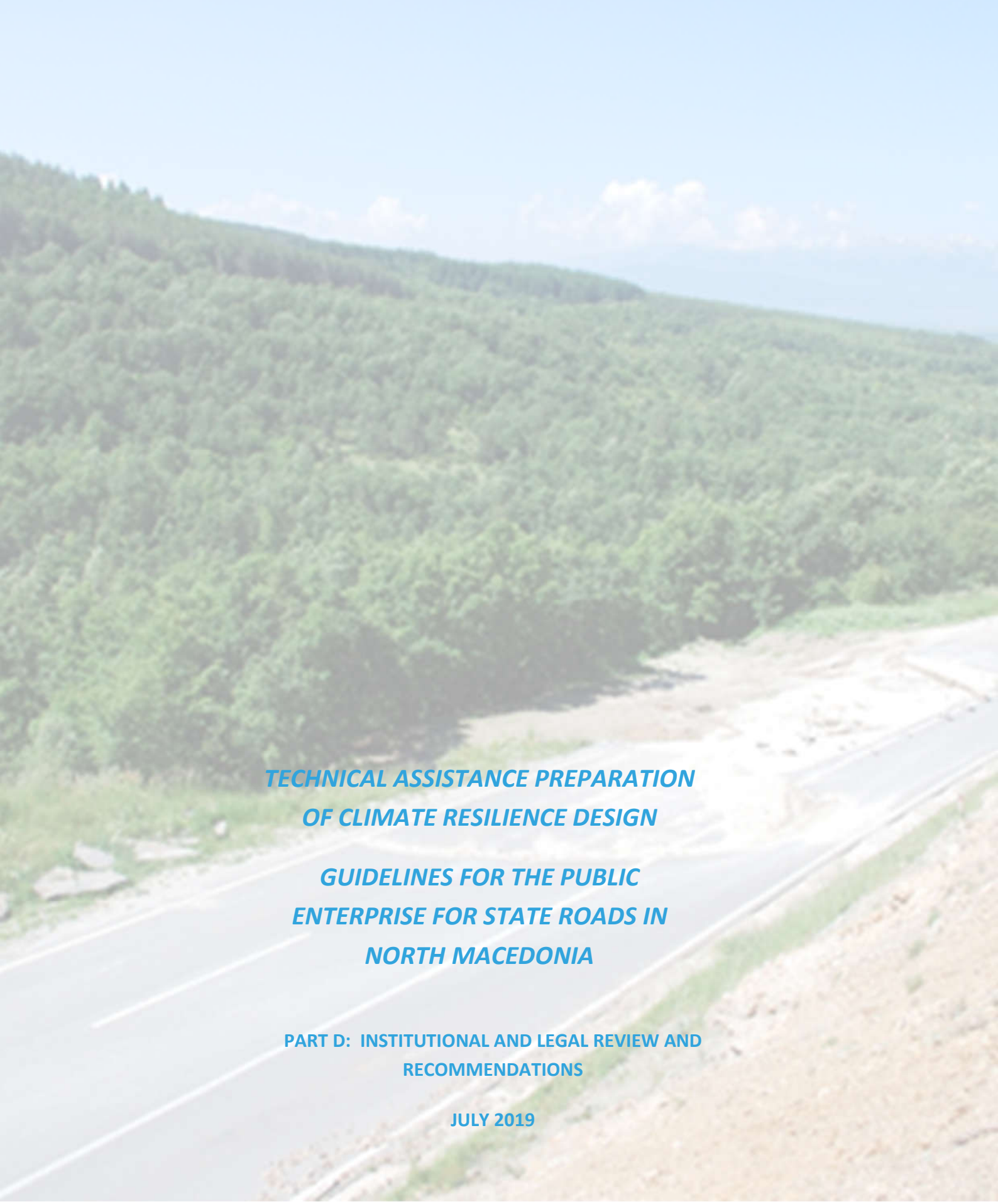

# TECHNICAL ASSISTANCE PREPARATION OF CLIMATE RESILIENCE DESIGN

# GUIDELINES FOR THE PUBLIC ENTERPRISE FOR STATE ROADS IN NORTH MACEDONIA

## PART D: INSTITUTIONAL AND LEGAL REVIEW AND RECOMMENDATIONS

JULY 2019

Client : Republic of North Macedonia – Public Enterprise for State Roads Project financed by the World Bank

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# 1 INTRODUCTION

## 1.1 THIS DOCUMENT

This document summarises the findings of the institutional and legal reviews of the road sector in North Macedonia, particularly with respect to the development of processes and procedures to strengthen the consideration of climate change resilience in the planning, operation and management of PESR's road network.

Section 2 of this document begins by assessing the current situation with regard to asset management and the incorporation of climate change mitigation in road sector management. A series of recommended interventions are then proposed in Section 3, including both institutional changes and non-engineering measures.

Section 4 then summarises the review of the current legal situation. Section 5 provides a summary of key conclusions and recommendations for changes to PESR's legal environment, to aid emergency response and assist in the planning of climate resilience interventions.

# 2 CLIMATE CHANGE AND ASSET MANAGEMENT IN NORTH MACEDONIA

## 2.1 METHODOLOGY

Climate and climate change impacts, ageing infrastructure, and an increase in transport volumes requires improved road construction and maintenance in the Republic of North Macedonia. The traditional way of doing business does little to preserve the value of road network assets. As the costs of operating, repairing or constructing roads is increasing and – at the same time – available funding is decreasing, it has become more challenging for governments to meet the demands of an ageing infrastructure and public expectations especially in climate-challenged regions. Additionally in North Macedonia the ongoing expansion of the road network to provide regional connectivity is increasing the future maintenance burden. The aim is therefore to provide better value for less money. There is also a strong demand for transparency and accountability from road operators, requiring justification for their decisions with responsibility being taken for the results.

To improve existing overall maintenance practice and readiness for climate change impacts PESR should consider adoption of the framework which groups operations and maintenance activities into four sections, as given below:

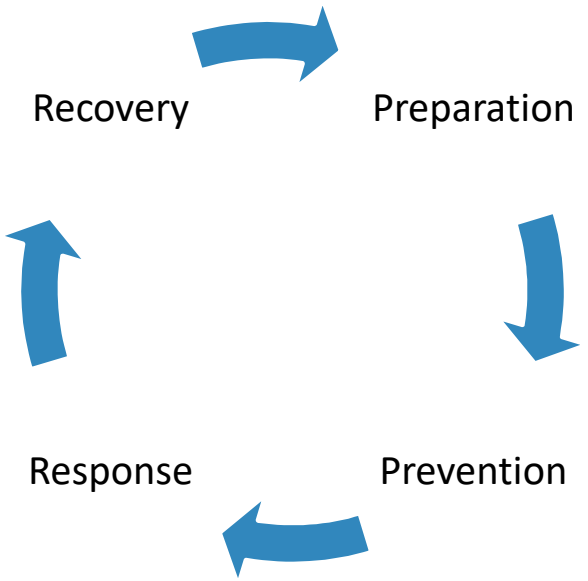



**Figure 1 Operations and maintenance framework**

**Preparation** consists of all activities which improve overall system capacity and capabilities. It is focused on the organisational perspective of climate resilience management in the road sub-sector. The preparation phase includes more strategic and tactical actions like sound planning of asset management activities and the split of roles and responsibilities in the sector's organisations.

