

## LOT 4: IIA 147, SMEDEREVSKA PALANKA (AZANJA) - VELIKA PLANA, L= 13.532 KM

### 1. BACKGROUND

Road Rehabilitation and Safety Project (RRSP) is a project of support of international financing institutions (World Bank, European Investment Bank and European Bank for Reconstruction and Development) to the Government of the Republic of Serbia in implementation of the National State Road Network Rehabilitation Program. This Project represents the implementation of the first phase of the Government's Program for the period 2014-2022 and covers the following:

- improvement of condition on state road network by means of rehabilitation of the existing roads,
- increase of road safety condition through appliance of measures for improvement of road safety in all phases of the Project implementation, and
- strengthening capacity and development of institutional coordination in the field of road and traffic safety through implementation of a number of various services.

The institution in charge for the Project implementation is the Public Enterprise “Roads of Serbia” (PERS). Within the PERS there is a Project Implementation Team (PIT) responsible for implementation of all necessary activities and actions for successful management and completion of the Project. During the performance of this assignment, the PIT will be assisted by relevant departments of the enterprise and will work in alliance with other stakeholder institutions of the Government of the Republic of Serbia.

Besides implementation of Works on heavy maintenance of roads, the Project will include activities, procedures and processes that advance contracting the Works. A key step of this phase is provision of detailed designs for heavy maintenance that would be completed in compliance with modern principles of safe road designing.

Procedure for provision of detailed design for heavy maintenance covers the following activities:

*Table 1.1: Procedure for preparation of design documents*

No	Activity	Responsibility	Purpose
1	Road diagnostic assessment (assessment of road condition)	JPPS/PIT (Client)	ToR preparation and control of the detailed design preparation
2	Preparation of detailed design for heavy maintenance (Services)	Design organization (Designer <sup>1</sup> )	Provision of detailed design in accordance with the law together with implementation of principles of safe road designing

<sup>1</sup> The term Designer indicates to a legal entity with which the Client concluded a Contract on providing a service which is subject to this public procurement.

No	Activity	Responsibility	Purpose
3	Road Safety Audit during design phase	Independent Auditor	Improvement of traffic safety. Based on the actual conditions in the field and prepared detailed design, audit of designed solutions from the aspect of traffic safety requirements shall be performed, with assessment of adequacy of applied measures and provision of recommendations for resolving the identified safety problems. For measures determined to be applicable and economically viable, the Designer shall receive the instruction from the Client about incorporation into the detailed design.
4	Technical control of design	Independent Consultant performing Technical Control	Represents a legal obligation. Technical inspection serves to check the completeness and validity of design, compliance with requirements from the ToR, as well as compliance with legislation and technical regulation.

In accordance with the Reference System of State Road Network from 2009, the section Smederevska Palanka 1 (Azanja) – Velika Plana 2 is in length of 13.666 km. Upon acceptance and enforcement of the State Road Classification from 2015, new reference system was established and the following changes are made:

- the node Smederevska Palanka 1 (Azanja) is renamed and new name Smederevska Palanka (Azanja) was introduced;
- the node Smederevska Palanka 2 (Pridvorce) is renamed and new name Smederevska Palanka (Pridvorce) was introduced;
- the node Velika Plana 2 is renamed in Velika Plana;
- The total length of the subject section is 13.652 km.

The State road of IIA category no. 147 belongs to the City of Belgrade district, Podunavski and Branicevski Administrative district. The road stretch is of regional character and connects the southern parts of the city of Belgrade (from Lipovicka forest), over the highway near Velika Plana with the eastern parts of Serbia, Branicevski district, near Kucevo. The section in length of 13.652 km. belongs to the State Road of IIA category no. 147 (old road mark R-17) („Official Gazette of RS “, No. 93/2015), and represents a connection of the Municipality of Smederevska Palanka and Velika Plana in the Podunavski district. The subject section is a part of the RRSP planned for heavy maintenance during the fourth year of the Project implementation. All chainages within the Terms of Reference are provided in accordance with the Reference System from November 2017. The excerpt from the Reference System is presented in the following table.

Table 1.2: Traffic sections and nodes according the reference system

No	Old section mark*	Section mark	Beginning node	Marking of the ending node	Name of the beginning node	Name of the ending node	Length of the section (km)
1	0922	14710	14708	14709	Smed. Palanka (Azanja)	Smed. Palanka (Pridvorce)	1.450
2	0923	14711	14709	14710	Smed. Palanka (Pridvorce)	Stojacak	5.062
3	0924	14712	14710	14711	Stojacak	Velika Plana	7.140 (**7.020)
<b>Total:</b>							<b>13 652 (**13 532)</b>

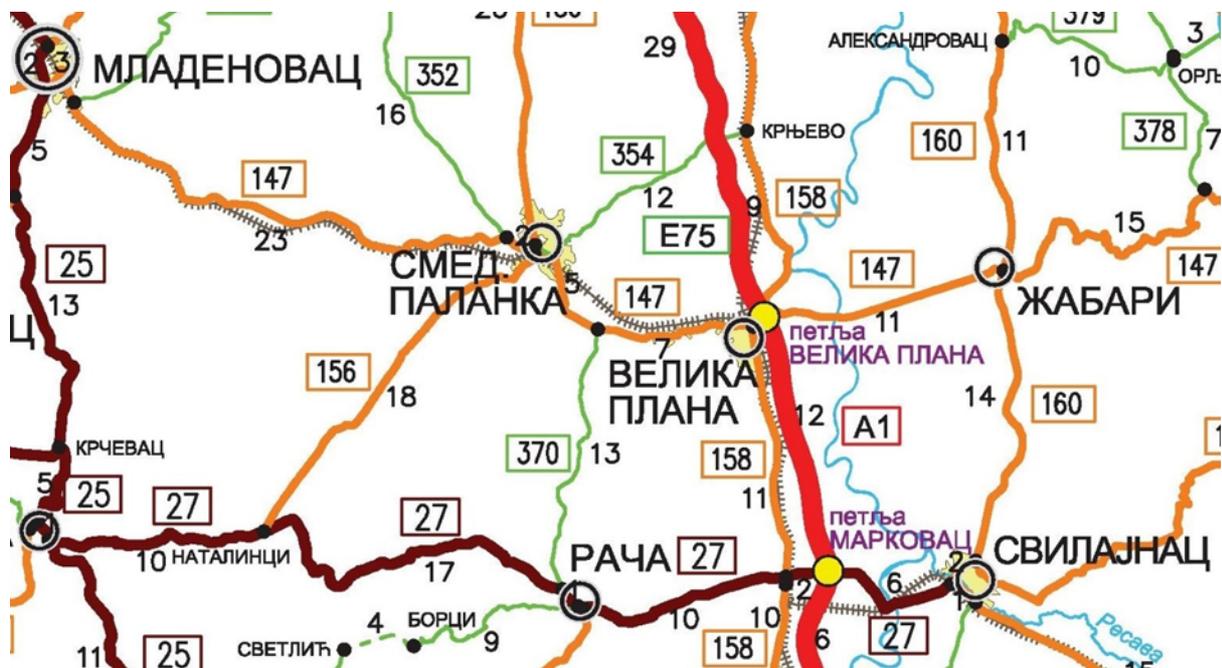
\* Mark of the section according to the old referent system 2008/2009 (JV CPL- Nievelt)

\*\* Length of the sub section foreseen for designing



Путни потез предвиђен за рехабилитацију Л=13 532 м

Picture 1.1: Scheme of the road foreseen for rehabilitation



Picture 1.2: Extract from the state roads reference system map, November 2017

Contract documents, reports and correspondence in regards to the Services and contract must include reference to the name of the section defined on the cover page of the RFP. While addressing the third parties in regards to the design (state institutions for conditions,

bases, consents, permits, etc.), name of the section stated for the main design should be used. If needed, the text may include a reference to the old reference system.

## **2. OBJECTIVE**

The objective is to have technical documents in form of the Detailed Design for Heavy Maintenance ready, which would ensure after completion of the works increase of usability value and durability of road, improvement of traffic safety, incorporation of requirements of local community (social aspect) and compliance of requirements for environmental protection to the greatest possible extent under conditions of spatial limitations (context of the section) and limitations that result from the type of allowed construction and traffic interventions (legal grounds).

The subject of the Services is preparation of the Main Design for length of 13.532 km. The beginning of the section is foreseen in node 14708 which is located on the beginning of the section 14710, road chainage category IIA no.147, km 74+201 (interchange of roads IIA category no.147 and IIB category no.352). The end of the section foreseen for heavy maintenance is defined before the gas station NIS and the interchange (with traffic lights) with Milosa Velikog street in Velika Plana. The end is app. 120 m.before the ending node no.14711 at app. chainage km 87+733.

The Cover Page and all other pages of the Main Design shall contain the name of the section in accordance with the new Reference System from 2017 and the exact chainage covered by the design. The Designer is obliged to elaborate the connection with all relevant classifications and reference systems of the state road network within the Technical Report.

Contract documents, reports and correspondence in regards to the Services and contract must include reference to the name of the section defined on the cover page of the RFP. While addressing the third parties in regards to the design (state institutions for conditions, bases, consents, permits, etc.), name of the section stated for the main design should be used. If needed, the text may include a reference to the old reference system.

## **3. SCOPE OF SERVICES AND REQUIREMENTS**

### **3.1 GENERAL REQUIREMENTS**

While preparing technical documents, the Designer shall:

- comply with valid laws, regulations and quality norms in connection with this type of structures;
- upgrade the structural bearing capacity and necessary completeness of the road through the design for heavy maintenance with correction of pavement structure in order to extend road usability. The requested designed life of rehabilitated road is 10 years;
- collect the existing planning documents and analyze their impact on designed solution and consequently inform the Client on conclusions before commencement of work on design preparation;
- establish necessary survey maps for preparation of designed solutions (geodetic, geotechnical, hydrological etc.). Designer is obliged to prepare a geodetic survey map on cadastral plan verified by the authorized company (geodetic organizations);

- perform all necessary geodetic surveys, investigation work and laboratory testing needed for establishment of the survey maps and bases for design preparation;
- while designing, identify, describe and from the aspect of traffic safety assess traffic conflicts among all traffic participants, with special consideration of vulnerable groups of participants;
- collect and process data on traffic accidents with fatalities and injuries for the observed road section for the period of at least 10 years;
- during a RSA phase, provide the Client with all documents needed for the road safety audit and express his/her opinion on observations of the independent RSA, and modify parts of design in accordance with the Client's instruction;
- act in accordance with remarks of Technical control in a manner and deadlines defined by this ToR and Contract.

## 3.2 BASIS FOR DESIGN

### 3.2.1 Traffic Volume

Traffic volume needed for a road designing process refers to a certain time period of road durability planned for the future, so a planning period has been defined according to the functional road type and type and scope of planned construction intervention for planned road durability of 10 years.

The following table gives the information on traffic volume for the period of 2013-2017<sup>2</sup> on the section in subject:

*Table 3.2.1.1: Traffic volume structure in the period of 2013-2017  
(section: Smederevska Palanka (Azanja) – Smederevska Palanka (Pridvorca), L=1.5 km)*

Year	Cars	Buses	Light trucks	Medium trucks	Heavy trucks	Train trucks	AADT (veh/day)
2013	2202	32	47	53	35	37	2406
2014	2208	29	45	50	34	36	2401
2015	2322	29	47	48	29	32	2508
2016	2368	29	45	53	32	32	2559
2017	3250	37	61	68	33	47	3496

<sup>2</sup> <http://www.putevi-srbije.rs/index.php/brojanje-saobraćaja>

*Table 3.2.1.2: Traffic volume structure in the period of 2013-2017  
(section: Smederevska Palanka (Pridvorce) – Stojacak, L=5.1 km)*

<b>Year</b>	<b>Cars</b>	<b>Buses</b>	<b>Light trucks</b>	<b>Medium trucks</b>	<b>Heavy trucks</b>	<b>Train trucks</b>	<b>AADT (veh/day)</b>
<b>2013</b>	1769	25	38	42	28	30	1932
<b>2014</b>	1612	21	31	35	24	29	1751
<b>2015</b>	1625	18	28	29	17	19	1737
<b>2016</b>	1720	21	38	44	26	28	1877
<b>2017</b>	3909	47	73	82	37	27	4206

*Table 3.2.1.3: Traffic volume structure in the period of 2013-2017  
(section: Stojacak – Velika Plana, L=7.1 km)*

<b>Year</b>	<b>Cars</b>	<b>Buses</b>	<b>Light trucks</b>	<b>Medium trucks</b>	<b>Heavy trucks</b>	<b>Train trucks</b>	<b>AADT (veh/day)</b>
<b>2013</b>	1072	23	55	67	51	47	1315
<b>2014</b>	1177	14	22	24	17	23	1277
<b>2015</b>	2275	22	35	36	21	23	2414
<b>2016</b>	3057	40	69	55	92	53	3366
<b>2017</b>	4105	49	77	86	39	60	4416

The presented data on traffic volume are given in accordance with the old referent system 2008/2009. Therefore, particular attention shall be paid in interpretation of these data with regard to the reference system from November 2017.

The Designer shall perform additional traffic counting (pedestrian, bicycle, motor vehicles) on all critical locations.

The Designer shall perform 7-day long control traffic counting in compliance with the structure indicated within the previous tables, i.e additional traffic counting (pedestrian, bicycle, motor vehicles) on all critical locations. Particular attention shall be paid to the selection of locations for traffic counting. Prior performing the control counting, the plan and programme of the control counting shall be submitted to the Client for approval. The Designer shall define applicable traffic volume, based on the available data on traffic counting and traffic control counting. Before the beginning of the designing process, the Designer shall deliver analysis of gathered results to Client for consideration.

The recommended forecast of traffic growth rates within a planned period are given in the following table (moderate scenario of traffic growth rate shall be adopted):

Table 3.2.1.4.: Recommended forecast of traffic growth rates

Scenario	Traffic growth rates in (%)				
	2017	2018	2019	2020-2025	2025-2030
Pessimistic	2.5	3.0	3.0	3.5	3.0
<b>Moderate</b>	<b>3.0</b>	<b>3.5</b>	<b>3.5</b>	<b>4.0</b>	<b>3.5</b>
Optimistic	3.5	4.0	4.0	4.5	4.0

The Designer shall perform an analysis of the influential parameters (traffic counting, regional macro-economic and development indicators, etc.) and propose corrected forecast of traffic growth rates, if necessary.

Maximum allowed axle loading relevant for pavement dimensioning should be taken from the "Rulebook on Partition of Motor Vehicles and Trailers and Technical Requirements for Vehicles in Traffic on Roads" ("The Official Gazette of the RS", No. 40/12).

