of the deadline for submission of opinions, the Competent Authority shall make the decision on the contents and scope of the Study.

In taking a decision, the Competent Authority shall take into account the opinions of authorities and organisations and public concerned.

The Competent Authority shall deliver the decision on the contents and scope of the Study to the project developer and it shall inform the authorities, organisations, and the public concerned about such decision within seven days from the date on which it has been passed.

3. Decision on the Approval to the EIA Study

Application for Approval

Article 17

The project developer shall submit to the Competent Authority the application for approval to the EIA Study.

The project developer shall submit the EIA Study together with the application referred to in paragraph 1 of this Article.

If the Competent Authority has decided on the scope and contents of the Study, the project developer shall submit the application for approval not later than within one year from the receipt of the final decision on the scope and contents of the EIA Study.

If the project developer referred to in paragraph 3 of this Article submits the application for approval upon the expiry of the prescribed period, the Competent Authority shall decide on the application depending on circumstances in each individual case.

Contents of the Study

Article 18

The Study analyses and assesses environment elements quality and their sensitivity at a certain site, mutual influence of the existing and planned activities, forecasts of direct and indirect impacts of project implementation to the environment as well as the measures and conditions for prevention, elimination, mitigation or remediation of harmful impact to the environment and human health.

The Study is an integral part of documentation necessary for obtaining a permit, an approval or authorisation for project implementation or for obtaining the certificate of occupancy.

The Study shall contain the data referred to in Art. 15, paragraph 2, bullet points 1 to 9 of this Law.

In addition to the data referred to in paragraph 3 of this Article, the Study shall also contain the data on organisations and persons who participated in its elaboration and environmental impact monitoring programme.

The conditions and authorisations obtained by other competent authorities and organisations shall be attached to the Study, in accordance with the Law.

The public authority responsible for environmental protection issues shall prescribe more precisely the contents of the Study.

Approval for Elaboration of the Study

Article 19

The Study can be elaborated by a legal person or an entrepreneur who are entered in the appropriate register for performing planning and engineering activities and development of studies and analyses.

Legal persons and entrepreneurs referred to in paragraph 1 of this Article shall entrust the multi-disciplinary team composed of persons qualified for analyses of project impact on each of the environmental elements with the task of the Study elaboration.
Persons holding a university degree and with at least 5 years of work experience in the certain field, or holding the title of an authorised designer or an appropriate academic title are considered qualified for the analysis of project impact on certain relevant environmental elements.

Public Debate on the Study

Article 20

Within ten days from the receipt of the application for approval for the Study, the Competent Authority shall inform authorities, organisations and the public concerned about the manner, time and venue for public viewing, submission of opinions and remarks, as well as the time and venue for holding the public debate on the Study.
The public debate referred to in paragraph 1 of this Article may not be held sooner than 20 days from the day when the authorities, organisations and the public concerned were informed.
The public debate shall be organised and chaired by the Competent Authority.
The project developer and at least one person who participated in the Study elaboration shall participate in the public debate.

Environmental Impact Assessment Commission

Article 21

The Competent Authority shall establish a Commission responsible for setting the contents and scope of the Study and its evaluation (hereinafter referred to as: Environmental Impact Assessment Commission), to determine the contents and scope of the Study and evaluate the Study.
The Environmental Impact Assessment Commission members shall be appointed among the employees of the Competent Authority and other experts.
The decision on the establishment of the Environmental Impact Assessment Commission shall stipulate its membership, composition and methods of its work.
Persons who participated in the Study elaboration, or employees of the legal person or entrepreneur that elaborated the Study, cannot be members of the Environmental Impact Assessment Commission.

Study Evaluation

Article 22

Within seven days from the date of the public debate, the Competent Authority shall submit the Study to the Environmental Impact Assessment Commission together with the remarks and opinions obtained during the public viewing period and the debate.
The Environmental Impact Assessment Commission may demand from the Project Developer to make certain modifications and amendments to the Study as submitted.
The project developer shall act as stipulated in Paragraph 2 of this Article and submit to the Environmental Impact Assessment Commission the modified and amended text of the Study within the deadline set forth by the Commission.
Should the project developer fail to act as stipulated in paragraphs 2 and 3 of this Article, the Environmental Impact Assessment Commission shall carry on with its work based on the available documentation.
The Environmental Impact Assessment Commission shall submit the report concerning the Study evaluation to the Competent Authority not later than within 30 days from the date of receipt of documentation referred to in paragraph 1 of this Article.
The time left to the project developer pursuant to the paragraph 3 of this Article shall not be calculated in the period referred to in paragraph 5 of this Article.