**Prevention** concentrates on more operational processes, resulting from the preparation phase. In this phase actions are focused on how to:

- Plan an appropriate maintenance strategy which becomes more proactive instead of reactive

- Specify and collect the data needed to support maintenance planning and how to incorporate them to the IT systems
- Define outputs and outcomes for routine maintenance and operations.

**Response** focuses on emergency maintenance, so how to organise the processes of reaction if disruption occurs and of **recovery** of minimum level of service.

To adopt this framework, current PESR management practices should be compared with the holistic Asset Management approach, the international standard of the business model for a modern road agency. This approach increases the efficiency of asset-intensive organisations, aligning the organisation's operational processes to its strategic goals and objectives.

Therefore, because resilience to climate change has become a strategic objective of PESR, we have used the methodology for assessing the maturity of asset management (described below) to select maintenance practices and processes which need improvements.

In international experience there are a number of frameworks to implement the Asset Management approach based on ISO 55000 et al standards. The ISO conceptual model became the basis for the approach adopted by the Conference of European Road Directors within their studies concerning road asset management. Building upon existing knowledge, CEDR's Task Group report[1] on Asset Management identified 5 main domains which they considered as embracing the implementation of asset management:

- Asset Knowledge and Information,
- Strategy and planning,
- People and PESR,
- Suppliers and stakeholders (including market approach and procurement strategies),
- Risk management

## 2.2 DESCRIPTION OF THE 5 DOMAINS

**Domain 1: Asset information and knowledge**

The basis of asset management is data and information about the assets that are managed. Assets should grouped in the following categories:

- Pavements
- Structures (i.e. bridges, tunnels)
- Road equipment (i.e. safety barriers, drainage, road signs and markings)

For pavements the condition data mostly consists of surface characteristics like skid resistance, roughness, rutting, surface distress (i.e. cracking or potholes), bearing capacity or retro-reflectivity of road signs or road markings.

PESR already has a comprehensive road asset management database, which incorporates all of the pavement and resilience information required.

**Domain 2: Strategy and planning**

[1] CEDR technical report 2017/06 – Asset Management TG Final Report 2017

This domain is related to the long-term approach of the organisation and includes a set of strategic statements that describe:

- the current status and objectives for the assets, asset management activities and capabilities
- the current and future levels of service the organisation aims to deliver
- the criticality, risk, prioritisation and decision making criteria.

The key point of this domain is the definition of the Levels of Service. These are a basis for setting the strategy and the plans at different time horizons. It is also focused on the selection of appropriate maintenance strategies.

**Domain 3: People and organisation**

This domain includes aspects of leadership, organisational culture and competence management, which have a great impact on the extent to which the Asset Management approach is adopted and implemented. There is already string commitment to the principles of asset management within PESR, evidenced by the investment in new and improved tools and processes.

**Domain 4: Suppliers and stakeholders**

Stakeholders are understood as persons or organisations that can affect, be affected by or perceive themselves to be affected by a decision or activity of the PESR. Thus the list of stakeholders and customers will consists not only the road users or the government (ministries) but also people living nearby the road network, people whose safety during climate-related events depends on the road sub-sector capacity and capabilities or PESR's activities and moreover supply chain and contractors.

According to the CEDR's methodology the key points of this domain are:

- Procurement strategy and performance of suppliers (relations with suppliers)
- Setting funds for asset management (relations with ministries, government)
- Communication with customers (i.e. collection of customer needs, comments, feedback or information about disruption to traffic)

**Domain 5: Risk management**

Risk assessment is considered as the engine of the asset management. CEDR's methodology emphasises the inclusion of risk considerations throughout all stages of the asset's life cycle. This considers certainly the climate-related risks.

## 2.3 ASSET MANAGEMENT MATURITY ASSESSMENT

The first step in implementation of Asset Management is to carry out gap analysis, which forms the starting point for incremental plan of improvements. The gap analysis should differentiate four levels of maturity, as given in CEDR's methodology:

- 1 - Initial – the road agency has not recognized the need for this requirement of if it has recognized it but there is no evidence of intent to progress it
- 2 - Basic – the agency has identified the way to achieve the requirements and can demonstrate some progress in achieving them. Procedures however may not be clear set out or repeatable.
- 3 - Competent – no formal ISO system applied but the agency can demonstrate that it achieves relevant requirements set out in ISO 55 001 in a systematic and consistent way

- 4 - Excellence – the agency has deployed and can demonstrate that it achieves all requirements set out in ISO 55 001, exceeds some of them and that is systematically looking for optimizations in its Asset Management practice, maximizing value from its assets.

## ASSET KNOWLEDGE

This domain intends to investigate the completeness, accuracy and up-to-date level of the inventory, the type and number of assets being registered, the integration and systematisation of the processes within the PESR, and the alignment of this domain with the agency's strategy.

In terms of data collection, PESR is in the process of developing a strategy for asset information and has identified the means to achieve it. It can demonstrate progress in the definition of an asset information strategy. However its processes are not well integrated, with limited consistency and coordination. PESR should currently focus on the collection of more data and information which are required for key decisions in the field of climate impact adaptation.

PESR is still working on its standards for data collection and registration. Moreover, it should take into consideration the need for, and the means for defining the quality and accuracy required for all asset information. Current status is presented in the figure 2 below.