### 3.2.2 Detailed Design for Geodetic Surveys

During a preparation of a detailed design for geodetic surveying, the Designer shall comply with all provisions of the Law on State Survey and Cadastre ("Official Gazette of RS", No. 72/09, 18/2010, 65/2013, 15/2015 – US Decision and 96/2015), Chapter XII Geodetic Surveying in Engineering and Technical Fields.

Positional base for determining coordinates of operational polygon stations is represented by trigonometrical stations on the state network. A topographic map in the scale of R=1:25,000 should include all stations of networks of all levels (trigonometrical and elevation) in wider area of the structure. These stations will serve also for potential linking of the operational polygon stations for the purpose of surveying the structures and terrain. While preparing the operational polygon, "Instructions for preparation and maintenance of geodetic base for details surveying", No. 951-83/96 from January 13, 1997, issued by the Republic Geodetic Authority shall be followed.

The operational polygon stations shall be designed continually, along one side of the structure, if possible, at lateral distance of max. 50 m from the right of way limits. A design of basic operational polygon shall also include stations of the existing trigonometrical and elevation network, which are located near the structure. Lists of coordinates of the existing stations and lists of heights of benchmarks verified by the relevant services of the Republic Geodetic Authority must be also provided. In addition, document from the RGA on submission/taking over of the indicated data must be enclosed. Operational polygon stations shall not be placed on locations where they can be destroyed during construction. Also, they must be located beyond the site working area and service roads or, if this is not possible, they must be protected against damage.

All operational polygon stations should be marked by the accepted type of marking in accordance with the "Rulebook for basic geodetic surveys". The stations marking shall be made 7-10 days before geodetic surveys.

Numbering of stations shall be performed continually, starting from 1 to n (regardless the borders of a cadastral municipality), where the initial letter of the name of cadastral municipality shall be joined to the number. Description of the particular position should be

provided for every station in the trigonometrical form no. 27.

Levels of stations of operational polygon shall be determined with a general levelling instruments. Level accuracy shall be determined based on the allowed deviation of differences in levelling back and forth  $\Delta \leq 4.0 \cdot m_0 \cdot \sqrt{d}$  mm, where  $m_0=4\text{mm/km}$ , and  $d$  represents a length of continued series of levels in km.

It is a requirement that the operational polygon is verified by the authorized company (geodetic organizations). It is also necessary for the Designer to submit for verification technical documents with technical report, measured and processed data, list of stations of operational polygon with coordinates, altitudes, description of position (form 27) and sketch of the operational polygon in analogue and digital form (DWG form) with stations of the state trigonometrical network in wider area. Within preparation of documents in digital form, it is necessary to comply with provisions of the "Decree on digital geodetic plan" ("Official Gazette of RS", No. 15/03, 18/03 and 85/08).

Geodetic surveys of the existing road condition shall be done both in horizontal and vertical position from the operational polygon network for needs of preparing the updated topographic plan in scale of 1:1000, which would serve as survey map for designing. For the purpose of consideration of possible interventions on junctions and structures, it is also necessary to prepare a topographic plan in scale of 1:500.

Designer shall also obtain from the Republic Geodetic Authority the official scanned and geo-referenced copy of a cadastral plan, which would include all data needed for marking the borders of the right of way.

Width of the surveyed area should be such (at least 20 m on the left and right from the road centerline) to enable preparation of a digital model of pavement surface and complex identification of all superstructures, substructures and objects within road zone (drainage system elements and road base elements, footpaths, retaining walls, access roads, approaches to construction etc.).

Cross-sections shall be surveyed at relevant distances (max. 20 m) according to actual conditions in the road section, as well as on typical locations (elements of drainage system for pavement and road base, sidewalks, retaining walls, access roads, approaches to construction etc.). Designer shall define each characteristic point by coordinates.

Special attention shall be paid to the surveying of existing installations and other structures within the right of way (aboveground and underground) that may represent a physical obstacle for the execution of the Works. The surveyed lines and structures shall be indicated on a topographic plan in the form requested for making entries into the cadaster of lines and immovable properties.

Within the separate layout, the Designer shall also present borders of the road right of way (ROW) area (data shall be taken from the cadaster of immovable property). The plan shall also indicate possible usurpations of road ROW area on behalf of the third parties, locations where road is located on private land (private or state owned) with cross profile elements that are out of the reserved road area, and to detect the number of parcels and type of ownership (state owned or private).

Designer shall also mark main points of the road axis (BTC, BC, MC, EC, ETC), hectometers and shall hand over the axis and stations of the operational polygon to the

Contractor in presence of Supervision.

Detailed Design for execution of geodetic surveys shall include the following:

- general data on subject of design and supporting documents;
- excerpt from the ToR for preparation of the detailed design;
- bases for the design preparation;
- technical report on completed preliminary Work;
- designed solution for geodetic surveys;
- organization of Works;
- graphic enclosures and tables.

### **3.2.3 Study on on Field Surveys and Testings**

Study shall include all results of field surveys and testings presented in form of tables, charts and diagrams. The relevant attachments in layout form shall present all locations and types of completed surveying work done during all design phases.

The work shall be done in three phases: site investigation work (field surveying), laboratory testing and collected data processing.

The site investigation work shall be done in accordance with the Law on geologic surveys ("Official Gazette of the RS 101/2005) and the Rulebook on contents of designs for geological surveys and studies on results of geological surveys ("Official Gazette of the RS", No. 51/96). Before commencing any of the surveys, the Designer shall approach a review of earlier surveys and shall provide comments on the received results and degree of coverage by surveys if such surveys have been performed and if data are available. These data shall be presented within the study.

Designer shall prepare a program of surveys and shall receive the approval of the Client for it before commencing the work. While preparing the investigation works programme, the data inter alia, collected during the examination of the functional and structural condition of the structure (chapter 3.2.4) shall be used. It is necessary to define a scope of surveying in a manner that the Designer may reliably determine the following:

- zones with similar characteristics;
- composition of pavement and characteristics of the materials in the pavement;
- composition and quality of material in final layer of embankment;
- conditions for replacement of material (if necessary);
- conditions for subsoil and quality of material for embankment construction;
- stability of embankment slopes;
- position of the layer in sample, thickness of layer and type of material;
- thickness of sub-layers (if any) and type of material under the formation level;
- measures to ensure traffic safety during execution of the investigation works.

During execution of works, the Designer shall apply all necessary measure to ensure safety of the laborers. The Designer shall be held responsible for the safety of the laborers during execution of the investigation works. While excavation or taking (mapping) samples, the pit sides shall be ensured by adequate support to prevent collapse. In a case that the pit excavation is performed below the underground water, while the soil is highly permeable, its extraction should be secured. In the trial pits the limits of the soil layers

shall be visually examined, their bedding, thickness, color etc. Undisturbed samples shall be taken from the trial pits and laboratory CBR experiment shall be performed.

Excavation of trial pits on pavement to the depth of 2 m, i.e. to the necessary depth shall be done, at mutual distance up to 1000 m. (i.e up to 500 m. if necessary, or if required due to determined inhomogeneity of the pavement structure while applying non-destructive investigation methods). Material sampling shall be performed between trial pits by coring. Coring is performed on (3) locations on the cross-section, one in the axle and two at distance of 0.5 m. from the pavement edge on the right and left side. Taken samples shall be identified macroscopically with determination of thickness of layers and internal connections. In a case of coherent soil in the pavement structure sub-grade, dynamic cone penetration (DCP) and calculation of CBR shall be performed at the location of sampling. Once the drilling i.e. excavation, is completed, it is necessary to backfill the hole i.e. trial pit so that the road is safe for traffic. Position of trial pits and cores shall be presented on the bar-type plan (R=1:2000).

Among others, the following shall be determined:

- physical condition of samples of bound materials (crumbed, cracked, bound-compacted);
- total pavement structure thickness;
- position of the layer in sample, thickness of layer and type of material;
- thickness of sub-layers (if any) and type of material under the formation level

Photo documentation on site surveying shall be also provided.

Hydro-technical and hydrological surveys for the sector requested by the relevant water management company shall be also conducted. During a preparation of hydro-technical documents, all necessary climate and hydrological maps shall be used, as well as data on design quantity of rain precipitation from the relevant weather station in order to get precise data on quantity of rain precipitation that has to be collected and drained from the subject road.

The results of surveys and analyses shall be presented with all necessary comments in order to resolve draining in appropriate manner according to the conditions provided by the relevant water management company.

It is mandatory to update, systematize and define data relevant for calculation and dimensioning of the structures and elements for road draining. During the process, all aspects of the environmental protection must be complied.

In order to determine soil mechanics properties, it is necessary to have laboratory testing of samples from trial pits and cores. Minimal scope of testing shall cover:

- determination of grading composition of materials;
- determination of bulk density and moisture content in the natural state;
- determination of maximum dry density and optimum moisture per standard Proctor's experiment;
- determination of consistency limits of materials;
- determination of soil bearing ratio (CBR).

For laboratory testing of the asphalt layers, the material from cores is used. For each asphalt layer samples per Marshall standard are prepared on which the following psychical - mechanical properties are tested:

- stability
- flow
- sample density
- density of the asphalt mixture
- voids in the sample
- voids in the stone material mixture
- voids filled with binder.

By the appliance of the extraction method from the Marshall samples the bitumen shall be extracted and following characteristics shall be determined:

- penetration
- softening point per R&B
- penetration index

Gradation composition of mineral material from core sample shall be determined.

Results and findings from performed surveys, testing and analyses shall be presented in form of the Report.

### **3.2.4 Assessment of the Existing Pavement Condition**

#### Assessment of functional characteristics of pavement surface

The assessment shall be provided based on the following:

- Visual survey of condition of pavement surface according to pavement distress catalogue stated and provided by the Client; At the same time, identification, scope and exact locations of the damages shall be provided;
- Measurement of longitudinal pavement roughness by appropriate measuring device expressed through the International Roughness Index IRI (m/km) at maximum of 100 m of distance;
- Measurement of transversal pavement roughness on stretches where rutting was noted or where deformation of cross-section is clearly visible. Measurement of transversal pavement roughness on such stretches shall be done at every 20 m. Measurement shall be conducted by appropriate measuring device or by a 1.2 m long rod and spud, in accordance with AASHTO Guidelines for rutting measurement or by a profilograph;
- Measurement of skid resistance of pavement surface, in accordance with one of the methods stated by standards.

#### Determination of Bearing Capacity of Existing Pavement

Bearing capacity of the existing pavement shall be determined based on measurement of deflections.

Deflection measurement shall be done by a falling weight deflector (FWD) at distances not greater than 100 m. Locations defined for sampling (core samples) should be identical with locations selected for deflection measurements. Correction of deflection in regard to temperature and normalization of deflection according to the load shall be also made. It is recommended to perform deflection measurements during temperature range of 20° C ±5° C.

The device for deflection measurement must be certified for measurement on pavement carriageways and must have a Certificate on completed calibration issued by the Manufacturer with the specified validity period. If the validity period is not indicated, the Certificate shall not be older than two years.

Based on the measured deflections, splitting into homogenous sub-sections shall be done. (not shorter than 500m). Module of layers shall be determined by back calculation method, from the measured deflections as well as by direct measurement on samples from the coherent asphalt layers, and direct measurements in the trial pits and boreholes. Based on the above data, residual pavement life cycle shall be determined. The verification of the calculation method for the structure shall be done by comparing the calculated moduli of pavement structure layers from the deflection analysis, and values of the moduli obtained from the laboratory testings of the samples.

Data and testing results shall be presented under the Detailed Pavement Design.

Designer shall determine a type, degree, quantity and cause of damage and prepare a graphical presentation on a layout in scale of R=1:500–1:1000. Based on previous information, the Designer shall provide the assessment of pavement structural properties.

### **3.2.5 Assessment of the Condition of System for Draining Pavement and Road Base**

Regarding drainage, a functional condition of shoulders, gutters, concrete gutters, curbs, drain flumes, culverts and other elements of drainage system shall be determined.

A condition assessment implies collection of condition indicators through visual inspection and assessment of every element of draining system according to the OECD Methodology from 1990.

Special attention shall be paid to the following:

- Terrain topography (cut/embankment);
- Pavement and embankment gradient;
- Geometry and condition of ditches and drain flumes;
- Geometry and gradient slope of side cut and embankment, including their condition;
- Effectiveness of the drainage system.

All structural damages shall be noted for drainage elements.

By use of hydraulic calculations and data from hydrological and hydro-technical surveys, it is necessary to check the capacity of drainage system.

Hydro-technical and hydrological investigations on the sector requested by the relevant water management company shall be performed. For preparation of hydro-technical documents, designer will collect all relevant data like: climate and hydrological maps, numeric rainfall records from nearby rainfall station, and all that in order to compute exact storm water quantity, to collect and evacuate from road profile to drainage system.

The results obtained during investigations and analyzes shall be presented with all required comments. Drainage design, prepared under opinion/conditions received from the relevant water management company, should give rational solution for drainage problem.

It is mandatory to update, systematize and define data relevant for calculation and dimensioning of the structures and elements for road drainage, while all aspects in terms of environmental protection shall be respected.

It is also necessary to assess type and degree of impact of the existing condition of drainage system on presence of structural and surface damages of the road.

Within the analysis and capacity calculations of the existing structures, if there is a need to increase the capacity, firstly the Designer will recommend improvement of the existing system, with the aim to obtain more efficient water flow. Based on the condition assessment, solutions for drainage improvement shall be proposed.

It is the Designer's obligation to perform the assessment of condition of all culverts (box, arched and pipe). It is also necessary to determine whether it is needed to have new culverts constructed in the road base of embankment of access roads, if they have a negative impact on draining along the road.

On spotted locations with erosion of the surrounding terrain and (or) tractional load in the structures of drainage system of the road base and pavement, special measures for water flow regulation should be predicted.

If over ground and/or underground installations that by type and position disturb the function of drainage elements which are to remain or of newly designed elements are noted, a proposed solution for improvement of drainage system shall contain an explanation.

### **3.2.6 Environmental Management Plan**

During preparatory phase and for the purpose of this Project, the Client has prepared Environmental Management Framework Document – EFD, available at the Client's internet presentation<sup>3</sup>.

The Designer is in obligation to prepare an Environmental Management Plan – EMP and to comply with all the requirements defined within EFD document, with special attention on review of Environmental Mitigation Plan and defined Monitoring Plan.

Based on information gathered during phase of designing (field research, conditions of relevant institutions), the Designer is in obligation to prescribe any other environmental protection measures required and to define an adequate Monitoring Plan.

The Designer is in obligation to submit prepared EMP to the Client for approval, in electronic and hard copy. After this the EMP will be submitted to the Finance institutions for their approval. In the event that the Client or the Finance institutions have any remarks to the submitted EMP, the designer shall be responsible to correct or amend the document in accordance with the remarks. The corrected document shall be again submitted to the Client for approval.