EIA Costs

Article 23

The costs for the elaboration of and the amendments to the Study, information dissemination and public participation, organising and leading the public debate, as well as the costs for the work of the Environmental Impact Assessment Commission shall be covered by the project developer.

Decision on Granting the Approval

Article 24

The Competent Authority shall decide on granting the approval or rejecting the application for approval of the Study based on the report and proposals of the Environmental Impact Assessment Commission.

Within ten days from receiving the report and proposals of the Environmental Impact Assessment Commission, the Competent Authority shall make and deliver to the Project Developer the decision referred to in paragraph 1 of this Article.
The Competent Authority is obliged to inform the authorities and organisations and public concerned about its decision referred to in paragraph 1 of this Article within the period referred to in Paragraph 2 of this Article, making available the following:
1) contents of the decision and conditions, if stipulated;
2) grounds for the Decision, including the reasons for accepting or rejecting the comments, suggestions and opinions of authorities and organisations and public concerned;
3) if needed, the description of the most important measures the project developer is obliged to undertake in order to prevent, eliminate, mitigate or remediate harmful consequences.

Right to Appeal
Article 25
An appeal against the Decision referred to in Article 16, paragraph 8 and Article 24, paragraph 1 of the Competent Authority referred to in Article 4, paragraph 1, bullet point 2, my be filed to the head administrator.
Termination of Approval Validity
Article 26
The Study approval shall terminate if the project developer fails to obtain the project execution permit or authorisation within two years from the date of delivery of the Decision on granting the approval.
Implementation of Measures Contained in the Study
Article 27
The project developer shall undertake all the measures envisaged by the Study that has been approved.
For the projects for which the Study has been approved, the Competent Authority shall ascertain whether all measures envisaged by the Study have been carried out.
If the Competent Authority referred to in paragraph 2 of this Article determines that not all the measures envisaged by the Study have been undertaken, the certificate of occupancy may not be issued.
Application of the Law on General Administrative Procedure
Article 28
The provisions of the Law regulating general administrative procedure shall apply accordingly to the decision making procedure pursuant to this Law with respect to those issues that have not been explicitly regulated by this Law.
III. INFORMATION, REGISTER KEEPING AND ACCESS TO DATA
Public Information Methods
Article 29
When the Competent Authority is obliged to inform the public pursuant to the provisions of this Law, such information shall be made public in at least one local or daily paper published in the territory to be affected by the intended project, as well as by means of electronic media.
The Competent Authority shall inform the authorities and organisations concerned delivering written notices by fax and electronic media.
Information on Transboundary Impact
Article 30
When an intended project may have a significant impact on the environment in another state, or when another state whose environment could be significantly threatened requests so, the state authority responsible for environmental protection issues shall promptly, and not later than within the deadlines set forth for informing its own public, submit to another state the information concerning:
1) the project, together with all available data on its possible impacts;
2) the nature of the decision that may be adopted; and
3) the period within which another state can announce its intention to participate in the impact assessment procedure.

The state authority responsible for environmental protection issues shall inform the
state that participated in the impact assessment procedure about the decision on granting or rejecting the approval to the EIA Study by providing information on:
1) the contents of the Decision and conditions if they were set;

2) the grounds for the Decision, including the reasons for accepting or rejecting the remarks, proposals and opinions of the authorities, organisations and the public concerned;
3) the most important measures the project developer should undertake in order to eliminate, prevent, mitigate or remediate harmful impact.

The state authority responsible for environmental protection issues shall inform the public as envisaged by Article 29 of this Law about the information it receives on transboundary impact of a proposed project in another state.
The state authority responsible for environmental protection issues shall take into account the obtained opinions of the public concerned when submitting the opinion to the competent authority of another state.
Information and consultations with other states about potential transboundary impact shall be carried out based on the principle of reciprocity, in accordance with the international agreements concluded.

Obligation to Keep Records and Set up a Data Base
Article 31

The Competent Authority shall keep records of procedures and decisions relating to granting or refusing to grant the approval for the Study.
The records referred to in paragraph 1 of this Article shall be in the form of the public register (hereinafter referred to as the: Register). The state authority responsible for environmental protection issues shall prescribe the contents, format and method of Register keeping.