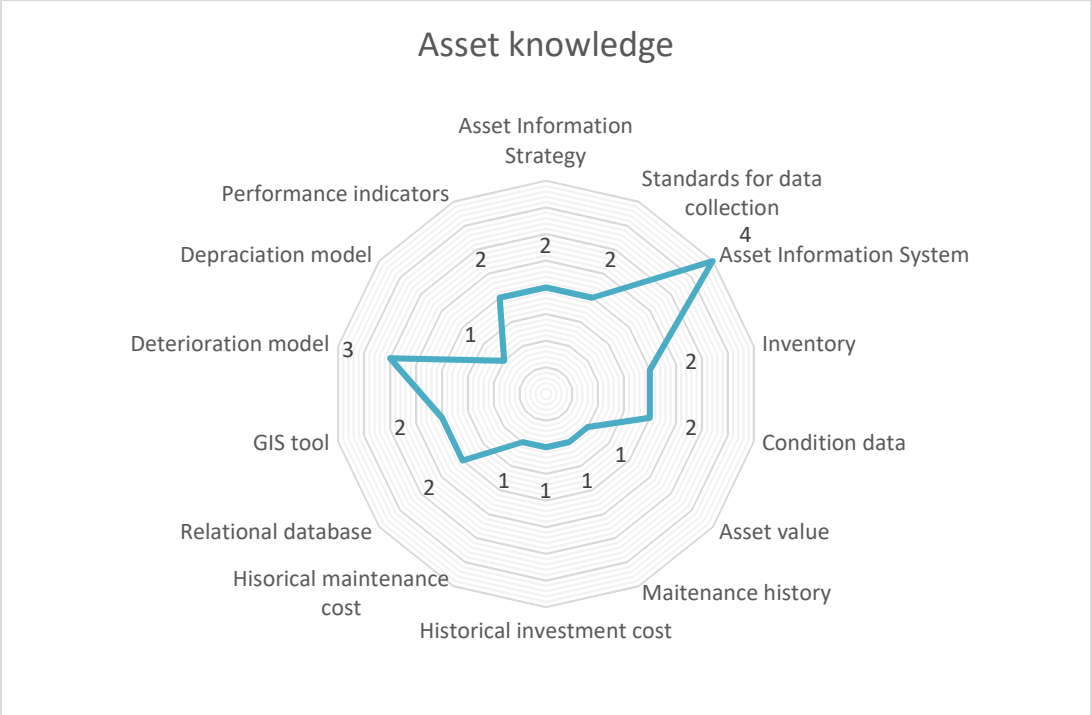



**Figure 2 - Spider Evaluation Chart – Asset knowledge**

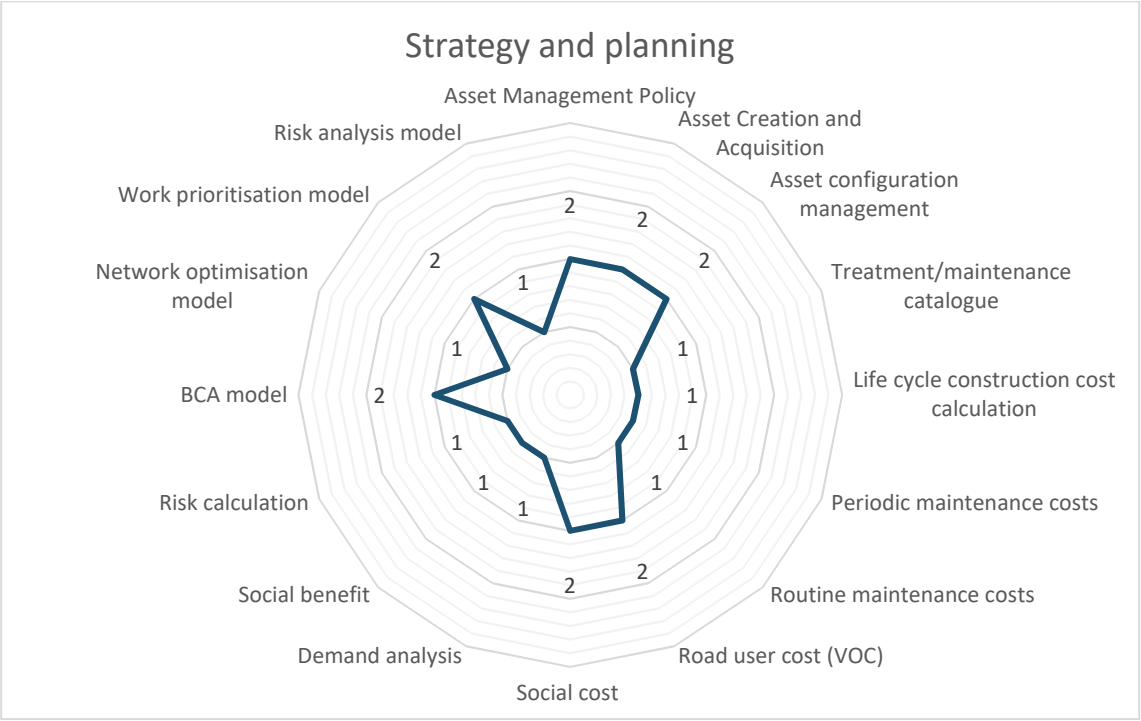
The strongest element within PESR is the recent implementation of RAMS and the current works on embedding this system within the organisation. The existing system has a pavement deterioration model implemented, giving PESR the basic capacity to foresee its needs in terms of maintenance and rehabilitation. What still needs to be improved is the completeness of the asset inventory. PESR is aware of this and has already started works toward a bridge management system.

As for now PESR also collects condition data for critical assets. However some work has to be done to enhance the existing system with climate impact related data. Detailed information are provided in the Section 2.2.2 Climate related data and RAMS.

## STRATEGY AND PLANNING

This sections aims to explore the level of development, application and documentation of strategies and policies. It investigates as well the existence of a methodology and the necessary tools to materialize the asset management strategy and the way of life cycle costs calculations and how they are followed consistently across the agency.

PESR has identified the need to develop an Asset Management policy and can demonstrate that it is being progressed with a credible and resourced plan. What requires more focus is the integration of life cycle and associated risks – especially climate-related – to the process of assets' construction and procurement. It is recommended also to prepare a maintenance catalogue to define the specifications, schedules and execution procedures of maintenance activities for all assets. Detailed information are given in the section 2.2.1. and 2.2.3. Current status is presented in the figure 3 below.




1 **Figure 3 - Spider Evaluation Chart – Strategy and planning**

PESR should consider improvement of demand analysis through the implementation of a traffic model. This will improve decision making processes and will enable a focus on the most important routes from the customer perspective, not only based on current results but also on forecasts of traffic volumes and loading.

What definitely needs to be supplemented in the existing Asset Management System are levels of services. The best starting point will be the establishment of the technical levels of service for maintenance contractors, which will improve the asset's protection against climate impact and extreme weather events causing floods and landslides (as defined in the section 2.2.3)

## PEOPLE AND PESR

This domain has been organized in two sub areas. The first, related to the PESR, evaluates the awareness of Asset Management and the formal frameworks across the PESR, the engagement at all levels and alignment of strategic goals with PESRal objectives. The second deals with resource and competence management, and investigates the recruitment, training, competence and individual development strategies.

From an PESRal perspective, PESR is aware of the existence of a formal Asset Management framework but as for now does not have a profound knowledge of it.

The PESR has a competent staff which understand the strategic goals and objectives of the PESR in terms of climate resilience. The feedback from the workshop emphasised the need for more extensive knowledge dissemination of the tools and processes for both CVRA and climate impact resilience initiatives within PESR. It is accepted that there is a shortage of the specialist skills required to complete all aspects of a CVRA. It has been highlighted by the PESR, that capacity and capabilities of Makedonija PAT may require focus and additional efforts. Current status is presented in the figure 4 below.


**Figure 4 - Spider Evaluation Chart – People and Organisations**

## SUPPLIERS AND STAKEHOLDERS (INCLUDING MARKET APPROACH AND PROCUREMENT STRATEGIES)

This domain explores the procurement strategy, the monitoring of suppliers' performance and the level to which supply chain relationships are based on long- term/risk-sharing strategies. It focuses also on stakeholder engagement and the level to which customer feedback is taken into account in the decision making processes.