#### Presentation of the EMP to the local community

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<sup>3</sup> [http://www.putevi-srbije.rs/images/pdf/investicije/rrsp\\_environmental\\_management.pdf](http://www.putevi-srbije.rs/images/pdf/investicije/rrsp_environmental_management.pdf)

In compliance with the requirements defined within the EFD document, the Designer shall prepare a presentation of the EMP document to the interested stakeholders. In addition, the Designer shall organize and attend the public consultations, all in accordance with procedure defined within EFD document, shall collect and review all comments, and present the conclusions in the report from the public presentation of the EMP document.

The detailed report on the public consultations shall form an integral part of the EMP document and it is an integral part of the required reporting for this section (Section 7).

### **3.2.7 Social Safeguard Requirements**

During preparatory phase and for the purpose of this Project, the Client has prepared a document titled as Resettlement Policy Framework – RPF, available at the Client's internet website<sup>4</sup>. The document describes the politics, procedures and processes being applied during the entire Project, in order to mitigate the negative social impact due to project activities.

Given the project context and requirements for improvement of local community position, the Designer's task shall be to take into consideration all road elements and contents along the road that may be of influence on life quality of local community and to benefit the improvement of that quality by his/her design solution within limits of the allowed and possible.

Under this part of the Service, the Designer shall take into consideration the following:

- intensity and flow of pedestrian movement with the analysis of needs and possibilities for constructing footpaths, fencing, footbridges etc.;
- necessity for construction of bike paths;
- necessity for regulation of parking surfaces i.e. accesses to certain commercial facilities;
- necessity for arrangement, i.e. construction of new bus stops;
- necessity for utility diversions, i.e. construction of lighting on certain parts of the section;
- necessity for arrangement of public areas located along the road side;
- necessity for arrangement of accesses to agriculture land with analysis of need for the construction of accesses to the road;
- all other details which based on the Designer's opinion may be of use to a local community.

The Designer shall organize public presentation of the preliminary design solution to the local community. All requests, comments etc. from the local community shall be duly noted.

When analyzing the data, the Designer shall be responsible to contact the following stakeholders:

- Local self-government(s) within the territory wherein the section is located;
- Local companies for public transport; (bus transport companies, taxi companies, car transport companies etc.);
- Local public utility companies in charge and take into consideration their views as per the above listed items.

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<sup>4</sup> [http://www.putevi-srbije.rs/images/pdf/investicije/rrsp\\_final\\_cleared\\_rpf\\_clean.pdf](http://www.putevi-srbije.rs/images/pdf/investicije/rrsp_final_cleared_rpf_clean.pdf)

The Designer shall prepare Minutes from every meeting. The Minutes shall include data on local representative's attendance, subject of discussion, expressed needs and requirements, and shall deliver it to the Client.

Following the expressed needs and requirements, the Designer shall be responsible to:

- In consultations with the Client, implement into design solution the requests of the local community to the extent that is reasonable and possible;
- Explain the reason why some of local community requests could not be implemented;
- Contact in writing local self-government(s) in territory where the section is located and organize a presentation of the project to local community;

The report on public consultations/hearings shall form an integral part to the requested reporting for this road Section (Section 7 of this ToR).

### Expropriation

If during any of the phases of design preparation the Designer identifies a need for expropriation, the Designer shall notify the Client and present in graphical and tabular form the areas that should be covered by expropriation. All this data shall be presented on the relevant cadastral maps with identified plot numbers.

The Client may order the Designer to prepare the project of re-allotment and allotment which will be than separately priced and paid for out of the contingency. This item shall not be incorporated into the tendered price which is subject to evaluation when design is contracted.

### **3.2.8 Traffic Safety Analysis**

While analysing traffic safety, the Designer shall implement the following:

- analysis of traffic accidents for the observed road and subject section;
- analysis of opinion of experts (police, regular maintenance service supervisors, inspection authorities etc.) and road users on traffic safety issues for the observed road;
- analysis of the traffic accidents causes;
- check of elements of the existing road from the aspect of traffic safety (Road Safety Inspection) according to principles of safe road designing;
- identification of dangerous locations based on the comparative analysis of objective and subjective risk, i.e. based on the analyses of accidents and opinions on traffic safety and possible measures for improving traffic safety on those dangerous locations.

In addition to the analysis of the existing condition according to the above listed requirements, the Designer shall provide in form of a Report on analysis of traffic safety, a proposal of measures to be applied to reduce a risk from occurrence of traffic accidents in comparison to the previously identified possible measures, together with the analysis of feasibility for appliance of proposed measures (economic assessment of justification of every particular measure and all measures in general). For the needs of economic assessment of justification of every particular measure and all measures in general the

rates for various types of injuries in traffic accidents presented in the “Manual for Costs and Benefits Analysis<sup>5</sup>” which is the product of the project “Assisting Serbia in Planning and Programming Road Infrastructure” (G2G09/SB/5/2) within the G2G initiative.

The Designer shall deliver the Report on analysis of traffic safety to the Client for consent. Approved measures for increasing traffic safety shall be included by the Designer in the designed solution.

Analysis of traffic accidents shall include:

- analysis of total number and structure of traffic accidents based on historical data for the previous 10 years,
- analysis of total number and structure of the people involved in accidents (fatalities, heavy and light injuries) based on historical data for the previous 10 years,
- analysis of trends and estimate of number of accidents during the next period of 5 years;
- spatial analysis of all accidents and the consequences, as well as a map of traffic accidents showing the location and the basic data for each accident with fatalities;
- spatial analysis of accidents with injured and fatalities,
- analysis of time distribution of traffic accidents and people injured in traffic (monthly distribution during one year, weekly distribution during one year, daily distribution during a week, hourly distribution during a week and hourly distribution during a day).

Data on traffic accidents received from the Traffic Police Department or the relevant department for traffic safety of the Ministry of Interior of Serbia, opinions of the officials and Road Safety Inspection on the field represent the base for analysis of traffic accidents.

For the purpose of doing the traffic safety analysis, it is necessary to apply the weighted number of traffic accidents (WNTA) through the use of the weights based on total socio-economic consequences of traffic accidents in Serbia. The following weights are to be applied:

- accidents with fatalities: 99,
- accidents with heavy injuries: 13,
- accidents with light injuries: 1.

For the purpose of completing this assignment, the Client shall make available to the Designer the “Manual for Safe Road Design – Modifications of the World Bank Manual” (April 2011), which is based on the Manual of the World Bank (Sustainable Safe Road Design) published in September 2005.

### **3.2.9 Analysis of the existing condition**

As an initial activity in the preparation of technical documentation, the Designer performs analysis of the existing condition of spatial and physical structure of the road within the road side area based on archive records and directly collected data in the field on geometrical characteristics of the road, substructure of the road, pavement (load capacity, roughness (longitudinal and transverse), the friction ability, pavement surface condition (degree of damage), supporting road elements (shoulders, berms, slopes), drainage (surface, intercepting, underground), road structures, intersections, access control, safety and traffic-technical equipment, environmental risk etc.

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<sup>5</sup> [http://www.putevi-srbije.rs/images/pdf/strategija/Prirucnik\\_za\\_analizu\\_troskova\\_i\\_koristi.pdf](http://www.putevi-srbije.rs/images/pdf/strategija/Prirucnik_za_analizu_troskova_i_koristi.pdf)

Within the analysis of the existing condition, the Designer is obligated to determine the parameters of importance for the road condition and safe traffic on the section of the public road, i.e.:

- Elements of the cross section and the longitudinal profile of the road
- Driving dynamic characteristics of the road
- Available sight distance
- Deflections
- Pavement roughness
- Friction ability of the pavement surface
- Level of damage of the pavement
- Condition of the existing road structures (bridges, tunnels, retaining walls, culverts etc.)
- Drainage system condition
- Substructure condition
- Type, thickness and condition of the pavement top layers:

In addition, attention should be paid to:

- Existing access roads and access control
- Traffic regulation at the intersections
- The need for left turn regulations
- Existing traffic signage
- The presence of road side construction
- Supporting facilities along the way
- The needs of local community and people who live alongside the road
- Existing environmental condition and
- Other parameters that may be of importance for the preparation of technical documentation or required by the Terms of Reference.

Established parameters, which describe the current road condition, shall be presented in a form that allows quantitative and qualitative analysis. Designer is required to compare determined parameters with prescribed values and determine deviations of individual elements from the prescribed values.

Analysis of the existing condition should include the demands of the local community. It is necessary to analyse all the elements of the road and facilities along the road that could have an impact on the local community. All identified deficiencies shall be eliminated within technical and economically justifiable possibilities by technical solutions within the design.

Analysis of the existing condition is an integral part of the technical documentation and shall be prepared in a form of Book 1.4 (Chapter 4.1 Content of the technical documents). Mandatory part of analysis is a graphical representation of the results. As this Terms of Reference requires that the analysis of traffic safety and analysis of the social aspects shall be prepared as separate documents, only the conclusions and final results of these two analyses shall be presented in the analysis of the existing condition.

### 3.3 DETAILED PAVEMENT DESIGN

Based on testing, surveying and analyses referred to the Section 3.2., traffic load, estimate of fatigue and remaining durability, design of necessary measures of pavement rehabilitation shall be prepared.

Selection of the optimal design solution should be performed based on:

- Analyze of available documentation and pavement structural assessment based on conducted investigation works
- Preparation of at least two applicable design pavement solutions
- Analysis of alternative solutions, primarily in terms of applicable construction technology, availability of construction materials, and construction costs.

Relevant climate and hydrological conditions for pavement structure dimensioning shall be determined based on results of surveying climate and hydrological properties of the area and spatial position of the section.

For each of three seasons i.e. winter, spring/fall and summer, due to significant difference in air temperature, pavement design should be prepared under following conditions:

- For each season and for each pavement layer, representative mechanical properties for used material should be defined.
- Referent air temperature, for each season, should be adopted in accordance to data obtained from relevant local meteo station, for the period of min previous 10 years.

Pavement dimensioning shall be made by appropriate empirical and/or theoretical procedures. Some of the recognized procedures may be also applied for dimensioning, appropriate for this category and significance of road, i.e. traffic load and surveyed material quality. The applied method shall be described and explained. The entry data shall be defined.

Client may ask the Designer to check the obtained results by applying a different method. In that case, the Designer shall have no right to request any compensation of costs that may occur due to the Client's request.

All proposed pavement design solutions must be checked in terms of resistance to frost damage, one of the valid and recognized procedures.

Relevant traffic load for pavement designing shall be calculated based on the data from the Section 3.2.1 of this ToR.

Design shall define the following:

- necessary preliminary Works on pavement, which refer to repair of damages or demolition and removal of layers;
- designed thickness of new layers and type and specifications of materials and mixtures, minimal and maximal technological thickness for construction of joints and levelling courses;
- solution for new pavement on widening of the existing pavement with drawings of typical details of connection between existing pavement and widening;
- technical specifications for construction covering all items and particularities of designed solutions.

The Designer shall prepare general and particular technical specifications in a manner indicated within Section 3.4.3.

### **3.4 DETAILED CONSTRUCTION DESIGN**

#### **3.4.1 General Requirements**

In compliance with the Rulebook on periodic road maintenance (Official Gazette RS no. 43/2015) and the "Methodology for Road Reconstruction Designing", the Designer shall prepare geometrical, optical and driving-dynamic analyses. Homogeneous sections shall be established, elements of plan and profile for preparation of construction design shall be defined, and bases for preparation of design for traffic signage shall be prepared.

Based on this Terms of Reference, geodetic survey and pavement design, the Detailed construction design for heavy maintenance shall define the following:

- elements of layout, longitudinal and cross sections profiles (radiuses of horizontal and vertical curves, intersecting angles, longitudinal and transverse slopes etc.) which provide required road sight distance; Determination of design elements should follow spatial and legal constraints for planned intervention.
- designed solution for pavement rehabilitation (repair of damaged pavement surface, correction of top layer of existing pavement, construction of new layers, recycling, milling and placement of new layers etc.) shown in adequate scale;
- pavement drainage solution;
- road base drainage solution,
- solutions for collection and drainage of rain and seepage water from the surrounding terrain,
- levelling solutions of the existing supporting facilities (accesses of other roads, bus stops, gas stations and parking lots) within the road area of the designed section
- solution for repair of the existing culverts and solution for construction of new culverts (if required) including all details and calculations required for performance of the works.

All solutions shall be given within the existing road side area to avoid expropriation of new land. Exceptionally, if design measures for improvement of dangerous spots require the expropriation of new area beyond the existing road side area, before the adoption of the final solution previous approval of the Client is mandatory.

In accordance with the previous request, elements of layout and longitudinal profile shall be selected under condition that design solution does not require expropriation of land, or does not lead to a significant disruption of the current situation on the field, except if these solutions come from the request for increase of road safety.

Cross-profile elements (traffic lanes, edge lanes, shoulders, drain flumes and benches) shall be adopted in compliance with the valid regulations and the particular requirements of this ToR.

When selecting elements of the plan and profile, the following provision of the Rulebook on conditions to be fulfilled by road structures and other elements of public roads from the traffic safety aspect shall be taken into consideration: "Deviation from the established values of the individual elements may be made only if technical and economic analyses show the feasibility of different solution and if requested level of safety, traffic flow and environmental protection are guaranteed, as well as if use of the investment funds is in accordance with the design description."

If the existing watercourse is planned for acceptance of precipitation water, and if the relevant water Management Institution stipulates such conditions, drained water from pavement shall be previously treated at separator in order to be cleared from aggregates, grease, oil and other floating materials, in accordance with the Decree regulating the prescribed value of the wastewaters quality.

For the purpose of preparing part of design dealing with the environmental protection, the Designer, for and on behalf of the Client, shall be responsible to obtain the conditions of the Serbian Institute for Nature Preservation as well as Serbian Institute for Protection of Cultural Monuments under which the design in question may be implemented.

After that, the Designer is responsible to prepare and submit to the Client a Request for issuing an opinion on the need to assess the environmental impacts of the subject design, together with the obtained conditions of relevant institutions, so that the Client could ask for opinion from the ministry in charge.

In case that a relevant authority prescribes obligation of carrying out impact assessment procedure of the subject design on the environment, the Designer is responsible to prepare and submit to the Client the Request for deciding on the need of the assessment of the impact on the environment.

In case that a relevant authority prescribes obligation of making an Environmental Impact assessment study of the subject design, the Designer is responsible to create Request for deciding on the scope and contents of the Study for the Client.

Locations of the existing registered bus stops shall be also identified in liaison with the local self-government and local public transport company. All existing locations of bus stops shall be included in the design for repair if the said bus stop locations comply with traffic safety requirements and valid regulations, or alternatively new bus stops shall be designed on locations out of the traffic lanes. All bus stops shall be uniform according to a typical model, if possible.

At locations where there is a real need for movement of pedestrians, pedestrian communications should be designed in a manner providing smooth and safe connection with the existing contents, taking into account the length and position of communications so that the pedestrians would willingly use them. Also, the need for reconstruction of the existing pedestrian paths should be checked.