Access to Data
Article 32

The Competent Authority is obliged to provide access to the data relating to the EIA procedure conducted to the authorities and organisations and public concerned within 15 days from the receipt of the written request for information.
Documents classified as business, official or state secret shall be excluded from the obligation of being disclosed to the public as stipulated by paragraph 1 of this Article.
Business, official or state secret cannot protect the data relating to harmful emissions, risks from accidents, monitoring results and inspection supervision.

IV. INSPECTION SUPERVISION

Supervision of Law Enforcement
Article 33

The competent state environmental protection authority and competent local authorities responsible for environmental protection issues shall carry out the inspection supervision over the enforcement of this Law and regulations enacted pursuant to it in accordance with their responsibilities set by this Law.
The Environmental Inspectorate shall carry out the inspection supervision within the responsibilities of the competent state environmental protection authorities and in accordance with the law.
While performing the inspection supervision, the environmental inspector shall check in particular:
1) whether the project developer has obtained the Decision of the Competent Authority on the need for EIA;
2) whether the project developer has obtained the approval on the EIA Study;
3) whether the project developer is undertaking measures envisaged by the Study that has been approved.

Measures of Environmental Inspector
Article 34

In addition to administrative measures and actions set forth by the law on inspection supervision, the environmental inspector shall undertake the following administrative measures and actions when stating that the law or other regulation has been violated:
1) order the project developer to obtain the Decision of the competent authority on the need for EIA elaboration;
2) order the project developer to obtain the approval for the Study;
3) order the project developer to undertake measures envisaged by the Study;
4) order the project developer to implement the programme for monitoring environmental impact; and
5) prohibit the project developer to execute the works until the approval of the competent authority for the Study is obtained.

V. PENALTY PROVISIONS
Violations

Article 35
A legal person or an entrepreneur shall be fined with the amount of one hundred to three hundred times the minimum wage in the Republic of Montenegro if they:
1) start the project implementation without having conducted the EIA procedure and obtained the approval of the Competent Authority for the Study (Article 6);

2) fail to undertake all the measures envisaged by the Study for which the approval has been granted for (Article 27, Par. 1).

The responsible person in the legal entity shall also be fined in the amount of one to twenty times the minimum wage in the Republic of Montenegro for the violation referred to in paragraph 1 of this Article.
For the violation referred to in paragraph 1 of this Article the perpetrator may also be imposed the protective measure of prohibiting the execution of activities for the period lasting from one month to one year.
Article 36
The competent state authority and the competent local authority shall be fined with the amount from one hundred to three hundred times the minimum wage in the Republic of Montenegro if:
1) they fail to organise the public debate in accordance with provisions of Article 20 of this Law;
2) they issue the approval for the Study contrary to provisions of Article 24, paragraph 1 of this Law;
3) they issue the certificate of occupancy contrary to provisions of Article 27, paragraph 2 of this Law;
4) they fail to inform the public of any transboundary impact in accordance with Article 30 of this Law;
5) they fail to keep records in accordance with Article 31 of this Law;
6) they fail to provide access to the EIA documentation in accordance with Article 32, paragraph 1 of this Law.

The responsible person in the competent state authority and the competent local authority shall also be fined with the amount from one to five times the minimum wage in the Republic of Montenegro for the violations referred to in paragraph 1 of this Article.
VI. TRANSITIONAL AND FINAL PROVISIONS
Deadline for Enactment of Bylaws
Article 37
Bylaws based on this Law shall be enacted within six months from this Law coming into force.
Consideration of Previously Submitted Applications
Article 38
The applications submitted prior to this Law entering into force shall be considered in accordance with the Environment Law (Official Gazette of the Republic of Montenegro, no. 12/96) and the Decree on the Impact of Undertakings on the
Environment (Official Gazette of the Republic of Montenegro, no. 14/97).
Expiry of Current Legislation
Article 39
The provisions of Art. 17, 18, 19, Art. 36, paragraph 1, bullet point 1, Art. 37, Art. 44, paragraph 1, bullet point 1 and Art. 46, paragraph 1, bullet points 2 and 3 of the Environment Law (Official Gazette of the Republic of Montenegro, no. 12/96) shall cease to be valid with this Law entering into force.
Entry into Force
Article 40
This Law shall enter into force on the eighth day from its publication in the Official Gazette of the Republic of Montenegro and it shall be applied beginning with January 1st, 2008.

APPENDIX D EIA RULE BOOK

On the grounds of article 18, paragraph 6, of the Environmental Impact Assessment Law ("Official Gazette of Montenegro", No 80/05), the Ministry of Tourism and Protection of the Environment, enacts

CODE OF RULES

ON THE CONTENTS OF THE DETAILED STUDY ON THE ENVIRONMENTAL IMPACT ASSESSMENT

Subject

Article 1

This Code or Rules is prescribing the contents of the detailed study on the Environmental Impact Assessment.