PESR has defined a procurement strategy that establishes and sets out standardised contracting processes. The PESR should however consider implementation of the more agile framework contracts, to improve emergency maintenance (as depicted in the section 2.3)

There are some limitations for a clear outsourcing strategy, especially as Makedonija Pat exists as default maintenance contractor, albeit with limited capabilities. It is worth emphasising however that PESR recently awarded two contracts for drainage and culvert cleaning, along two TEN-T corridors. We understand that the scope of these contracts is to, inter alia, improve the overall drainage systems of these corridors. It is proposed to use examples of these contracts as a support for recommendations for further outsourcing policy and supply chain management. Current status is presented in the figure 5 below.


**Figure 5 Spider Evaluation Chart Suppliers and Stakeholders**

## RISK MANAGEMENT

This part investigates the existence of a regular and consistent procedure for managing risks across an assets' lifecycle. In PESR this is the area that requires the most improvement. Implementation of the recommendations from these guidelines, in terms of climate impact resilience, will be a good starting point and will guide PESR towards higher levels of maturity. Current status is presented in the figure 6 below.


**Figure 6 Spider Evaluation Chart Risk Management**

## 2.4 STRATEGIC INITIATIVES

There are many ways to account for climate imapac and climate change and reduce this business risk. In fact, many operations and maintenance adaptation measures will enable PESR preparation for climate change, in contrast to changes to infrastructure design[2].

Incremental steps toward a more comprehensive program that fully considers how to incorporate potential climate impacts will be easier for PESR to manage than an immediate, full-fledged, comprehensive overhaul of their existing implementation plan.

Building from the above presented asset management gap analysis it is proposed to focus on key initiatives to improve the climate resilience of the road network of the Republic of North Macedonia in regard to the proposed framework for maintenance and operations presented in the table 2 below:

| Phase of framework | Types of initiatives |
|---|---|
| Preparation | Asset Management Plan |
| | Road sub-sector capabilities |
| Prevention | Planned maintenance |
| | Climate-related data and RAMS |
| | Routine maintenance and operations |
| Response | Procuring emergency maintenance |
| | Financing emergency maintenance |

Table 1 Types of proposed initiatives for maintenance practice improvements

Incorporating climate impactand climate change considerations into how PESR plans and executes its operations and maintenance programs, would help it to become more resilient to unanticipated shocks to the system. Adjustments to operations and maintenance programs - ranging from minor to major changes - can help to minimise current and future risks to effective maintenance and operations.

Both functions – operation and maintenance – involve day-to-day activities in the use of the road network. Operation functions include traffic management, traffic incident management, traveller information services, traffic signal coordination, work zone management, planned special event management, road weather management, vegetation management or other elements of roads management (e.g. drainage).

Maintenance activities help to preserve and extend the use of transportation infrastructure and aim at carrying out day-to-day protective and repair measures to limit degradation due to natural processes (e.g. climate) or imposed processes (e.g. traffic volumes).

Climate impact and climate change will bring some additional operational influences which may include:

- Increase in traffic incident management activities
- Road or lane closures

[2] Climate Change Adaptation Guide, US Department of Transportation Federal Highway Administration

- Reduced and variable speed limit
- Disruption of transit service
- Road and transit diversions
- Truck restrictions
- Work zone management (to accommodate additional lane closures)

These bring changes to system maintenance and operations practices and strategies, which may consist of:

- Frequency of the inspection
- Frequency of the repairs
- Requirement for "quick maintenance" patrols
- More frequent diversion to more robust alternate routes (if possible).

Without proactive steps to anticipate the above potential changes and respond to them, the ability of PESR to support their core mission could be compromised.

## PREPARATION

Based upon the gap analysis, for better preparation for climate resilience PESR may wish to consider:

- Improvement of existing asset management plan (according to point 2.2 of this chapter)
- Improvement of road sub-sector capabilities, especially maintenance contractors (according to point 2.3 of this chapter)

## ASSET MANAGEMENT PLAN

The generic Asset Management planning process consists of few steps which, according to the international best practice[3], should comprise:

1. **Development of asset inventory** (database of all assets within asset group or service. At minimum it needs to include pavement and bridge assets; inclusion of other physical assets like culverts is recommended). This is ongoing within PESR.
2. **Assessment of performance and failure modes** (to identify maintenance and rehabilitation needs and to monitor state of the assets. Asset performance has three primary components: (a) operating cost, (b) utilization, (c) condition. It should be known to estimate possible failure modes: (a) economic failure, (b) capacity failure, (c) physical and functional failure).
3. **Determination of residual life** (the time until failure; particularly important for high-cost, high-risk, high-consequences assets).
4. **Determination of lifecycle and replacement costs** (LCC: all costs of owning and operating the asset from planning through retirement or replacement; LCC = capital costs + lifetime operating costs + lifetime maintenance costs + disposal costs – residual value).

[3] Asset Management Manual, World Road Association (PIARC), 2017

5. **Determination of future demand for network** (i.e. traffic analysis and stakeholders needs).
6. **Determination of business risk** (identification of critical assets with high cost and/or result in detrimental levels of service and significant consequences if they fail; it may give impact for the focus of investment/maintenance strategy).
7. **Optimisation of operations and maintenance** (setting appropriate levels of services, performance measures and targets; managing toward proactive maintenance; implementation of performance-based approach).
8. **Optimisation of capital investments** (on the basis of data and information collected within steps from 1 to 7 it is possible to evaluate the best operation, maintenance and capital investment strategy, to deliver required levels of service at the best cost and level of risk exposure.
9. **Determination the best funding strategy** (an analysis of the expenditures for the proposed maintenance, operations and capital expenditures required to meet the prescribed levels of service over the planning period. This information then represents the net increase (or decrease) in the cost of service associated with the investment plan).
10. **Financial plan** (must demonstrate the funding required to meet the performance set out in the asset management strategy; the most effective financial plans cover between 5 and 15 years; its main function is to do following: (a) identify the financial resources that will be available in the coming years, (b) select the appropriate maintenance strategy (scenario), (c) determine realistic objectives that can be assigned for the asset management plan). According to best international practice, the process of building the financial plan, is as follows:

    - **Step 1: Determining the cost of proposed works.** The financial plan should be built on the works plans that contain activities the PESR is required to undertake; the works plan should contain the schemes that have been prioritized according to the policy of the PESR at least for upcoming year but it is better to have it for next 3 to 5 years; ideally each asset group should have determined costs of its own work plan.
    - **Step 2: Allocating the funds among program areas.** Advanced PESRs consider prioritizing their assets to ensure that both those assets most in need of funding to meet levels of service and those that may be critical towards the PESR; possible approach to allocate funding among different assets may be based on ensuring the optimum performance rather than the maximum performance.
    - **Step 3: Assessing financial sustainability.** Financial plan should preserve the value of the assets in the PESR's ownership as much as possible; financial plans may be used to make the case to decision makers; the case should present the consequences of underfunding in terms of (a) impact on the transportation network, (b) impact of assets value and performance, (c) economic impact evaluated in terms of the increase of whole-life costs and vehicle operating costs).