All accesses to the road shall be identified and the data shall be presented in form of a table through a separate attachment. The data to be presented are the following:

- chainage of axis of the access road
- position of access road in the cross-section (left/right)
- type of the access (individual/unclassified road/municipal road)
- whether the access road is in the settlement
- width of the access road
- angle of access, left and right radius
- is the access in collision with designed solution for widening or drainage
- is the axis piped (yes/no)
- type of pavement surfacing on the access road (concrete/asphalt/crushed stone or the access is without surfacing)

- assessment of necessity of having the access (is there an option of the access cancellation, i.e. relocation).
- access roads in length up to 50 m or in length needed for fitting
- acceleration/deceleration lanes in whole length
- exits for parkings and petrol stations in length up to 10 m or in length needed for fitting.

A detailed calculations for the Works shall be prepared for all accesses that should be returned into the original condition after the intervention stated by the design.

Before commencement of work on preparation of technical documents, the Designer shall obtain all necessary opinions and conditions from the relevant institutions. Design solutions must be harmonized with the received opinions and conditions.

It is not required to provide new or additional water management conditions, if the intervention envisaged within the design solution retains within the existing gabarit space of the structure and road, hence the Designer shall obtain an opinion from the relevant water management Institution. This condition refers to the road itself, to the structure as well as to the regulation of the river flow within the zone of the road or structure. This paragraph is stipulated in accordance with the Conclusion of the Ministry for construction, transport and infrastructure, no: 06-00-00126/2016-03 issued on September 09, 2016, following the meeting with the Ministry, water Directorate and the PERS.

Designer shall be obliged to collect data on existing installations within the right of way and prepare a synchronized plan in an appropriate scale. A design shall identify the installations that cannot remain at the current location, i.e. the installations that must be relocated due to construction of the designed Works. Designer shall inform in writing the Client on existence of such installations as soon as they are identified.

After completing the work on the design, the Designer shall obtain all necessary approvals for issue of confirmation on receipt of design documents/Construction permit i.e. documents by which the relevant authority approves the execution of the designed Works.

Since the process of preparation of a detailed design for heavy maintenance also covers the implementation of an independent RSA on the subject section, it shall be in the Designer's responsibility, further to the Client's request, to make available to the Auditor together with a detailed design all necessary data, plans and documents and upon receipt and analysis of the RSA Report to declare in writing opinion with supporting arguments on the Auditor's conclusions and findings.

After reaching a decision on applying additional measures for improvement of traffic safety from the RSA Report, which were not initially planned under the designed solution and upon receipt of the Client's written notice on the matter, Designer shall, at his own expense, amend the designed solution in accordance with the accepted additional measures and make modification of all parts of detailed design for heavy maintenance under impact of the additional measures.

The Designer shall within the Main Design identify and describe the construction technology of of designed works, as well as all other aspects typical for safe execution of works and environmental and structures protection during the execution of works.

When deciding on requirements for quality of construction materials, special attention shall be paid primarily to quality of the final product and use of materials from the domestic market, whenever possible, under condition that quality of designed solution is not jeopardized.

While deciding on technology, special attention should be paid to minimum of technical criteria needed for appliance of certain technology.

In addition, when selecting the technology for execution of works particular attention shall be paid to the fact that the works are to be executed under traffic flow on the subject section.

### 3.4.2 Particular Requirements

The Designer shall include in the construction design the accepted measures for improving traffic safety resulting from the traffic safety analysis and implying civil works.

The existing basic width of the pavement without widenings is app. 6.0 m. Given the dominance of the local traffic and that the section mainly passes through populated areas, the design solutions should enable increase of the traffic flow safety. The proposal is to adopt/retain the following traffic profile:

Traffic Lane	Edge Lane	Number of Lanes	Total pavement width
2.75	0.25	2	6.0

The beginning and the final stretches on the observed section are in the settlements Cuprija and Despotovac. Those stretches shall be treated as traffic road in settlement and the whole regulation stretch with the sidewalks shall be considered.

All cross profile elements shall be adopted after detailed analysis of the existing conditions.

Deviation from the determined values for individual elements shall be allowed only if different solution proved justified by technical and economic feasibility analysis as mentioned under general requirements for execution of the detailed construction design under item no. 3.4.1.

Efficient drainage of the road section elements shall be provided.

Designing of extensions of the existing culverts shall be done, if needed. If during the site inspection, it becomes obvious that the existing culvert is significantly damaged (Section 3.2.5) and that repair would be economically unviable, the design shall also include a solution for construction of a new culvert with appropriate put-through capacity.

Within the designed measures for improvement of the drainage system, the Designer shall be responsible to define the recipients including solutions for controlled runoff to the ultimate recipients.

The engineering geological investigation works and geodetic surveying shall encompass all elements required for designing of road rehabilitation and preparation of relevant designs/elaborates:

- repair of bridges,
- regulation of river bed,
- repair of the existing culverts, retaining walls,
- construction of new retaining walls,
- repair of unstable slopes
- road drainage and runoff to ultimate recipient
- reconstruction of junctions;
- construction/reconstruction of sidewalks.

Specific Requirements from the aspect of geometry:

- If there are no interventions in terms of change of the road geometry, measures to increase the visibility shall be indeed implemented, and additional information for the traffic participants shall be introduced.
- Along the observed road, there is a frequent appearance of connections from the local roads, from the adjacent agricultural lands and from the temporary residential/commercial structures. All connections shall be separately treated in order to enable safer entrance into traffic from the secondary roads.
- On the subject section the pavement crossfall is crown on central line, two-sided. In accordance with the solutions for rehabilitation of the pavement structure and drainage of the road stretch, the designed crossfall on the subject section shall be also adopted.
- The negative impact of the long directions to the traffic flow safety on the observed section, shall be decreased.

Specific requirements from the aspect of pavement:

- Significant damages on the entire road stretch on the pavement wearing course are observed, with an exception of the stretches recently overlaid. Pavement repairs are done locally without design, in full pavement profile and in profile parts of individual traffic lanes without changes in the initial pavement width. The repairs mainly referred to overlaying with wearing course and they are done on the most damaged locations. However, more extensive intervention measures including strengthening of the pavement structure are undertaken only on the last stretch (in length of app. 3500 m), the entrance and passing through Velika Plana. As on some locations there are damages, and for the structure too, the drainage elements and other facilities, this stretch must not be excluded from the project rehabilitation scope.
- The pavement structure is highly degraded due to the traffic overload and other impact parameters. In addition to the selection of method for rehabilitation of the pavement structure, particular attention shall be paid to the damaged stretches where the cause for the damage is in the lower layers.
- The design shall include the road crossing in the level of Smederevska Palanka.
- Within the investigation works, additional investigation works for the needs of preparation of design for repair of the embankment at the exit of Smederevska Palanka shall be foreseen, before the bridge over Jasenica river at km 78+000.

Based on all above stated, the Designer shall propose optimal solution taking into regard all relevant aspects.

Special requirements from the aspect of drainage:

- Using of updated rain intensity data, capacity and functionality of the existing drainage elements shall be checked.

- Drainage of the collected water (ditches, gutters, culverts) from the road to the receptionists shall be enabled.
- Before and after the bridge, concrete channels along embankment slopes shall be foreseen for proper collection and drainage to prevent erosion of the embankments and shoulders in the zone of the bridge.
- Within the design all connections for the local roads shall be processed and solutions to prevent flow of storm waters and sediments on the subject section shall be proposed.
- On certain locations parts of the shoulders and channels are concreted by private individuals. All existing drainage elements shall be thoroughly reviewed and incorporated in the designed drainage system, or demolition and replacement shall be foreseen in compliance with solutions from the design.

Particular requirements from the aspect of environmental protection:

- The Designer shall check the status of all waste deposits (landfills) in the close vicinity of the road, and depending on the status of the waste deposits and existence of adequate documentation, propose i.e. prevent their usage through the EMP document.
- The EMP document shall be prepared in the phase of preparation of the Detailed Design.
- Following the preparation of the draft version, the EMP document shall be subject to public consultations on which the interested stakeholders will be able to have an insight into the eco aspect of the road rehabilitation project.
- Detailed report on the public consultations shall be an integral part of the EMP Document.

Particular social impact requirements:

- Particular attention shall be paid to the road stretches through settlements.
- The Designer shall be responsible to propose design solutions and to propose Design for traffic management during the execution of works which will reduce to the minimum the disturbance of business activities within the road zone.
- The school zones shall be treated from the aspect of pedestrian movements as well as pedestrian crossings.

### **3.4.3 Technical Conditions for Construction / Specifications**

The Specifications are part of the detailed construction design and shall encompass: identification and description of the technology for the execution of the designed works, technical conditions for works execution, requirements and criteria for the quality of the material and works, the method of measurement and calculation, including all other aspects specific for the safe performance of works and protection of the structures and the environment during execution of the works.

While selecting the technology for execution of works, particular attention shall be paid to the fact that works are carried out under the traffic flow on the section.

The Designer shall be obliged to prepare Technical Conditions/Specifications. These technical conditions shall be based on the guidelines of the following relevant documents (standard technical conditions):

- SRCS “Technical Conditions for Road Construction in the Republic of Serbia”, edition no.1, dated 30.04.2012, Public Enterprise Roads of Serbia (SRCS), and
- “Quality Control Plan” (QCP).

Each item from the BoQ must be individually described within the technical conditions for construction.

Technical specification for each item from Main Design shall contain:

- Detailed technical description
- Quality requirement for componential materials and requirements for acceptance of works.
- Requirements for technology process including production of materials, transportation and stock piling, conditions for construction, conditions for required equipment for production and construction, requirements for safety and protection of adjacent structures and environment etc.
- Measurement.
- Method of payment
- Basis and methodology for reduction of payment from the aspect of quality, for items of works which are specific for the adopted design solution and which are not contained within the relevant documents.

The Designer shall be obliged to harmonize the items from Bill of Quantities and Priced Bill of Quantities with both SRCS and QCP.

The Designer may modify or amend SRCS technical conditions. In a case of modification or amendment of SRCS technical conditions, the Designer shall attach an Addendum with tabular review of the performed modifications and amendments of the standard technical conditions for construction.

The amendment of the technical conditions shall contain complete description of works, technology for construction, prescribe the method of measurement, the basis and methodology of payment.

When applying quality control guidelines of the relevant documents in controlling the quality of executed works if there is nonconformity with prescribed conditions, the Contractor shall apply the Quality Control Plan from the “QCP”.

While determining the request for the quality of the material to be used, primarily the quality of finished product shall be taken into account, but also the characteristics of the material from the domestic market shall be considered, whenever possible, to prevent endangerment of the structure quality.

Use of the above sources and consultations with the Client do not release the Designer of his full responsibility for the contents of completed technical conditions. The Client shall make available those relevant documents in electronic format to the Designer.

The Designer shall prepare tabular form with items of works marked and described, and he/she shall state which item of the above-mentioned documents shall be used for execution, measurement and payment of works. Shown below is an example of the above-mentioned table format for items and corresponding technical conditions to be used (Table No. 3.4.3.1):

Table no. 3.4.3.1: Table overview of items of works and corresponding technical conditions

No	Item	Name of item	Unit measure	SRCS Technical conditions for road construction	QCP Quality Control Plan	Additional technical conditions
1	Item from the B&Q	Name of item of works from B&Q	Unit measure from B&Q	It should be recorded here per which item of SRCS the quoted item of works is executed per provided description	It should be recorded here per which item of QCP the quality of materials and executed works is to be controlled per provided description.	It should be recorded here per which item is not contained and described within SRCS and QCP Prescribed conditions should be either further elaborated or amended in technical specifications.

The Designer shall prepare complete description of works, technology of execution of works, stipulate the method of measurement and method of payment, as well as the basis and methodology for reduction of payment for items of works, which are specific for the adopted design solution and which are not included in the relevant documents.

### 3.4.4 Bill of Quantities (BoQ)

Bill of Quantities should provide all necessary information for comprehending the scope of works and should enable efficient and accurate preparation of the Tender for the execution of works.

The BoQ shall be prepared in a form of table.

The items of works within the BoQ should be organized in a way to provide a clear division to various groups and subgroups of works according to the location /section. By its form and content, the Bill of Quantities must be clear, comprehensible and simple.

All works encompassed within the design must be contained in the item of works in the BoQ.

The classification of items of works shall be done per groups and subgroups of works.

The Designer is advised to perform the classification according to the methodology described in CESMM4 (Civil Engineering Standard Method of Measurement) or similar.

The mark (code) of item may be consisted of maximum four levels. The first level indicates the group, the second level the subgroup (max.9), while the third and the fourth level indicate the item within the subgroup.

Each part of the Bill of Quantities must have a title above each group and subgroup of works which are an integral part of the description of works position. If the description is

transferred from the previous page, the title of the group and subgroup of works is repeated in the header.

In addition to the quantity calculations, the Designer shall also enclose the list of key positions of works together with the designed quantities in the technical documentation.

Within the items of works, the Bill of Quantities should also include title of items of works, a brief description, and each item of works is referenced with technical conditions and referenced with the document based on which control quality is assessed, as well as unit by which calculation of quantities is made and calculated quantity of works.

Besides the data from BoQ, the priced BoQ shall contain unit and price amount of works item. Unit price includes all direct and indirect costs required for execution of relevant position. Each group of works must have a cumulative price which is entered in the cumulative priced BoQ.

In the cumulative priced BoQ of Works as a separate item, a Value Added Tax shall be presented.

The total sum is cumulative price with VAT included.

### **3.5 DETAILED DESIGN FOR STRUCTURES**

The actual number, type and condition of the existing culverts, bridges and retaining walls shall be determined by the Designer.

Using structural analysis of existing culverts, bridges and all other relevant parameters, the Designer shall decide about necessity for interventions on the existing culverts (repair, replacement, extension or the need for construction of new culverts).

According to records available to the Client, on the section there are 15 culverts and 3 bridges (Table 3.5.1.1.). On the subject section there are no tunnels nor retaining structures.

For every structure, bridge, wall or culvert requiring any of interventions, the Designer shall prepare particular solution, which shall contain all necessary details for efficient performance of the Works and calculation of the Works. Bill of Quantities shall be provided within the solutions, while all works items on the structures shall be clearly presented within the technical conditions.

#### **3.5.1 Detailed Design for Rehabilitation of Bridges**

On the road section IIA-147 from Smederevska Palanka to Velika Plana there are 3 bridges.

The basic data on the bridge, condition of the bridge and proposals for interventions are given the following table. In addition to the proposed interventions, based on detailed inspection of all structures on the subject section, all other measures required to repair the deficiencies determined during the inspection shall be applied.