The contents of the Detailed Study of the Impact Assessment

Article 2

Detailed Study of the Environmental Impact Assessment contains as follows:

1) General information;
2) Description of the location;
3) Description of the project;
4) Description of considered alternatives;
5) Description of the specific segment of the environment;
6) Description of project's potential significant impacts on the environment;
7) Description of measures aimed at preventing, mitigating, or eliminating harmful impact on the environment;
8) Environmental impact monitoring program;
9) Summary of information from point 2 to 7 of the paragraph;
10) Data on eventual difficulties project holder encountered when collecting data and documentation.

General information

Article 3

General information cover:

1) Data on the project holder (title of the juristic persons/entrepreneur, name and last name of the responsible person, address, registration/identification number, phone and fax numbers, and e-mail address);
2) Main data on the project (full and abbreviated title, location, address);
3) Data on organization and persons who participated in drafting the detailed study (excerpt from the registry for the juristic person/entrepreneur confirming it/he is registered/competent to do the design, engineering, development of detailed studies and analyses; resolution on establishment of multidisciplinary team; evidence that person making the multidisciplinary team meet prescribed conditions).

Location description

Article 4

Data on location where project is planned to be implemented, relate to micro-location and macro-location, and they cover:

1) Copy of the cadastre lots plan where project is to be implemented, with drawn structures, because of which the impact assessment procedure is being carried out;

2) Data on needed land area in m^2, during the construction, with description of physical characteristics and mapping display in the appropriate scale, as well as data on area that will be covered once the Project is completed and operational;
3) Description of pedological, geo-morphological, geological, and hydro-geological and seismological features of the soil;
4) Data on water supply source (distance, capacity, imperilment, sanitary protection zones) and basic hydrological characteristics;
5) Description of climatic characteristics with appropriate meteorological indicators;
6) Description of flora and fauna, protected natural assets, rare and endangered wild plants and animal species and their habitats;
7) Review of basic landscape characteristics;
8) Review of protected structures and cultural-historical heritage assets;
9) Data on population, population density, and demographic characteristics with respect to planned Project;
10) Data on existing business facilities and residential structures, as well as infrastructure.

Depending on the area features, location description contains the following data as well: on other protected areas, areas envisaged for scientific researches, archeological sites, especially sensitive areas, special land use areas, etc.

Project description

Article 5

Project description contains:

1) Basic parameters relating to reviewing the purpose and physical characteristics of the Project, including: attached infrastructure, production organization, transport organization, number and structure of employees, etc.
2) Description of previous/preparatory works for the implementation of the Project (size of needed land; construction technology; internal transport organization; intended application of mechanization, equipment, and other means; implementation dynamics per phases; use of water, energy, and row materials; creation of waste; emissions of hazardous, harmful, poisonous, or unpleasant odors in the air; increased noise, vibrations)
3) Detailed Project description, planned production process, and production lines, starting from the inflow of row materials to end product;
4) Description of type and quantity of needed energy, water, row materials, and other expenditures, used during the technological process with special emphasis on quantities and characteristics of hazardous materials and others;
5) Description of type and quantity of gas emissions, discharged wastewaters and other solid, liquid, and gas waste materials, per technological blocks, including:
    - Air emissions;
    - Discharge into water currents;
    - Disposal on the soil;
    - Noise, vibration, heat;
    - radiation (ionization and non-ionization);
    - other;
6) review of treatment technologies (processing, recycling, discharging, etc.) of all types of waste;

If dealing with time-limited Project, methods of removing the entire Project, after expiring, and bringing the location into original state, should be proposed.

Description of reviewed alternatives

Article 6

Description of reviewed alternatives contains the review and description of alternatives, studied by the Project holder, with elaboration of key reasons for making certain choices, and the environmental impacts in respect to those choices, which relate to:

1) Location or route;
2) Production processes or technology;
3) Work methods during the implementation and functioning of the Project;
4) Location plans and project drafts;
5) Type and choice of materials for building the Project;
6) Timeline for implementation and termination of the Project;
7) Starting and finishing construction dates;
8) Size of the location or the structure;
9) Production volume;
10) Pollution control;
11) Developing waste-disposal areas, including recycling, repeated use, and final disposal;
12) Developing access and transport roads;
13) Responsibility and procedure for environment management;
14) Trainings;
15) Monitoring;
16) Emergency plans, and
17) Removing the Project and bringing the location in its original state (for temporary projects).