The presented generic approach should be complemented by climate-related information to achieve climate resilience of the road network. The resilience of road assets to climate hazards starts by defining the desired Level of Service (LoS) however is not limited to the LoS only. LoS defined parameters characterize the essential service delivery requirements for a particular service, against which performance may be measured.

Criteria for the LOS can relate to availability of the service, quality/condition, quantity, reliability, responsiveness, environmental acceptability and financial implications. Resilience against weather

hazards is usually not expressed directly, but is included in criteria such as availability of service, life cycle performance or environmental acceptability. These criteria can be significantly affected by climate change if appropriate actions are not taken.

Therefore the content of appropriate Asset Management Plan should be supplemented by the climate-related information as follows[4]:

| **Section of Asset Mangement Plan** | ***Introduction*** |
|---|---|
| Generic | The Introduction provides the rationale for developing the plan, goals, and the role that the PESR's assets play in supporting a state's economy, providing necessary services to communities. |
| Climate change supplementation | 1. Explain how PESR assets have been affected by extreme weather related events such as flooding and landslides in the last years.<br><br>2. Describe expected trends on how extreme weather events might change in the future according to the results of this TA. |
| **Section** | ***Inventory and Condition*** |
| Generic part | The Inventory and Conditions section describes the assets the PESR is responsible for, and provides a high level description of the current conditions of the assets. As part of the current condition description plans usually present information on condition or sufficiency ratings, replacement value, and asset age distributions. A list (summary or count) of all assets for which the PESR is responsible:<br><br>▪ Historic data<br><br>▪ Corresponding condition and performance data for those assets (likely to be presented in tabular format, with details in an appendix)<br><br>▪ Summary of how data on the inventory are managed (if not presented elsewhere)<br><br>▪ Summary of how data are used to consider adjustments to the process<br><br>▪ Impact of future growth on asset needs |
| Climate change supplementation | 1. Provide a narrative and visual (e.g. table) describing the frequency, type of extreme weather, and impact of event by asset type in the last three decades. Discuss replacement costs such as labor, equipment, and materials for different types of assets.<br><br>2. Provide information what are the possible impacts of future extreme weather events on the PESR's assets, both in terms of the possible greater intensity of such events or the likelihood |

[4] Integrating Extreme Weather into Transportation Asset Management Plans, AASHTO 2015

| | |
|---|---|
| | of increased asset failures with deteriorating asset conditions in light extreme weather events.<br><br>3. List certain types of assets more vulnerable to extreme weather events than others (e.g., culverts). |
| **Section** | ***Objectives and Measures*** |
| Generic part | This part identifies the measures that will be used to track and manage asset performance. This section highlights the ways that asset management program activities are helping achieve PESR goals and objectives.<br><br>• PESR's objectives and measures, with discussion of the elements that link directly to asset management<br><br>• Program objectives<br><br>• Program measures linked to PESR objectives<br><br>• Asset baseline conditions, reported through performance measures<br><br>• Snapshot of how the PESR hopes the objectives will be met<br><br>• PESR's process for measuring, tracking, reporting and revising the measures |
| Climate change supplementation | 1. Implement objectives concerning cleaning of all culverts and drainage systems on the main network as it has been done for the TEN-T corridors<br><br>2. Implement objectives concerning monitoring systems (e. number of Road Weather Information Systems in each hot spot by the end of 2020)<br><br>3. Implement operational objectives for routine maintenance practices as given in the section concerning routine maintenance and operations<br><br>4. Implement technical targets in line with mixed maintenance strategy |
| **Section** | ***Lifecycle Management*** |
| Generic part | Describes the management of the lifecycle of the PESR's assets<br><br>• Plans for each asset type, or asset sub-group<br><br>• Relationship between lifecycle plans and performance measures<br><br>• Implementation of lifecycle management into the agency's decision making process |
| Climate change supplementation | Describe the maintenance strategy selected for different types of assets: reactive, preventive, predictive, proactive as described above |
| **Section** | ***Risk Management*** |

| | |
|---|---|
| Generic part | Discusses the concept of risk, how it is incorporated and the ways in which the consideration of risk informs maintenance practices, asset replacement or rehabilitation, and emergency response.<br>▪ Agency-wide risk management strategy<br>▪ Risk management process for<br>– Risk-based asset inspections<br>– Risk-based maintenance planning and practices<br>– Emergency response plans<br>▪ Risk management monitoring, reporting and revising<br>▪ Risk register |
| Climate change supplementation | Present climate-related risks as an input from this TA. List engineering and non-engineering measures for climate impact adaptation as given in this report. |
| **Section** | **Financial plan and investment strategies** |
| Generic part | It details available funding for asset-related interventions, and the distribution of funds to date. This is done most often by asset type.<br>▪ Annual funding sources and budget<br>▪ Budgeting cycle and allocation decision process<br>▪ Overall RAMS budget by activity type (e.g. maintenance, rehabilitation, data collection, etc.)<br>▪ RAMS budget by asset type (and possibly sub-asset type) |
| Climate change supplementation | 1. Consider adding buffer in the budget forecast to account for the uncertainty in coming weather conditions. It is estimated that around 15% of the total budget is currently used for the emergency maintenance, in any given year.<br>2. Add scenario analysis of maintenance needs distinguishing funds needs for maintaining (reaching) the expected technical level of the network and the funds required for enhancing resilience |
| **Section** | **Process improvements** |
| Generic part | The section describes the methods used to measure and provide input for<br>improvements to ongoing practice.<br>▪ Process to assess and improve RAMS activities |

| | |
|---|---|
| | ▪ Results of any previous findings and subsequent process adjustments |
| Climate change supplementation | 1. Present already undertaken actions on two TEN-T corridors and its (expected) results.<br>2. Describe the strategy of road sub-sector's capability building. |

**Table 2 Asset management plan climate-related information**

## 2.5 ROAD SUB-SECTOR CAPABILITIES

North Macedonia's National Transport Strategy, which was adopted in 2007, confirmed the need for investments in roads to ensure better communication among the regional centers within the country, as one of the main tools to promote North Macedonia's competitiveness in international markets and to support harmonious development of the country as whole.

The strategy stipulated that investments should focus on the maintenance and preservation of, and repairs to, existing roads and on enhancing the functionality of the existing road network, with a very limited expansion of that network.

This approach is deployed by the road sub-sector PESRs:

- Ministry of Transport and Communications
- Public Enterprise for State Roads
- Maintenance company Makedonija PAT

The Ministry of Transport and Communications oversees roads sector strategic guidance and policy.