Table 3.5.1.1: Data on the first bridge which is not recorded in DBP:

<b>Name of the structure:</b>	<b>Bridge over Ivak stream</b>
<b>ID of the structure</b>	-
<b>Road mark:</b>	IIA-147
<b>ID of the section:</b>	14710
<b>Chainage:</b>	75+139
<b>Type and name of the barrier:</b>	Ivak stream
<b>Span/length</b>	Opening from the left side: 5,7 m. From the right side: 9,4 m.
<b>Pavement width:</b>	5,9 m.
<b>Width of the left sidewalk:</b>	1.1 m.
<b>Width of the right sidewalk</b>	2,7 m.
<b>Description of the structure with the observed defects</b>	<p>The span structure is reinforced concrete, cast in situ. Extension on the both sides of the bridge is done for formation of pedestrian sidewalks. Crack on the left edge girder is observed. Extension of the structure on the right side, width 2,95 m, steel structure with concrete slab supported on pier who's foundation is corroded. Extension of the culvert on the left side, width 1,0 m, steel structure with steel sheet-metal. Left pedestrian sidewalk: steel structure with steel sheet-metal. Right pedestrian sidewalk: Steel structure with concrete slab. The asphalt is in poor condition. Regulation of the watercourse is ongoing.</p> <p>Detailed control of the span structure bearing capacity is required, most likely construction of new parts of pavement slab for pedestrian sidewalks and adequate solution of the traffic profile on the bridge with appropriate kerbs, pedestrian sidewalks and cornices will be required.</p>

Table 3.5.1.2: Data from the data base on Bridges (DBB)

<b>Name of the structure:</b>	<b>Bridge over Jasenica</b>
<b>ID of the structure</b>	10110
<b>Road mark:</b>	IIA-147
<b>ID of the section:</b>	14711
<b>Chainage:</b>	78+880
<b>Type and name of the barrier:</b>	Jasenica river
<b>Static system:</b>	Continuous girder on 5 spans.
<b>Span/length:</b>	13,65+3x18,2+13.65 m / 93,9 m (length)
<b>Pavement width:</b>	7,1 m
<b>Width of the left sidewalk:</b>	1.18 m
<b>Width of the right sidewalk</b>	1,23 m
<b>Bearings</b>	Not existing, damages on the abutment's bearing beams in the zone of supporting on the main girders.
<b>Expansion joints</b>	Not existing, asphalt damages in the zones on crossings on the bridge.
<b>Abutment with wing walls</b>	Generally in good condition. Damages in the zone of supporting of longitudinal (main girders) to the abutments.
<b>Middle pier</b>	In good condition.
<b>Main girder/slab</b>	In good condition.
<b>Sidewalks / cantilever</b>	Damages on the cantilevers. Water penetration. Formed stalactites.
<b>Waterproofing</b>	Probably mastic.
<b>Pavement</b>	Asphalt with damages.
<b>Cone Slopes</b>	In good condition.
<b>Fences</b>	Rails of the pedestrian sidewalks are in poor condition.
<b>Kerbs</b>	Stone 8 cm.
<b>Pedestrian sidewalks</b>	Cornices are in poor condition, damaged concrete and corroded reinforcement.
<b>Drainage</b>	Gullies, double grade of the pavement wearing course.
<b>Proposal for intervention</b>	The zones of supporting of the longitudinal (main) girders to the abutments shall be repaired. Repair of the damaged concrete surfaces and protective coating shall be done. The possibility of formation of one sided cross grade on the bridge shall be considered. Installation of waterproofing in full width of the bridge shall be envisaged including construction of adequate edge cornices. The transition from shoulders to bridge shall be regulated. Drainage through slope before and behind the bridge shall be enabled. Formation of closed drainage system on the bridge is advice. The need of placement of guardrails on the bridge shall be checked. Cone slopes and the area around the bridge shall be arranged.

Continuation of Table 3.5.1.3:

<b>Name of the structure:</b>	<b>Bridge over Bukovicki stream</b>
<b>ID of the structure</b>	10111
<b>Road mark:</b>	IIA-147
<b>ID of the section:</b>	14712
<b>Chainage:</b>	84+598
<b>Type and name of the barrier:</b>	Bukovicki stream.
<b>Static system:</b>	Simply supported beam.
<b>Span/length:</b>	6.6m from dilatation to dilatation, length 12,2 m,
<b>Pavement width:</b>	5,9 m
<b>Width of the left sidewalk:</b>	0,8 m (0,5m+0,3m con.parapet)
<b>Width of the right sidewalk</b>	0,8m (0,5m+0,3m con.parapet)
<b>Bearings</b>	-
<b>Expansion joints</b>	Not existing, cracks in asphalt.
<b>Abutment with wing walls</b>	The abutments are generally in good condition. The access retaining walls have movements/rotations which are visible on the expansion joints.
<b>Main girder/slab</b>	In good condition.
<b>Sidewalks / cantilever</b>	Not existing.
<b>Waterproofing</b>	Probably mastic.
<b>Pavement</b>	Asphalt.
<b>Cone Slopes</b>	Neglected.
<b>Fences</b>	Concrete parapets.
<b>Kerbs</b>	Not existing, the edge of concrete pedestrian sidewalk, app. 5 cm. height.
<b>Pedestrian sidewalks</b>	Concrete.
<b>Drainage</b>	Not existing.
<b>Proposal for intervention</b>	The possibility of extension of the traffic profile on the bridge with adequate pedestrian sidewalks from both sides shall be considered. Protective coating of the concrete surfaces shall be done. Expansion joints shall be installed and waterproofing in full width of the bridge shall be done. Adequate kerbs shall be installed. The transition from shoulders to bridge shall be regulated. Drainage through slope before and behind the bridge shall be enabled. Cone slopes and the area around the bridge shall be arranged.

The Designer shall:

- perform detailed geodetic survey of the structure and the area around the structure;
- prepare a layout of the location with topographic data, longitudinal profiles and cross sections in the appropriate scale. Cross-sections shall be surveyed at maximum distance of 5 m; The existing installations on the structure and in zone of the structure shall be noted and their exact position shall be drawn down;
- perform detailed inspection of the structure and shall perform the required investigation works to control/determine the geometry of the bridge and the mechanical characteristics of all structure elements of the bridge and note down

damages on all bridge elements and bridge equipment. Programme and the scope of the investigation works shall be approved by the Client;

- If it is necessary to define the system of funding, and the design on the existing condition and the original elaborate on engineering geological and geotechnical investigations are not available, the investigation works may encompass excavation of trial pits within the zone of piers for definition of the manner and the depth of the funding, trial drilling for definition of the geological composition of the field under the foundations, laboratory testing and preparation of geological-geotechnical basis for preparation of the elaborate of geological-geotechnical investigations;
- Prepare report on detailed inspection of the structure and the investigation works accompanied by photos,
- Prepare layout of the existing condition;
- Prepare static calculation of the existing bridge structure – determine the bearing capacity of the span and supporting structure existing elements, static calculation of the elements for strengthening of the structure, if necessary; conclusion on the bearing capacity, durability and usability of the existing newly designed bridge structure.
- The bearing capacity shall be determined in compliance with the Rulebook on determination of the bearing capacity of the existing bridges on the state roads – Amendment, Version peB3: 2012 ;
- prepare an analysis of the existing condition and propose measures and activities to remove the observed damages in order to return the structure into its regular condition.

Based on the results of previous activities, the Designer shall provide a technical solution for intervention on the bridge.

Design solution shall include all works needed in order to make the structure fully technically and functionally acceptable. The Detailed Design for Rehabilitation of Bridge should secure needed bearing capacity, durability and usability of the structure.

Width of pavement and footpaths on the bridge (traffic profile) shall be harmonized with the designed solution for traffic profile of the subject road section.

Geometric characteristics of the road on approaches to the bridge shall be adjusted to the geometry of the designed structure.

As part of technical documents for the bridge, it is necessary to plan a solution for draining that would ensure efficient and controlled draining of atmospheric water in accordance with relevant regulations. In order to ensure safety of the existing bridge, it is necessary to perform testing of hydraulic put-through capacity in accordance with criteria prescribed by fundamentals of water management ("Official Gazette of RS", No. 11/2002).

If the existing watercourse is planned for acceptance of precipitation water, and if the relevant water Management Institution stipulates such conditions, drained water from pavement shall be previously treated at separator in order to be cleared from aggregates, grease, oil and other floating materials, in accordance with the Decree regulating the prescribed value of the wastewaters quality.

Detailed design for structures shall include separate BoQ for all designed Works as well as Specifications of the Works prepared in a manner described under the Section 3.4.3.

Particular BoQs must be included in Summery BoQ.

*The rehabilitation Design shall be performed in compliance with the Manual for road designing in the Republic of Serbia, issue 1: 30.04.2012.*

### **3.5.2 Detailed design of engineering structures**

From Smederevska Palanka to Velika Plana there is a number of different culverts (pipe, arched and box), there are no visible retaining walls in function of the road stability. The retaining and parapet walls present on the section are in function of protection of private structures and within the road bridges/culverts/channels. There are damages on the concrete surfaces which should be repaired.

Within the structure zone the drainage is not regulated, it is therefore required implementation of the kerbs, concrete gutters and other elements to evacuate water from the pavement. Placement of guardrails shall be foreseen as well as pedestrian (inspection) sidewalks. The old culverts that cannot be repaired should be replaced with new ones.

The investigation works shall encompass the locations on which due to designing of extensions or improvement of the geometric road elements, the need for new supporting structures will appear.

For all culverts and walls on the section, the existing and the newly designed, detailed drawings and all required details for performance of the construction works shall be prepared.

## **3.6 DETAILED DESIGN OF TRAFFIC SIGNAGE**

### **3.6.1 General requirements**

Based on the field inspection of the subject section of the state road, existing condition of spatial and physical structure in road side should be determined, as well as other elements significant for traffic safety. Designer's obligation is to make appropriate photo documentation, especially for intersection areas.

Designer of traffic signage and road furniture shall take over from the construction design all completed plans and shall perform revision of the solutions that refer to the following:

- driving-dynamic and visual characteristics of the section,
- maximum speed of the vehicles in curves,
- internal conformity and dynamic homogeneity of elements of road alignment,
- traffic safety for all participants,
- determination of required stopping visibility, available and overtaking visibility etc.

While designing, special consideration shall be given to all interventions stated by the construction design, as well as to solutions resulting from the traffic safety analysis.

As part of the design for traffic signage and road furniture, the Designer shall anticipate and include all necessary solutions for horizontal and vertical signage (traffic signs, sign girders, signs constructions and calculation of foundation) and road furniture.

Installation of rigid elements on the road, without an adequate protection is not permitted. On the high speed locations (for an example: entrance and exits from the Motorway, State roads etc.) all equipment installed within roadside, such as lighting columns, structure

poles and others, should be designed in compliance with standard SRPS-EN 12767. In a case of limited shoulder width (inability of installing of guardrails system), usage of break away poles with high energy absorption should be envisaged.

Elements of traffic signage and road furniture such as guardrails for vehicles, signposts etc. shall be separately treated and designed in accordance with valid SRPS-EN standards. Centre line and edge lines on particular locations along the road section as a rumble strips could be envisaged, if needed.

Proposed traffic solution and proposed traffic signage and furniture must be in compliance with the category of the subject section. Dimensions, quality of materials and durability of traffic signage and road furniture shall also comply with the category of the subject road and shall be based on the SRPS-EN standards and valid Rulebook on traffic signage ("Official Gazette RS" No. 134/2014).

Proposed solution for traffic management system and system of signposts should ensure efficient and safe traffic on the state road with mandatory use of indication of number of international and state road. Provisions of the valid Law on Official Use of Language and Letter shall be respected.

In case that proposed road furniture elements not covered by the Serbian standards, the Designer shall justify the proposal in writing and identify relevant legal provisions enabling appliance of such solution so that could provide Client's consent. Use of these elements must be limited and meaningful.

For non-standard signs, board and touristic signs, a static calculation of the structure of traffic sign in respect of a wind impact on the structure shall be done which shall also include an estimate of number and type of traffic poles, calculation of pole bearings and calculation of foundations. An Expert (licenced engineer) for this type of works shall perform the static calculation.

Plan of horizontal and vertical signage and road furniture within the detailed design shall be presented through graphical attachments that include chainages and levels needed for positioning and placement/incorporation of signage and road furniture in the field. The chainage of the traffic signage must be complied with Construction part of the Design.

Detailed design for traffic signage and road furniture shall not include alternative solutions or different options.

Starting-ending structures of protective elements (elastic guardrails) shall be designed to be curved in the arch from the pavement edge. At locations where appliance of this principle is not possible, protective elements shall be designed with appropriate starting-ending structures in order to maximally reduce negative impact if vehicle potentially crush into it. If necessary, guardrails with different degrees of sustaining the vehicle should be applied in an uninterrupted sequence, where transition structures should be also planned.

Designer is obligated to justify specific solutions separately within the Technical Report.

Technical Report shall include:

- description of the location, the most important features and description of proposed traffic solution,
- description of proposed elements of traffic signage and road furniture,

- other data and justifications of the Designer that are of relevance for elaborated and proposed traffic solution.

Detailed design for traffic signage and road furniture shall mandatorily include BoQ. Items for dismantling the existing elements of traffic signs and road furniture which are in disagreement with the designed solution and which need to be removed shall be presented as part of BoQ. While preparing priced BoQ the actual market unit prices shall be used. Items in estimate of quantities within the detailed design for traffic signage and road furniture should be grouped in the following manner:

1. Vertical signage
  - 1.1. Standard traffic signs
  - 1.2. Boards and lattice girders
  - 1.3. Traffic sign poles
2. Horizontal signage
3. Road furniture
4. Other works (dismantling of existing elements etc.)

The Designer shall prepare general and particular specifications in a manner indicated within Section 3.4.3 of this Terms of Reference.

For elements of traffic signs that are standardized, marking stated by Serbian standards shall be applied.

All descriptions of the items shall be mentioned in the Specifications and must be precisely defined and harmonized with details on drawings. Same item shall not be described differently on different places in the design, i.e. data in the quantity of the Works, Specifications and on drawings must be identical.

As part of the attachment in details of Detailed Design, contents that support a precise and quality incorporation of proposed traffic signage and road furniture should be presented. Graphical drawings and detail drawings should be presented as magnified.

As part of details of the Detailed Design, all elements that enable construction of traffic signage for guidance of the road users (traffic signpost and touristic signage) at the level of details of so called shop drawings should be also presented.

All relevant technical details and descriptions that enable ordering of traffic signage and road furniture must be presented in Specifications, without favoring of particular suppliers and their products.