Environment segments description

Article 7

Description of the environment segments contains information and data on the existing state of all the environment's segments to which planned Project would have the greatest impact, and relates in particular to:

1) population (total number and density);
2) flora and fauna (data on rare and protected species);
3) soil (quality of soil, geological and geo-morphological characteristics);
4) water (quality of water resources with special emphasis on wastewaters discharges);
5) air quality;
6) landscape and topography;
7) climate factors;
8) level of location development, and its surroundings;
9) immovable cultural assets and protected natural assets, and
10) interrelation of abovementioned factors.

Description of potential significant impacts

Article 8

Description of potential significant environmental impacts of the proposed Project, contains qualitative and quantitative description of possible changes in the environment during the implementation of the Project, during the regular functioning of the Project, and in case of accidents, as well as the assessments whether the changes are temporary or permanent.

Description from paragraph 1 of the article covers in particular:

1) air quality
   a) level and concentration of polluting materials emission in the air, and comparison with indicators prescribed by norms and standards,
   b) meteorological parameters and climatic characteristics,
   c) potential cross-border air pollution;
2) water quality
   a) Impact of pollutants on quality of surface and ground waters, and comparison with indicators prescribed by norms and standards,
   b) potential cross-border water pollution;
3) soil
   a) physical impacts (change of local topography, soil erosion, sliding of soil, and similar),
   b) pollutants emissions impact on the location of the planned Project and on surrounding area, and comparison with indicators prescribed by norms and standards,
   c) impact on soil exploitation and exploitation of natural assets,
   d) quantity and quality of lost agricultural land,
   e) blocking of mineral assets,
   f) waste disposal;
4) local population
   a) changes in number and structure of the population and in relation, potential environmental impacts (number of people, density, and migrations),
   b) visual impacts,
   c) pollutants emissions impacts, impacts of noise, vibration, heat, and all types of radiation on people's health;
5) Ecosystems and geology
   a) Loss and damage of plants and animals' species and their habitats ,
   b) Loss and damage of geological, paleontological and geo-morphological features;
6) Land use
   a) Developed and undeveloped areas,
   b) Agricultural land use, etc;
7) Public utility infrastructure
   a) transport,
   b) water supply,
   c) energy,
   d) wastewaters discharge,
   e) creation of waste and similar;
8) protected natural and cultural assets and their surroundings;
9) landscape characteristics, and similar.

Description of measures for preventing, mitigating, or eliminating harmful impacts

Article 9

Measures that will be taken aiming to prevent, mitigate, or eliminate significant harmful impacts on all segments of the environment, during the project implementation, during regular operations, or in case of possible accidents, includes:

1) measures prescribed by law and other regulations, norms and standards, and deadlines for their enforcement;
2) measures that will be taken in case of accidents;
3) plans and technical solutions in terms of environmental protection (recycling, treatment and disposal of waste, re-cultivation, rehabilitation, etc);
4) other measures that can impact prevention or mitigation of harmful environmental impacts.

Measures from paragraph 1 point 2 of the article, which relate to accident assessment risk, contains description of hazardous materials, their quantities and characteristics.

Environmental Impact Monitoring Program

Article 10

Environmental Impact Monitoring Program contains:

1) description of the state of environment before the project becomes operational or before the start of activities on locations where environmental impact is expected to occur;
2) parameters based on which harmful environmental impacts can be identified;
3) locations, methods, and frequency of measuring the identified parameters;
4) contents and timeframe for submission of reports on executed measuring;
5) obligation to inform the public about the measuring results.

Summary information

Article 11

In this part it is necessary to produce the summary of the entire Detailed Study on the Environment Impact, in manner understandable to persons with basic technical education.

Data on potential difficulties

Article 12

Data on potential difficulties encountered by the project holder when collecting data and documentation, contains detailed review on absence of adequate solutions to protect the environment (lack of scientific, technological, legislative, and other solutions) or inability to collect certain data, information, etc.

Termination of the regulation

Article 13

On the day when this Code of Rules enters into force, the Instruction on the Contents of Detailed Study on Environmental Impact Assessment ("Official Gazette of Montenegro" No 21/97) will be terminated.

Entry into force

Article 14

This Code of Rules will enter into force on the eight day since its publication in the "Official Gazette of Montenegro", and shall be enforced since January 1st, 2008. godine.

No: 01-3892/1 MINISTER
Podgorica, December 17, 2007 Predrag Nenezić