As of 2013, management of national and regional roads has been entrusted to the managerially and financially independent Public Enterprise for State Roads (PESR), which is mandated to owner of the national and regional road infrastructure, responsible for planning the construction, reconstruction, maintenance, operation and protection of the state roads, monitoring and analysis of the conditions in relation to the construction, reconstruction, maintenance and protection of the state roads. Local roads are entrusted to municipalities.

National and regional roads receive funding from the state budget; these funds are planned and implemented by the Fund for National and Regional Roads (FNRR). Local roads management are financed by municipalities, which set aside funds within their budgets for this purpose. In addition, on a yearly basis all municipalities receive a transfer from the state budget specifically for the maintenance of local roads.

Public enterprise for maintenance of public roads "Makedonijapat" is responsible for regular and winter maintenance of state roads, construction and installation of vertical and horizontal signalling and protection of roads. Winter maintenance is a priority, including the reparation of the potholes, urgent cleaning of landslides, trimming of the grass (although not regular) or renewal of the horizontal signalling.

Bearing in mind current split of roles and responsibilities, adaptation of maintenance practice to the climate changes requires improvement activities both in maintenance management and planning and also maintenance works execution.

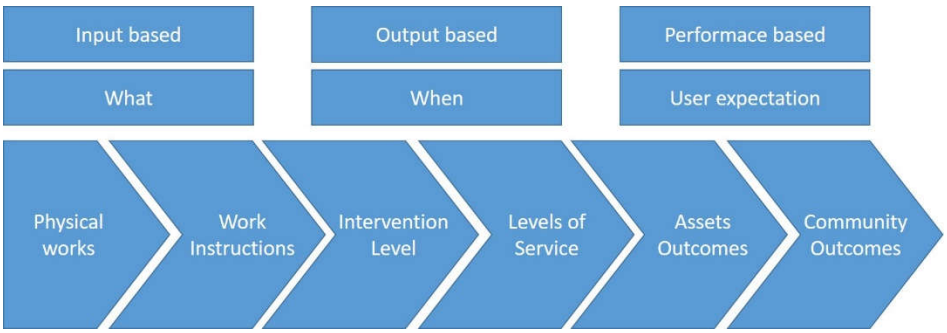
**In terms of maintenance management PESR has appropriate units – road asset management unit, environmental protection unit and road maintenance unit - which should be responsible for implementation of climate change adaptation measures described in the section 2.2 of this chapter**.

For the maintenance works , Makedonija PAT is not sufficient for carrying out the required level of service, but also currently, there are no specific requirements or standards to which routine maintenance company must comply.

**PESR should therefore analyse (on the basis of current pilot project on two TEN-T corridors) the process to replicate the approach for implementing more comprehensive maintenance contracts and to start to build the maintenance service providers market.**

This should be an incremental process which will take into consideration both the private partners capabilities, potential sustainable rePESR of Makedonija PAT, users' needs and economy expectations.

This process may look as presented below:




Designing the market development it is also important to take into consideration the split of risks between customer and contractor.

| | Input | Output | Outcome |
|---|---|---|---|
| Common name | Force Account | Traditional | Performance based |
| Payment | $/input | $/output | Lump sum if performance delivered |
| Sophistication required from contractor | Low | Medium | High |
| Contractors' motivation | As many inputs as possible with no emphasis on efficiency | As many outputs as possible as efficiently as possible; no driver to be effective | As little work as possible to delivered specified level of service. Both efficient and effective |
| Efficiency risk | Customer | Contractor | Contractor |
| Effectiveness risk | Customer | Customer | Contractor |

**Table 3 Risks application**

**Outcome-based contracts are required, not only for routine maintenance improvement and improving preventive measures for climate resilience. They may as well increase capabilities in terms of response efficacy to extreme weather events.**

How to enhance technical standards for routine maintenance is presented in the section 2.2.3 of this chapter and for emergency maintenance in the section 2.3.

**Case study: Poland**

This is responsibility of National Road Authority (General Directorate for National Roads and Motorways equal to PESR) to carry out appropriate actions for preparation for response to emergency

situations.

For many years all actions as a response to emergency situation were undertaken by the employees of Directorate, however in the last 15 years it has changed when they decided to engage more private sector and to split responsibilities between the customer (National Road Authority) and contractors (private sector companies) responsible for maintenance.

It is therefore National Road Authority who procure contracts for maintenance, including emergency maintenance.

National Road Authority in Poland regulated roles and responsibilities for responses to emergency in internal bylaws. One of this documents concerns roles and responsibilities in the structure of road authority (i.e. what is expected from the local, regional and central levels) in different types of emergency situations.

In general legislation there is certainly regulated who and what has to be done in the crisis situation, however during each year there are number of situations which cannot be qualified as crisis situation when special regulations come into force. Occurred emergency situations may disturb regular service delivery or bring threats in terms of safety and security for road users.

In Poland they defined four types of emergency situation where first and second will not be qualified as crisis situation according to general state-wide legislation however it may require non-standard actions of road operator and its supply chain and may escalate in the crisis situation.

1. Green Alert (1st category): disruption will last over three hours; response measures are available for the respective regional branch of the road authority; there is no need to use other branches resources and contractors; communication with headquarters through single point of contact open 24/7.
2. Yellow Alert (2nd category): extreme situation which exceeds the capabilities of one regional branch and its contractors; coordination goes to the headquarters for road authority as support from other regions is required; dedicated “Threat Monitoring Group” starts to work which if situation escalate will become the Crisis Management Team. Communication through single point of contact open 24/7.

To ensure that the private companies will be ready for emergency responses and restoration of even basic services of the road network it was decided to sign long-term maintenance contracts including preparations for emergency response.

According to this type of contracts – which are standardized for all categories of national road network in Poland - the Contractor is obliged to carry out routine and structural maintenance of road(s) for the period of 5 years along its entire length and width.

The Contractor is obliged to ensure roads’ availability and safety for its users and bears full responsibility for the proper condition of the road throughout the duration of the Agreement.

These contracts put also responsibilities on the contractor side in terms of preparation for responses to emergency management and maintenance.

The contractor has to:

- be ready to react immediately and remove the effects of events
- to restore availability on maintained section of the Road or other section indicated by the employer in order to minimize the effects of events and,

- if necessary, to send additional equipment to remove the effects of events (i.e. this may happen when the Yellow Alert is initiated, according to given above regulations).

Moreover road authority can oblige the contractor to delegate certain resources to support local authorities. In that case however the settlement of the cost of these services will take place between the contractor and the local authority.

If the emergency situation occurs this is a responsibility of the contractor to:

1. Secure the spot of the event,
2. Minimize or eliminate the threat.

In general, contractors on daily basis carry out routine maintenance on the road network, however according to this framework contracts they may be asked to provide structural maintenance works like rehabilitation or reconstruction.

The contract foresees the way how the representative of road authority may order additional works from the contractor and how the contractor will calculate the price – based on the measurement of the scope of the works and on the unit rates which are part of his offer during the tender procedure. The contractor is obliged to use this rates for the whole time of the contract (except from annual indexation); the customer is not obliged to use services of this particular contractor for the restoration, but usually it happens especially to restore the basic level of services.