### **3.6.2 Particular Requirements**

In addition to general requirements, the following particular requirements shall also apply:

- The Designer shall define measures for improving of the traffic safety, taking into account the intensity and structure of traffic flows on the road sections Smederevska Palanka (Azanja) – Velika Plana;
- Stretches that are experiencing congestions on road such as blind corner, connection, structure in the road base, etc., shall be treated with appropriate measures to improve the traffic safety at the such locations;

- It is mandatory to analyse all triangles of visibility on crossings and intersections which need to be regulated by the design and in line with the afore-said design priority traffic signs;
- On the auxiliary local intersections, in addition to the priority traffic signs, horizontal marks as additional information on priority shall be designed;
- The Designer shall precisely determine the borders of settlements on the subject road section based on the spatial layout plans, i.e. urban-planning layout of the municipality, i.e. town and the existing designs. In line with the above, traffic signage and equipment for settlement shall be designed;
- In accordance with the traffic safety requirements, the mutual compliance of the geometric elements along the alignment of the subject section shall be verified. In this regard, in accordance with the spatial possibilities and adopted design solution, appropriate interventions shall be foreseen, where required;
- Based on the site inspection and actual condition on site, the Designer shall consider and propose measures for improving traffic safety on long directions viewed from the aspect of exceeding speed limit, safety of the vulnerable traffic participants as well as connections from secondary and other access roads. In this regard, particular attention shall be paid to the mid part of the section between the settlements Smederevska Palanka and Velika Plana;
- In compliance with the spatial possibilities and the adopted design solution for the respective section, mitigation of the discharge channels slopes shall be envisaged in accordance with the traffic safety requirements. Otherwise, proposals to improve the traffic safety on these stretches shall be provided;
- While preparing the design solution, the number of cyclists using the stretches of the state road and particularly the passages through the urban settlements shall be taken into account. The subject stretches shall be treated from the aspect of traffic safety as well as from the aspect of appropriate traffic signage;
- The entrance and the exit zones of the horizontal curves and structures (bridges and culverts), where the designer assess a need, shall be treated by guardrails with appropriate characteristics and length, bearing in mind the possibility of appearance of frost within the said zones; Replacement of the existing concrete rails by guardrails with adequate characteristics shall be envisaged;
- As there are tourist locations alongside the road (tourism potential in general) adequate tourist signage should be designed to direct beneficiaries to those locations. The needs, as well as conditions for placing tourist signage should be defined in agreement with the local self-government;
- At black spots, which are determined on the basis of traffic safety analysis, it should be necessary to design traffic signs with fluorescent backgrounds;
- As to increase level of traffic safety on sections with sliding pavement, i.e. sections susceptible to frost, adequate changeable traffic signage shall be anticipated;
- The visibility elements of the horizontal and vertical curves should be improved, where justified and possible;
- Based on the actual conditions on site, it should be necessary to regulate pedestrian communications and anticipate footpaths, particularly in settlements and bus stop zones;
- School zones in Smederevska Palanka, Vodice, Bresje and Velika Plana should be specially treated from the aspect of pedestrian movements, as well as pedestrian crossings. Within the Design solution, the Designer shall be obliged to include the zones of all schools located on the subject section, and which are not indicated;

- For the elementary school zones, it should be necessary to anticipate adequate regulatory-technical measures for traffic slowing down as to protect vulnerable traffic participants;
- The Designer shall consider possibilities and anticipate pedestrian central reserves at locations where pedestrian crossings should be marked;
- The bus stops should be designed off the road with arranged pedestrian communications to and from the bus stop. The functionality of the existing bus stops shall be checked and appropriate measures shall be foreseen in compliance with the traffic safety requirements;
- The design solution shall particularly include regulation of the following interchanges:
  - for Vodice, at app. chainage km 79+081;
  - for Raca in node 14710 Stojacak, at app. chainage km 80+713;
  - for Koporin Monastery, at app. chainage km 84+044
  - with Momira Gajica and Milorada Stankovica streets in Velika Plana, at app. chainage km 86+760.
- Structures situated at non-safe distance from the pavement edge (light columns, trees, massive lattice sign girders, etc.) should be removed or shifted. If this is not feasible, structures shall be secured by adequate guardrails of adequate level of protection;
- The design solution shall include proposals for regulation of all connections on the road stretch that are estimated as risky from the aspect of traffic safety;
- Construction of cobblestone pavement wearing course on district access roads to the state road (“Otresista”) shall be foreseen. Part of the access roads along with the state road shall be foreseen with asphalt wearing course in appropriate length, while the same shall be treated by proper traffic signage.

### **3.7 DESIGN FOR TRAFFIC MANAGEMENT DURING CONSTRUCTION WORKS**

Design shall include temporary traffic signage and equipment necessary to provide management and regulation of traffic on sections of road where disturbances occur in normal traffic flow caused by construction works.

Proposed solutions for traffic signage should be in agreement with category of the road and should ensure undisturbed and safe traffic flow on the road section where the Work is being performed. These should also guarantee full safety of all traffic participants and workers in the area of the Work performance. Designed solution for traffic management during Work execution shall cover the traffic loading and spatial and temporal distribution of traffic flows on the subject section.

Special attention during preparation of the design for traffic signage during works execution shall be paid to vulnerable traffic participants and accessibility to the supporting facilities along the road.

Traffic management plans shall be prepared based on the scope and importance of the Works due to which it is necessary to have partial closure of traffic with special treatment of areas of intersections, structures, individual accesses and provision of flows for pedestrian movement. At locations with partial traffic closure where narrowed pavement does not allow two-directional traffic, it is necessary to plan intermittent traffic by use of light signals (traffic lights) and alternatively, use of manual management by flags.

Dimensioning of parameters of signalling plan within intermittent traffic flow by using light signals (traffic lights) shall be done according to conditions of traffic flow in order to make time losses in traffic tolerable. There should be more than one signalling plan developed to accommodate hourly variance in traffic flows.

Prepared traffic management plan shall contain a layout of traffic signage on the subject road section in typical form of appropriate scale with analysis of impact of the works on road on reduction of capacity of the road and increase of travel time due to narrowing or partial closure of the section. Layouts shall present the existing traffic signage and manner of their treatment in accordance with the designed solution.

For parts where the works on widening of the existing pavement are performed and where difference in levels of excavation and the existing pavement endangers traffic safety, it is mandatory to plan a placement of appropriate equipment (vertical barriers, concrete barriers etc.)

The following typical solutions shall be planned for specific traffic situations, which may be observed and noted as particular:

- On the open road section with width less than 5.5 m, with traffic lights and alternatively with manual use of flags;
- In wider area of intersections, in maximum length of 150 m with manual traffic management by flags;
- In an immediate zone of intersection where the Works are performed with manual traffic management by flags;
- In zone of structures on the road with traffic lights; and
- On the open road section in the area of Works, with a greater width than 5.5 m, with partial closure of traffic lane or for Works off the pavement.

In cases when it is not possible to apply typical solutions for traffic management or in case of road closing for traffic, it is necessary to prepare a plan for traffic management under actual conditions.

If the technology is such that demands suspension of traffic on the subject road for execution of work, the Designer shall:

- predict regime of traffic suspension during the execution of works;
- if planned regime of traffic suspension demands so, predict alternative roads for traffic diversion;
- provide conditions from managers of alternative roads for traffic diversion;
- prepare design of guidance of traffic during works execution;
- provide approval of the Client on design;

Shall it be necessary to define alternative roads, the Designer is obligated to use the State road network to the greatest possible extent for guidance of traffic to the appropriate destinations.

Special attention shall be paid to the placement of traffic signpost signage during execution of works.

Depending on technology of Work performance and proposed designed solution, appropriate quantities of traffic signage should be planned and designed.

A design should include blinkers and strobe lights for marking the Works on the road, especially during night and under conditions of reduced visibility (fog, dust, rain etc.). On sub-sections where due to the applied work technology (milling of asphalt) the horizontal signage is temporarily missing, a design should include temporary horizontal signage for safe traffic management.

Widths of traffic lanes should be planned in function of speed limit during Work performance on the section in accordance with the document "Technical instruction for signing work zones during state road maintenance in the Republic of Serbia", Belgrade 2016<sup>6</sup>.

Designed solutions should be prepared in accordance with valid standards and "Technical instruction for signing work zones during state road maintenance in the Republic of Serbia", Belgrade 2016<sup>40</sup>. Use of this source and consultations with the Client do not release the Designer from full responsibility for quality of designed solutions.

Characteristics of elements of vertical signage shall be applied in accordance with valid SRPS-EN standards. Materials for manufacturing of traffic signs shall possess reflective properties stated by the Rulebook on traffic signage and shall correspond to the class of the road ("Official Gazette RS" No. 134/2014).

In case that proposed road furniture elements not covered by the Serbian standards, the Designer shall justify the proposal in writing and identify relevant legal provisions enabling appliance of such solution so that could provide Client's consent. Use of these elements must be limited and reasonable.

For non-standard signs and board signs, a static calculation of the structure of traffic sign in respect of a wind impact on the structure shall be done, which shall also include an estimate of number and type of traffic poles, calculation of pole bearing and calculation of foundations. An Expert (licenced engineer) for this type of works shall perform the static calculation.

In addition to description of the problem, limitations, description of proposed solution, traffic-technical calculation and expected effects on the section, the technical report should also include description of locations that require special treatment from the traffic safety aspect (school zones, bus stops, locations with increased intensity of pedestrian movement etc.).

Contents that are in accordance with the defined manner of placement and that support quality and precise construction of proposed signage should be presented in the attachment in Details. Graphical presentations and drawings of details should be treated in increased scale.

Existing and potential dangers that may appear during the Work execution on placement of traffic signage and road use should be identified as part of attachment on measures for safety at work. Based on the findings, appropriate measures for avoiding the identified dangers should be proposed.

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<sup>6</sup> [http://www.putevi-srbije.rs/images/pdf/regulativa/Tehnicko\\_uputstvo\\_za\\_oznacavanje\\_zona\\_radova\\_na\\_odrzavanju\\_drzavnih\\_puteva.pdf](http://www.putevi-srbije.rs/images/pdf/regulativa/Tehnicko_uputstvo_za_oznacavanje_zona_radova_na_odrzavanju_drzavnih_puteva.pdf)  
[http://www.putevi-srbije.rs/images/pdf/regulativa/Seme\\_izgleda\\_zone\\_radova.pdf](http://www.putevi-srbije.rs/images/pdf/regulativa/Seme_izgleda_zone_radova.pdf)

### 3.8 ECONOMIC ANALYSIS

Objective of the design economic analysis is to provide the economic valuation of designed solution for heavy maintenance in comparison to the basic option (do nothing - do a minimum).

#### 3.8.1 Applied Methodology

Economic analysis for the design shall be completed based on one of the recognized models of economic analysis at the section level (Project Analysis). It is necessary to provide a justification for selection of the model, as well as a description for the selected model of economic analysis. For all entry data, it is necessary to state adopted assumptions and source of data.

Economic analysis of design shall be based on the following assumptions:

- Traffic analysis and forecast of traffic growth during the analyzed period shall be based on the Section 3.2.1 of this Terms of Reference,
- Period for the analysis is 10 years,
- Start year for the economic analysis is 2019,
- Discount rate is 8%,
- All costs are expressed in €,
- Initial period of road heavy maintenance shall be specified with the assumed investment (realization) schedule
- Relation of economic and financial value of costs is 0.80,
- Economic analysis shall include the benefit of decreased traffic accidents<sup>7</sup>,
- Salvage value for road rehabilitation is 10%.

Calibration of model for local conditions shall be done for needs of preparation of economic analysis. Accepted data shall be presented with detailed justification of grounds for their acceptance.

Available data on climate characteristics and vehicle fleet composition are presented in the following tables (The data from the table shall be used solely for the needs of calibration of the HDM4 model, if the same is used in the economic analysis):

*Table 3.8.1.1: Climate characteristics of the Republic of Serbia*

Parameter	Parameter Value
Climate type	Moderately continental
Humidity classification	Moderately dry
Humidity index	- 40
Length of dry period	0.5
Average monthly precipitation	56 mm
Average temperature	10°C
Average temperature range	38°C
Number of days during a year with temperature higher than 32°C	22 days

<sup>7</sup> For the purposes of assessment, the prices of various types of injuries in traffic accidents shall be used, shown within the "Manual of cost and benefit analysis", product of the Project "Assistance to the Republic of Serbia in Planning and Programming of the Road Infrastructure" (G2G09/SB/5/2), in the frames of G2G initiative.

Parameter	Parameter Value
Frost index	207°C-days
Number of days when pavement is covered by snow	15
Number of days when pavement is covered by water	0

*Table 3.8.1.2: Composition of vehicle fleet (representative vehicles in vehicle fleet)*

Vehicle type	Mark and model
Car (PA)	FIAT PUNTO CLASSIC (ZASTAVA 10)
Bus (BUS)	SKANIA
Light Truck (to 2.5t) (LT)	IVECO Daily 40 (ZASTAVA)
Medium Truck (2.5-10.0t) (ST)	Mercedes Actros 1841 (load capacity 9t)
Heavy truck (TT) > 10t	Mercedes Actros 2544 (load capacity 14.5t)
Train truck (AV) > 10t	Mercedes Actros 1843 with semi-trailer (load capacity 26t)

*Note:*

*Data have been taken from the "Program Analysis for state road network and TRP performance indicators" (September 2011).*

In case of use of other data, it is necessary to specify a source of data and provide appropriate justification.

For calibration of a model of pavement deterioration, some of recommended values of rates of occurrence and development of particular types of damages from generally accepted models shall be used. It is necessary to specify and justify the used rates.

If there are particularities about traffic flows that are present on the observed state road, it is necessary to define speed flow type for all phases of the project implementation scenario (existing and future condition of speed flows) depending on type and manner of execution of the proposed Works. It is also necessary to indicate and justify the accepted characteristics of traffic flows.

### 3.8.2 Design Description

For the purpose of better review of design, it is necessary to provide a description of the following elements:

- Location of the road section
- Construction history
- Maintenance history
- Design-technical documentation
- Geometric properties (existing and designed): Geometric properties of the section should be provided through a description of cross-section, longitudinal profile and layout. Based on geometric properties, operational speed of vehicles shall be calculated
- Pavement: Structure and characteristics of the existing pavement on the section shall be presented (type of surfacing, description and thickness of layers, soil mechanics properties of materials in subgrade, structural number in accordance with AASHTO recommendations). Presentation of surveys for the section (trial pits, cores etc. in accordance with the Section 3.2.3 of this ToR) through a relevant table shall be also included. Structure of designed pavement (type of surfacing, description and

thickness of layers, soil mechanics properties of materials in subgrade, structural number in accordance with AASHTO recommendations) shall be also presented, as well as a description of methodology applied for dimensioning of pavement

- Pavement surface condition: Pavement surface condition shall be presented through longitudinal roughness (average value on homogeneous stretches) expressed through International Roughness Index of pavement surface (IRI m/mm), transversal roughness (average value of rutting on homogenous stretches), damaged pavement surface (cracks, potholes, aggregate crumbling etc. on homogenous stretches), pavement bearing capacity (measuring results on homogenous stretches) etc.
- Structures
- Drainage
- Commercial facilities
- Traffic signage and road furniture
- Environmental protection and
- Social factors.

In a case that previous technical documents in connection with the subject section or any of its parts exist, it is necessary to mention such documents in the report.

Description of the existing condition and designed solution for structures, draining, traffic signage and road furniture shall be provided. Amount of needed funds shall be also provided.

Comments on possible impact of road on social factors shall be included. Assessment of impacts of social factors of relevance for scope of the proposed works shall be also made.

### **3.8.3 Traffic Analysis**

Based on the available data on traffic volume (traffic counting on Serbian road network from 2013-2017 and continuous control counting of at least 7 days), the Designer shall determine:

- Average annual daily traffic (AADT) on the road way (per sections) in the base year 2017;
- Cumulative traffic and equivalent axle load shall be determined for the design period;
- Scope of traffic load during analysed period shall be determined by using growth rates specified under the item 3.2.1 of this ToR;
- Assessment of transit traffic growth (if any) shall be made and methods used for the assessment, data and assumptions shall be specified;
- Assessment of generated traffic during analysed period shall be made and methods used for the assessment, data and assumptions shall be stated.

For analysis of data on traffic accidents, the Designer shall use necessary data and results from the Section 3.2.8. Analysis shall be done at the section level. Comments on possible decrease of number and consequences of traffic accidents shall be also provided. Assumptions, sources of data and supporting justifications shall be specified.

For the purpose of economic analysis, data on characteristics of vehicle fleet presented in the following tables shall be used. In case of use of other data, it is necessary to provide a source for data and justification.

*Table 3.8.3.1: Technical and operational characteristics of the vehicle fleet*

<b>Basic type of vehicle</b>	<b>No. of wheels</b>	<b>No. of axles</b>	<b>Annual km</b>	<b>Annual working hours</b>	<b>Average life (years)</b>	<b>No. of passengers</b>	<b>ESAL</b>	<b>Weight (t)</b>
Car	4	2	12,000	500	12	2	0.00	1.30
Bus	6	2	100,000	2,500	12	35	1.37	13.00
Light truck	6	2	50,000	2,000	12	0	0.01	2.55
Medium truck	6	2	50,000	2,000	12	0	0.65	8.45
Heavy truck	10	3	55,000	2,000	14	0	2.67	19.15
Train truck	18	5	100,000	2,000	12	0	3.25	30.41

Table 3.8.3.2: Economic characteristics of the vehicle fleet

Basic type of vehicle	New vehicle	Tires	Fuel	Oil	Price of maintenance working hour	Price of crew working hour	Price of passenger working hour	Price of passenger free hour	Freight price
	(€)	(€)	(€/l)	(€/l)	(€/h)	(€/h)	(€/h)	(€/h)	(€/h/t)
Car	10,000	50.0	0.68	3.10	5.70	0.00	5.00	0.70	0.00
Bus	100,000	230.0	0.61	3.10	5.70	11.40	5.00	0.70	0.00
Light truck	20,000	150.0	0.61	3.10	5.70	5.70	0.00	0.00	0.20
Medium truck	30,000	180.0	0.61	3.10	5.70	5.70	0.00	0.00	0.20
Heavy truck	60,000	220.0	0.61	3.10	5.70	11.40	0.00	0.00	0.20
Train truck	54,560	260.0	0.61	3.10	5.70	11.40	0.00	0.00	0.20

Note: Data have been taken from the "Program analysis for state road network and TRP performance indicators" (September 2011).

### 3.8.4 Results of the Economic Analysis

It is necessary to provide a description for basic option (do nothing – do a minimum), i.e. to determine a minimum of Works on routine road maintenance. It is also necessary to provide a definition of scope and value of Works on routine maintenance for every year of the analysed period (maintenance regime).

It is also necessary to present scope and value of the Works on routine road maintenance after intervention, i.e. for the option of heavy maintenance.

Costs of Works on routine maintenance should be presented separately according to main items. For the work costs analysis on routine road maintenance, the prices received from the relevant departments of the Client shall be used.

For each year of the analysed period next shall be shown:

- Unit and total costs of designed Works;
- Unit and total costs of routine road maintenance Works;
- Unit and total vehicle operating costs (fuel consumption, costs of spare parts, wasted tires etc.) for every category of vehicles;
- Unit and total travel time costs (working hours, vacation time etc.) for every year of the analysed period;
- Average operational speeds for every type of vehicle;
- Level of road deterioration;
- Number of traffic accidents according to their consequences (accidents with killed, severe or light injuries, i.e. accidents with material damage).

For all the assumptions, source of data and explanation shall be specified.

As part of the economic analysis, it is a requirement to prepare the analysis of economic indicators, as well as the analysis of data sensitivity.

For the purpose of economic analysis, “economic” prices without VAT and taxes shall be used.

It is necessary to have the analysis of relation of costs and benefits. Following economic indicators will be established:

- Savings in vehicle operating costs (mil. €)
- Savings in travel time (mil. €)
- Savings in reducing the number of traffic accidents (mil. €)
- Internal rate of return (*EIRR in %*)
- Net present value (NPV in mil. €) for a sequence of discount rates (8%, 10% and 12%)
- Relation of net present value and investment (*NPV/CAP*).

Results sensitivity analysis shall be done for the following cases:

- Reduction of traffic volume for -20%
- Increase of total costs of the Works for +20%
- Reduction of traffic flow volume for -20% with increase of total costs of the Works for +20%.

Based on the finished total economic analysis, it is necessary to make conclusions and recommendations.

## **4. CONTENTS, PROCESSING AND DELIVERY OF TECHNICAL DOCUMENTS**

### **4.1 CONTENTS OF TECHNICAL DOCUMENTS**

Design-technical documentation shall include all necessary documents and sections requested by the valid legislation.

Contents of the technical documentation shall be structured in the following manner:

- Volume 1: Detailed construction design for heavy road maintenance:
  - book 1.1: Text
  - book 1.2: Drawings
  - book 1.3: Cross-sections
  - book 1.4: Analysis of existing condition
- Volume 2: Geodetic Survey for detailed design
- Volume 3: Study on Field Surveys and Testings
- Volume 4: Detailed pavement design
- Volume 5: Detailed design for structures
  - book 5.1: Detailed design for rehabilitation of bridges
  - book 5.2: Detailed design of engineering structures
- Volume 6: Detailed design of traffic signage
- Volume 7: Report on Traffic Safety Analysis
- Volume 8: Economic Analysis
- Volume 9: Design for traffic management during construction

In accordance with valid regulation, as part of each volume of design documentation it is necessary to include obligatory general documents (licenses, statements, confirmations etc.), ToR/extract, technical report, study on safety and protection at work in compliance with the requirements defined within the Legislation of the Republic of Serbia and with the Safety and Labor Management Plan, prepared by the PE "Roads of Serbia" particularly for the purposes of this Project. Relevant calculations, technical specifications, particular and joint BoQs, drawings and data needed for quality performance of the Works are included in each volume.

In the bottom right corner, each drawing contains a table of max 18cm: with following data:

- 1) Name of the Client
- 2) Name of Project
- 3) Name of the Designer
- 4) Label and type of Design
- 5) Label and name of part of Design
- 6) Name of Drawing
- 7) Scale
- 8) Name, Surname and license number of responsible engineer
- 9) Number of drawings
- 10) Date
- 11) Revision dwg register

In addition to the standard requirements for contents of certain volumes of technical documents, the Designer shall also meet specific requirements indicated within this ToR.

As part of the book 1.1, in addition to other documents, the following needs to be submitted:

- Final Report on Technical control of the documents
- Complete technical report justifying in detail the designed solution. The technical report shall contain extracts from reports of all responsible designers
- All conditions, opinions and consents of relevant public companies
- List of coordinates of operational polygon points.
- List of coordinates of detailed axis points
- Axis setting out elements
- Technical Specifications for all designed works in accordance with item 3.4.3 of this TOR
- General BoQ, which covers summary presentation of all particular BoQs from every separate volume
- Particular BoQs (from all volumes) in compliance with standard BofQ form, from Bidding Document (WB/EIB and EBRD), and item 3.4.4 of this TOR
- Environmental Management Plan – EMP
- Report on completed presentation of design to a local community
- Other textual appendixes relevant to project and construction works.

As part of the book 1.2, in addition to other documents, the following needs to be submitted:

- Comprehensive layout (general map) 1:25000
- Layout plan with right of way border presentation 1:1000

- Layout plan with presentation of all installations and structures within right of ways 1:500
- New design Layout plan 1:1000
- Longitudinal profile 1:100/1000
- Normal cross section profiles 1:50
- Leveling plan for sections in settlements 1:500
- Pavement details
- Details of elements of plan and profile (curbs, ditches, channels etc)
- Details of utility installations (if any)
- Details of access roads 1:500
- Leveling plan for junctions and intersections with crosssections 1:250
- Details of individual accesses
- Type of bus stops
- Leveling solutions and details for connection between new and existing pavement R=1:250

As part of the book 1.3, in addition to other documents, the following needs to be submitted:

- Crosssection profiles 1:100, for pavement (UL and SL) 1:100/20.

As part of the book 1.4, in addition to other documents, the following needs to be submitted:

- Graphic presentation of pavement condition index (PCI)
- Graphic presentation of longitudinal and transverse unevenness
- Graphic presentation of surface friction level
- Graphic presentation of homogenous sections
- Graphic presentation of modules of existing pavement layers

As part of the Volume 2, in addition to other documents, the following needs to be submitted:

- Disposition of points of operational polygon on maps of appropriate scale with indicated links to the basic state network, as well as position of elevation network along the alignment
- Table presentation of basic positional and level network verified by authorized company (geodetic organization).
- Description of position and method of stabilization of points of operational polygon, as well as of presented level points – benchmarks (trig. form 27)
- Data on levelling of operational polygon with all other data included in levelling process
- Record of general levelling with linking to the existing state level network
- Table presentation of coordinates and levels of operational polygon
- Table presentation of data for transfer of designed axis into the field (key points of curves, hectometres)
- Layout of boundaries of right of way
- Study on the records of occupancy

As part of the Volume 4, in addition to other documents, the following needs to be submitted:

- Results and analysis of results of testing of the existing pavement

- Description of method for pavement dimensioning
- Justification of the method selection
- Pavement structure details

As part of the book 5.1, it is mandatory to submit :

- Analysis of the existing condition and report on detailed review of the structure and of investigation works;
- Textual documentation of the bridge rehabilitation design (technical report, technical conditions for construction/specifications, BoQ, description of technology of the implementation of the works, static calculation-numeric control of the bearing capacity of the existing bridge structure and the required calculations for all new elements of the span and supporting bridge structure, conclusion on the bearing capacity, durability and usability of the bridge structure) .
- Graphic documents – disposition of the existing condition of the bridge (layout, bridge basis, appearance of the bridge, characteristic cross section of the bridge, longitudinal cross sections, cross sections, foundation basis).
- Graphical documents – layout of the existing structure showing the damages, defects and elements on which the works are carried out with a description of the bridge rehabilitation works;
- Graphical documentation of the bridge rehabilitation design (layout plan, the base of the bridge, the appearance of the bridge, characteristic cross-sections, longitudinal section, cross-sections, details of the elements on which the works are carried out, and what is new in comparison to the current condition, details of rehabilitation, reinforcement details and reinforcement extracts, material specification)
- Design for regulation of the watercourse in the zone of the bridge;
- Programme of bridge testing by trial overload.

As part of the book 5.2, it is mandatory to submit:

- Analysis of the existing condition
- Report on detailed inspection of the structure
- Textual and graphical documentation of the rehabilitation design

As part of the Volume 6, it is mandatory to submit:

- description of problems,
- limitations
- description of the proposed solution
- technical calculations
- expected effects
- detailed working drawings

As part of the Volume 7, in addition to other documents, the following needs to be submitted:

- Analysis of traffic accidents on the observed road
- RSA
- Analysis of feasibility for proposed measures (economic assessment of feasibility of certain measures, i.e. measures in general).

As part of the Volume 8, in addition to other documents, the following needs to be submitted:

- basic assumptions, source of data and justification
- description of applied methodology and justification for selection
- traffic analysis
- analysis of the basic option
- analysis of the heavy maintenance option
- analysis of economic indicators and sensitivity analyses
- conclusions and recommendations.

As part of the Volume 9, it is mandatory to submit traffic calculations and analyses.

## 4.2 PROCESSING AND SUBMISSION OF TECHNICAL DOCUMENTATION

Detailed design of heavy maintenance, verified by the Technical control (technical documentation) shall be prepared, bounded and submitted to the Client in hard and soft copies and shall contain relevant textual, graphical and numerical attachments.

Technical documentation shall be prepared in Serbian and in English.

Technical documentation shall be delivered to the Client in **6 (six) copies** with the cover letter which in addition to basic data on the design and Designer, shall include identification of the contract. Copy implies printed version of design and e-form on a CD of appropriate capacity.

While processing the technical documents, the following shall be respected:

- e-form of technical documents shall cover all source files (unprotected e-documents in form of program used for preparation and processing) and unprotected pdf form. Both e-forms shall be identical;
- e-form of technical documents shall be fully compliant with the printed copy;
- text of technical documents shall be written by UNICODE font. No YUTTF fonts are allowed;
- document processing (text, graphics, vector, grids) shall imply use of generally accepted and available commercial programs (such as applications from package MS Office, Auto CAD etc.). Forms of these documents shall be compatible with older versions of those programs;
- if the Designer, for processing of documents, uses non-standard programs which are not available to the Client, the Designer shall, with previous agreement with the Client, convert all documents to formats available to the Client before final processing of technical documents;
- e-documents are titled in accordance with contents of the design, logically and in full title or associatively if use of the full title requires the usage of big number of characters. Title of the documents shall be in Latin letters. Title shall not include special characters and letters characteristic for Serbian letters. It is not allowed to specify the file title in Cyrillic;
- documents including contents in English shall bear the title in English, while documents containing contents in Serbian shall bear the titles in Serbian. Bilingual documents shall have a Serbian title with a unique postfix mark SE to indicate bilingual form;
- cover of a CD that contains e-documents shall bear the name of Designer, title of technical documentation and date, where the date represents the month of verification of design by technical control. Text on the cover shall be printed

electronically. Also, the disc shall bear legible name of technical documents and Designer;

- textual parts of design shall be processed, printed and packed in hard covers in A4 format;
- graphical attachments shall be processed and printed in appropriate format A1/A3 and bound in A4 format;
- printed copies shall be bound in hard covers, verified and sealed in accordance with valid regulations

It shall be considered that the Designer has not complied with contracted obligations and become entitled to payment in accordance with the contract conditions as long as the Designer does not completely meet the above stated requirements.