The contractor has to prepare its own measurement in terms of what has to be done and propose a calculation of this works. The local representative of the customer compare this with the contract unit prices and the current unit prices data base and depending on the result of this verification send a request for approval to the regional branch of road authority. In the regional branch it is double checked and goes to the headquarters for final approval.

This process does not requires additional procurement of new contractor but it does not limit the road authority to do so if there is enough time to restore full level of service. This process as well secure the contractor and the customer will not ask this company to restore the full level of service within the remuneration for routine maintenance.

However the approval of the budget for restoration activities has to be done through the headquarters it worth to remember that according to internal regulations mentioned above in the case of emergency situation there is the “Threat Monitoring Group” working 24/7 thus the approval procedure does not last long time. It also minimize the risk of corruption.

**Case Study Scotland**

REMIT AND PRIORITIES

Transport Scotland is responsible for ongoing maintenance work across its network of trunk roads, bridges and other structures. We prioritise repairs and improvements to ensure safe travel and steady movement of traffic.

We have contracts in place with the operating companies BEAR Scotland, Amey and Scotland Transerv to deliver this work.

Their remit includes:

- trunk road and motorway maintenance
- bridge maintenance

- incident management and support
- clearing motorways and certain trunk roads of litter
- lighting the trunk road network
- undertaking an annual road condition survey
- minimising the risk of landslides

A significant proportion of our maintenance work and budget is directed towards the general wear and tear of the trunk road network. Ongoing maintenance work maintains the required structural integrity on all of their trunk roads.

Maintenance schemes are conducted by Transport Scotland's contracted operating companies after their have obtained approval. They assess each scheme based on priority and value for money.

In some cases, maintenance operations may lead to unavoidable delays at road works. They aim to minimise disruption and keep our staff safe by working during less busy periods.

**Road condition surveys**

Their operating companies undergo annual road condition surveys as part of their contract. They ensure that the best value is achieved from our maintenance scheme by analysing the information and condition trends before planning work accordingly.

Transport Scotland use three types of vehicle for surveying.

- The **Deflectograph** measured the strength of road structures, determining the long-term requirements to maintain structural integrity. From this they can determine the useful life of a road and identify areas for strengthening.
- The **SCANNER**, or Surface Condition Assessment for the National NEtwork of Roads, measures and records surface condition and ride quality, pointing Transport Scotland towards the sections that need relayering.
- The **SCRIM**, or Sideways Co-efficient Routine Investigation Machine, helps reduce accident rates by measuring the wet skidding resistance of road surfaces. As a result of these tests, Transport Scotland can target the best skid-resistant materials and further reduce accidents.

DFBO CONTRACTS

In addition to regular maintenance, Transport Scotland operate individual Design, Build, Finance and Operate (DFBO) contracts.

Design-Build-Finance-Operate (DBFO)

A project delivery structure in which:

- The private sector party is awarded a contract to design, construct, finance and operate a capital project. In consideration for performing its obligations under the agreement, the private sector party may be paid by the government agency (for example, availability payments) or from fees collected from the project's end users.
- The government or government-owned entity retains ownership of the project.

Contract link: https://www.transport.gov.scot/media/8126/m8m73m74-motorway-improvements-contract-project-agreement-web-version.pdf

# 2.6 PREVENTION

## PLANNED MAINTENANCE STRATEGY

PESR has implemented in 2018 Road Asset Management System as a supportive tool for the decision making process for planned road network maintenance. The system is currently at its initial phase and training for PESR employees is still required. The aim is to prepare the first plan for road network maintenance using the system by the end of 2019[5].

So far, the planning process has been based on an experience-based selection approach but it will become more data-driven in near future. Currently system consists of asset inventory which is focused on pavements. Other elements of the road network (i.e. culverts, drainage system, landslides) are not incorporated yet, however the PESR plans to enlarge it incrementally. Pavements condition data has been collected in 2015 and has been used for the implementation of the RAMS system. Currently PESR carries out the process of pavements condition assessment to update existing data base.

In terms of condition data, implemented system now consists information that includes:

- roughness (IRI),
- deflection
- bearing capacity

The roughness indicator (IRI) is used by PESR as a technical target for network improvement.

Whilst PESR possess current traffic data, which are used for determination of demand, there is no traffic model which would present the traffic volumes scenarios. It is an important factor for improvement of network resilience and analysis not only of demands but also the consequences of extreme weather events.

Within the process of maintenance management improvement PESR should consider new technical indicators to follow on the road network, i.e.:

- Rutting
- Grid cracks
- Transverse cracks

The technical standards for these factors may be adopted from the COST 354[6] norm as demonstrated in the below table.

| Classification | Rut Depth (mm) – Highways and State Roads | Rut Depth (mm) - Country Roads and Local Roads |
|---|---|---|
| very good | < 4,5 | < 4,9 |
| good | 4,5 to 9,3 | 4,9 to 10,5 |
| acceptable | 9,3 to 14,5 | 10,5 to 17,2 |

[5] According to the information obtained during interviews in PESR.
[6] COST (European Cooperation in Science and Technology); Action 354 Performance Indicators for Road Pavements

| | | |
|---|---|---|
| bad | 14,5 to 20,1 | 17,2 to 25,8 |
| very bad | 20,1 to 26,4 | 25,8 to 46,6 |
| Classification | Cracking of the pavement surface (%) | |
| very good | without cracks | |
| good | < 5 % | |
| acceptable | 5 – 20 % | |
| bad | 20 – 40 % | |
| very bad | > 40 % | |
| Classification | Cracking of the pavement surface (%) | |
| very good | without cracks | |
| good | < 2 % | |
| acceptable | 2 – 10 % | |
| bad | 10 – 20 % | |
| very bad | > 20 % | |

**Table 4 Technical standards COST 354[7] norm**

As a reactive maintenance strategy is not sufficient, it is recommended to adopt a proper mix of reactive, preventive, prognostic and proactive strategies, depending on the types of assets and their actual and forecast deterioration. According to the international best practice "worst-first" approach is the least efficient and effective and exposes the state budget to higher spending in the long term perspective[8]. This will improve network resilience as proactively maintained roads will be less exposed to the risk of deterioration as a result of climate impact. Detailed measures are given in the section 3.

**Preventive strategy** is one of the most effective proactive strategy, the essence is to make interventions within given timeframes or after some period of asset utilization (service life). The preventive strategy however does not rely on sophisticated performance indicators and intervention periods do not have to rely on profound analysis. Maintenance carried out with preventive strategy is not focused on eliminating the sources of failures but will improve the assets service life or functionality. It is however, a good approach for routine maintenance in terms of drainage, culverts or ditches maintenance and cleaning.