### 4.3 STANDARD DOCUMENT NUMBERING AND CODING

All e-form documents (mails, project documents, project files, etc) shall start according to sequence: **IIA147SPVP - 0 - AA - AAA - NN –Title** where (**IIA147SPVP – 0** stands for identification of the project and should remain unchanged, **AA** stands for Document Type, **AAA** stands for Originator code, **NN** for Version Number – Version Numbers starts at 01 and Title with maximum of three words).

#### Type of Document (AA)

<i>DOC CODE</i>	<i>DESCRIPTION</i>	<i>DOC CODE</i>	<i>DESCRIPTION</i>
BG	GUARANTEES	MM	MINUTES OF MEETING
CM	CLAIMS	OT	ANY OTHER DOCUMENTS
DG	DRAWINGS, IMAGES, SKETCH, VIDEOS ETC.	RM	MONTHLY REPORT
IP	INVOICES AND PAYMENTS	RP	REPORTS
LD	LEGAL DOCUMENTS, (PERMITS, AND CERTIFICATION, CV'S ETC.)	RQ	REQUESTS, ORDERS, INQUIRIES, ISSUES, APPROVALS ETC.

#### Originator code (AAA)

<i>ORIGIN CODE</i>	<i>DESCRIPTION</i>	<i>ORIGIN CODE</i>	<i>DESCRIPTION</i>
ARP	Technical assistance to Project Implementation Team	PIT	Public Enterprise "Roads of Serbia"
EBR	European Bank for Reconstruction and Development	RSA	Road Safety Audit
EIB	European Investment Bank	TCD	Technical Control
IBR	International Bank for Reconstruction and Development		Designer for this Contract (shall be defined on the initial meeting)

## 5. CONTROL OF PREPARATION OF DESIGN FOR HEAVY ROAD MAINTENANCE

Preparation of detailed design for heavy maintenance shall be continually monitored and controlled by the Client through its appointed representative.

Detailed design for heavy maintenance shall be subject to the following external controls:

- RSA,
- Design control on behalf of the international financing institutions, and
- Technical control.

### RSA:

- Design shall be subject to RSA. The RSA shall be implemented after preparation of the detailed design and before the final technical control;
- Client shall notify the Designer who has been appointed as Road Safety Auditor. The Designer is in obligation to cooperate with RSA;
- Designer shall review the audit report and shall provide a justified opinion about all conclusions of the audit;
- Client gives the order to the Designer to act in regards to the requirements from findings of the audit and in regards to their inclusion into technical documentation;
- Designer does not have right for compensation of the costs of work on modifications and amendments of the technical documentation that arise from findings of RSA and it shall be considered that all work based on this ground was included into the contract price.

### Design review on behalf of the international financing institutions:

- Detailed design for heavy maintenance may be subject of review and analyses of expert services/staff of the international financing institutions, which finance the Project described under the Section 1.
- Designer shall, with the Client's coordination, cooperate with representatives of international financing institutions, and with the Client's consent shall act in accordance with suggestions and requests resulting from such review.
- Designer is not entitled to compensation of work costs resulting from requests of international financing institutions and it shall be considered that all work on modifications and amendments of design based on this reason has been included in the contract price.

In accordance with the law, the detailed design for heavy maintenance shall be subject of Technical control. Since the Technical control will be also performed during preparation of the detailed design, the Designer shall be responsible to provide to the Consultant appointed for Technical control on his/her demand with all necessary data, bases, information and justifications. Client shall inform the Designer on the appointed Consultant for Technical control.

Technical documents which include incorporated agreed measures resulting from the RSA, shall be also subject to (final) technical control of design. Final Report of technical control shall be a part of the Volume 1, Book 1.1.

Designer shall not be entitled to any compensation for costs of work resulting from findings of the Technical control and it shall be regarded that all work on modifications and amendments of design based on this reason has been included in the contract price.

## 6. TIME AND DYNAMICS FOR PERFORMING SERVICES, WORK PLAN

Time for performance of the Service: Time for performance of the Service and duration of the Contract is stipulated by the GCC and SCC Clauses 13.1 and 14.1.

Schedule of performance of the Services represents a mandatory part of Work Plan presented as part of the Proposal, initial Work Plan and updated Work Plans and shall include time for submission of all reports specified under Section 7 of this ToR, as well as the following activities:

- Mobilization, preparation of appointment decisions for members of key and non-key staff, preparation of initial and updated work plans;
- Performance of continuous 7-day traffic counting;
- Examination of available archive documents, obtaining of conditions and consents and necessary documents from the relevant institutions;
- Geodetic, geo-technical and other field surveys in accordance with this ToR;
- Preparation of preliminary design solution which includes:
  - analysis of the existing condition of the road section
  - layout plan on cadastral base and characteristic solutions from construction design
  - design solution of pavement design
  - selection of measures for improvement of traffic safety and comparison of the selected measures and conclusions from traffic safety analysis
  - selection of measures for improvement of needs of the local community and comparison of the selected measures and conclusions from social aspect analysis
  - selection of environmental protection measures and supporting Monitoring Plan
  - description of technology of works execution for key items, items that can impact method or dynamics of works execution and specific items (for example appliance of technology or equipment that is new on our market)

Preliminary design has minimum of textual, graphical and numerical annexes which define the design solutions of a roadbed and road profile by characteristic lines with the possibility of verification of satisfaction of the basic criteria arising from various aspects, also the proposed solutions to specific problems at the micro locations along the route, if there is any.

- Delivery of draft EMP to the Client for control;
- Public presentation of the preliminary design solution and EMP to the local community, upon approval of the Client and financiers;
- Preparation of the complete technical documentation in accordance with requirements of this ToR and submission for Road Safety Audit<sup>8</sup>;
- Modification/amendment of the technical documentation based on the Client's order in accordance with the findings of the RSA;
- Preparation of version of the technical documentation ready for final review of the technical control which represents complete technical documentation prepared fully in

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<sup>8</sup> Prior submission of the technical documents to the traffic safety Audit, the Designer must obtain a Certificate on the adequacy and completeness of the technical documents from the Technical control together with a statement that all remarks given by the technical control are corrected.

accordance with requirements of the ToR and submission to the technical control for final review;

- Correction of the remarks by the Technical control;
- Submission of the complete technical documentation to the Client verified by the technical control to the Client.
- Submission of technical documentation to the relevant Ministry for the purpose of issuance of the Certificate of acceptance..

Work Plan shall include:

- Textual part where the Designer presents a description of the following: manner in which he/she intends to perform the assignment, method to be used and key activities that the Designer intends to implement during performance of the Service. This part shall be prepared by the Designer in a free form;
- Organizational chart of the team to be engaged on performance of the Service. The chart shall be prepared in form of an appropriate diagram and shall cover all members of the Designer's team, including key and other staff;
- Schedule for performance of the Service (Time chart of Activities): Designer shall provide the time chart of activities in form of an appropriate linear or net diagram. The diagram shall present all key and other activities and must clearly indicate the critical time path of activities;
- Plan for engagement of staff, including key and other staff intended for realization of the Service. Designer shall provide a plan of key staff engagement as well as the plan of engagement of other staff in appropriate forms. Designer shall provide the requested data for key staff and non-key staff. While preparing the plan for engagement of the staff, the Designer shall plan engagement of key staff during whole time of the Service, while for the other staff, the engagement shall be for the time needed for completion of particular assignment for which the engagement of particular staff is planned.

Designer submits for the Client's approval the initial and updated Work Plans for performing the Service within the schedule and in a manner stated by the GCC and SCC Clause 26.

## **7. REPORTING REQUIREMENTS**

Reports requested from the Designer under this section represent base for monitoring the quality and dynamics of performance under the Service, as well as base for payment according to the GCC and SCC Clause 42.2

Designer is obliged to specify dates of delivery of all requested reports under the dynamics for performance of the Service, which is a constituting part of the Work Plan.

Requested reports are the following:

1. Report on a 7-day continuous control traffic counting not later than 30 calendar days from the commencement of the Services
2. Report on collected opinions and conditions of all relevant institutions not later than 65 calendar days from the commencement of the Services
3. Report on completed geodetic Work, not later than 50 calendar days from the commencement of the Services

4. Report on completed engineering, geologic, geo-technical and other field investigations and laboratory testing not later than 50 calendar days from the commencement of the Services
5. Report on preliminary designed solution not later than 100 calendar days from the commencement of the Services
6. Report on completed presentation of the preliminary design solution to local community not later than 125 calendar days from the commencement of the Services
7. Extract from EMP – Environmental Mitigation Plan Environmental Monitoring Plan not later than 95 calendar days from the commencement of the Services
8. Report from the public presentation of the EMP not later than 125 calendar days from the commencement of the Services
9. Report on delivery of technical documents to RSA not later than 14 calendar days from the report of the Technical Control on completeness and adequacy of design documents and not later than 180 calendar days from the date of commencement of the Services
10. Report on measures included in designed solution based on the RSA report not later than 14 calendar days from the date of RSA report receipt
11. Report on corrections of technical documents made according to remarks of technical control and consents obtained, if they are requested, not later than 7 calendar days from receipt of remarks.

In addition to the stated obligations, the Designer shall prepare and provide the Client with monthly reports, which will be delivered by the 5<sup>th</sup> of the following month. Monthly reports shall include, in addition to the updated Work Plan, the statements on progress (in general and according to main activities), possible problems and proposals for their resolving and other events important for realization of the Service.

Minimum scope and content of the requested reports is defined in the text below of this Section.

#### Report on a 7-day control traffic counting

Designer is obliged to perform continuous 7-day traffic counting as stated in the Section 3.2.1 of this ToR, based on which, in accordance with the recognized methodology, it would be required to calculate the AADT. The report shall present the obtained results and shall contain a comparison of those results and results taken from the publication "Traffic counting on roads of the Republic of Serbia" for 2011, 2012, 2013, 2014 and 2015. In case of significant discrepancies, the Designer shall provide a proposal for selection of data source.

#### Report on collected opinions and conditions of all relevant institutions

During field surveys and investigations and prior to preparation of preliminary version of design, the Designer is obliged to collect all necessary opinions and/or conditions of all relevant institutions and present them to the Client as part of this report.

#### Report on completed geodetic work

In accordance with requirements of the Section 3.2.2, the Designer shall prepare and submit to the Client a report on completed geodetic surveying. The report shall include:

- List of points of placed operational polygon;
- Verification of operational polygon by the Republic Geodetic Authority;

- Verified cadastral base maps verified by the Republic Geodetic Authority, i.e. its local branch office;
- Photos of points of operational polygon;
- Copy of a cadastral plan with data needed for marking the boundaries of road side area.

#### Report on completed engineering, geological, geo-technical and other field surveys and laboratory testing

Designer shall prepare and provide the Client with a report on completed engineering, geological and geo-technical surveys fully in accordance with requirements from the Items 3.2.3 and 3.2.4 of this ToR. The report shall include the following:

- Approved plan of surveys with graphical presentation of surveying work on a layout;
- Graphical and numerical presentation of results of engineering, geological and geo-technical surveys;
- Hydro-technical and hydrological surveys, if these are requested by conditions of relevant water management company;
- Results of testing the pavement bearing capacity by measuring deflections;
- Photo documentation from field surveys;
- Results of laboratory testing;
- Analysis of data and conclusions.

#### Report on preliminary design solution

In accordance with Section 6 of this ToR, preliminary design solution includes fully completed technical documentation, which was previously approved by the Client by acceptance of the preliminary designed solution. This report must include description of the considered and explanation of the selected technical solutions, with special emphasis on the treatment of the contents beside the road, selection of measures for improvement of traffic safety, as well as other important aspects stated within the Item 3.2.7 of this ToR. Purpose of this report, together with preparation of the preliminary design solution is, inter alia, the creation of substantiated baseline for the presentation of the design to the local community.

#### The report on completed presentation of design to the local community

In accordance with the Item 3.2.7 of this ToR, and in relation to obligations stated by already prepared document (Resettlement Policy Framework - RPF), the Designer shall organize public presentation of preliminary design solution and shall collect all comments of present parties, note them down, consider them and make the conclusions which shall be included in the Report. The report shall include the following:

- General information on presentation (date, place, time, number and structure of present parties etc.)
- Photo documentation
- Received comments
- Analysis of the comments
- General conclusions on social impacts of the design on the local community.

#### Environmental Mitigation Plan and Environmental Monitoring Plan

Designer is obliged to prepare and deliver to the Client for approval extract for EMP, i.e. Environmental Mitigation Plan and Environmental Monitoring Plan for the designed solution. Within the report, particular attention shall be paid to elaboration of the conditions and locations for structural debris.

#### Report on public presentation of EMP

In accordance with Item 3.2.6 of this ToR, the Designer shall organize public presentation of the EMP and collect all comments of the attendees, record them, consider them and show the conclusions within the Report. Report from public presentation shall include the following:

- General data on presentation (date, location, time, number and structure of the attendees etc.)
- Photo documentation
- Received comments
- Analysis of the comments
- General conclusions on Design's impact on environment and local community.

#### Report on delivery of technical documentation to the RSA

This report, as base for payment, shall include the following:

- Statement that the design is ready for the RSA;
- Confirmation issued by technical control on completeness and adequacy of technical documentation;
- Full contents of technical documentation and other documents being delivered to the RSA;
- An excerpt from the report on analysis on traffic safety, where dangerous or potentially dangerous locations on the section are identified, description of applied designed solutions to reduce/eliminate the road impact on potential outcomes of traffic accidents and measures by which the Designer improved traffic safety conditions with special consideration of vulnerable traffic participants is provided.

The report is prepared in an appropriate form (text, graphics, tables).

#### Report on measures included in designed solution based on the RSA Report

In addition to the list of measures from the RSA Report, this report shall include the Designer's justified opinion about all findings of the audit and the Client's instructions about incorporation of the particular audit's findings in the technical documents, as specified under the Section 5 of the ToR, as well as description of a manner in which the Designer included the accepted measures in his/her designed solution.

#### Report on performed corrections of technical documentation according to remarks of the technical control and collected consents, if requested

Designer is obliged to comply with remarks of the performer of the technical control in reference to technical documentation, which is subject of the final technical control, if such remarks exist. For every particular remark of technical control, the said report shall include a statement from the request for correction, as well as description of manner in which the remark was corrected with appropriate justification.

All reports that are conditions for payment shall be prepared in Serbian and in English.

## **8. DESIGNER'S STAFF**

Designer is required to engage Key staff for the implementation of the services. The minimum requirements for Key staff are defined in this Request for Proposal Section 2. Instructions to Consultants, Data Sheet article 15.1.1.

Designer shall specify in its Proposal key staff to be engaged in case of the contract award, requested references in accordance with the conditions of the Request for Proposal.

Key staff specified in the Proposal cannot be replaced, except in cases and under conditions clearly stated in General and Particular conditions of the contract.

In addition to key staff, the Designer shall engage sufficient number of other staff of necessary expertise. A list of other staff engaged on the contract with description of assignments and responsibilities with periods of engagement shall be a composing element of the Work Plan.