**Predictive strategy** follows the deterioration model and forecasts of the anticipated (analysed) technical condition of the asset. Depending on the adopted levels of service this strategy may optimize the direct costs of the infrastructure owner and to minimize the indirect costs (of users, social or environmental costs). Frequently the predictive strategy focuses on the origins of the failure. Thus it limits the risk of damage and increases the asset's functionality.

[7] COST (European Cooperation in Science and Technology); Action 354 Performance Indicators for Road Pavements
[8] Proactive strategy for management of road infrastructure, Adam Zofka, Institute of Roads and Bridges Research, Warsaw 2019

**Proactive strategy,** often referred to as Reliability-Centred Maintenance (RCM) is the most advanced approach for the maintenance planning. It comprises Preventive and Predictive strategy with addition to new elements that incorporate the climate related elements:

- Risk (including climate-related)
- Assets prioritisation
- Functionality scenarios
- Failure scenarios and a robust spectrum of treatments

The current situation in the Republic of North Macedonia gives a good basis for considering the adoption of an appropriate mixture of maintenance strategies. In most countries, there are many kilometres of roads which require rehabilitation (restoration of expected technical standards)[9]. However, the newly built roads should be treated in more proactive way so as to limit their deterioration rates. To achieve this it is possible to split the budget for maintenance to at least three groups:

- Planned maintenance (restoration, rehabilitation of deteriorated assets)
- Planned proactive maintenance (new assets)
- Preventive routine maintenance.

## 2.7 CLIMATE-RELATED DATA AND RAMS

The following steps should be followed to determine what climate-related data should be integrated into the RAMS:

- The first step is to establish what are RAMS key data that the climate risk data is associated with. The main objective of the RAMS is to inform planning and management of road assets. Climate-related data should be chosen depending on the assets included in the RAMS. **Thus, it is critical to make sure the main vulnerable assets are already integrated in the RAMS (bridges, culverts, drainage structures – full list in table 4**), and - if not - then the RAMS has to be completed accordingly with the data related to the identified vulnerable assets
- Once the list of the RAMS vulnerable assets is defined, the second step is to identify and select the climate related data required for assessing the risks and proposing adaptation options

  The third step is to define the data structure in a format easily convertible into a geodatabase for compatibility with RAMS. These considerations about data identification cannot be dissociated from data collection issues. It is not advisable to waste time with data that cannot be collected or can be but with major difficulties, using the CVRA method for exposure of the road to floods and landslides in these Guidelines as well as the field inspections and filed inspection forms provided. . (hazard maps provided based on the CVRA methodology in these Guidelines)

The PESR RAMS system is of high quality and valuable content. However, some room for improvement is identified.

[9] According to the International Road Federation and McKinsey and Company Report "A better road to the future", April 2018. Also according to the World Economic Forum today's global infrastructure demand is estimated at about US$ 4 trillion in annual expenditure with a gap – or missed opportunity – of at least US$ 1 trillion every year.

Firstly, the system is currently not entirely dynamic, so all potentially new collected data (IRI, AADT, etc.) are uploaded sequentially. The current RAMS version covers the data from up to 2015, as the first uploaded epoch, while a more up-to-date insight is required. The PESR has a plan of renewing the data after 3-5 years, but it is advisable to keep the historic records as well, since it is needed the system to facilitate a comparison between this first and some of the subsequent epochs of data.

Another important improvement is the **data inputs of the landslide and flood hot-spot record**. Currently, the operative data are collected in great detail, but usually filed only in paper form, which is available to limited personnel. The information of the location and timing, the type of intervention undertaken and similar important pieces of information are not digitally stored.

**The existing RAMS system, with its existing database architecture, needs to be used as a supporting platform for digital recording of landslide or flood events.** The recording would still be made during the regular field visits and interventions, with no extra field costs, while increasing the effectiveness of the database.

This ideally requires an additional mobile/tablet application linked to the main RAMS database, and suitable for, e.g., android devices/tablets, which can automatically record the location and time of acquisition and store a unique, e.g. point feature in the appropriate vector form (compatible with the database architecture).

All the other relevant data, including photographs and comments can be linked to that unique point directly through the predefined off-line template form, during the field work. Once reconnected again to the internet, the mobile device can directly upload all collected data to the main RAMS database.

This would ensure the integrity of the information and provide support for planning and logistics for preventive measures or post-event interventions.

A similar approach, as a good practice example, is applied in Serbia through the BEWARE project: http://195.222.98.44/beware/?page_id=279&lang=sr.

It is recommended to consider the following data sets for integration into the RAMS:

- Climate and Hazard Data: it will be sufficient to include the hazard maps created using CVRA methodology, directly into GIS environment
- Data on Exposure and Risk: the analogue logic as for climate and hazard data applies for data on exposure and risks
- Physical and Functional Vulnerability Data: it is assumed that road and traffic data are already part of functioning RAMS. It is suggested to extend the databases with additional data on physical and functional vulnerability. Depending on sophistication of assessment this can be arbitrary number of set of characteristics that will be automatically derived into vulnerability index
- Socio-economic criticality: similarly the database on socio-economic criticality should be added to the RAMS. Either as simple number linked to the road asset and fed from external source (e. transport model) or by compiling more comprehensive database that will include all relevant socio-economic data.

Below in table 5, a list of assets, parameters and hazards is presented as a possible improvement of existing RAMS in the Republic of North Macedonia.

**Table 5 Road Assets Related Parameters Recommended for RAMS for Climate Risk Assessment**

| Road Assets | Parameters |
|---|---|
| Major hydraulics | ▪ Main hydraulics features of bridges (catchment area, reference peak flow, design return period)<br>▪ Hydrological characteristics (height-flow relation, IDF curves)<br>▪ Debris flow susceptibility |
| Minor hydraulics | ▪ Culvert characteristics (pipe/box/arch) and type of construction (metal/masonry/concrete), principal dimensions, year of commissioning<br>▪ Surface area and average slope of the catchment basin, reference peak flow, design return period<br>▪ Debris flow susceptibility<br>▪ Slide drainage characteristics (lined/unlined ditches) or gutters, reference peak flow |
| Geotechnics | ▪ Location and characteristics of cuts and fills (slope, height, benches)<br>▪ Cut slope protection characteristics (nets, revetment, galleries, catch walls)<br>▪ Retaining wall characteristics (side slope and cut slope)<br>▪ Main characteristics of side embankment in flood plains or riverside (slope, height, erosion protection structure |
| Environment | ▪ Land-use (forest, urban, open)<br>▪ Location of power lines, gas pipes<br>▪ Tree alignments alongside the roadway |
| Performance data | ▪ Flood events resulting in blockage and/or structural damage to bridges, drainage structures and road pavement<br>▪ Flood events resulting in erosion of side embankments and damage to retaining walls or road structure<br>▪ Debris-slide and rock fall events resulting in disruption to traffic<br>▪ Temperatures extremes resulting in pavement damage<br>▪ Low sections of the road network and spots affected by recurrent drainage issues (flood, runoff, high water table)<br>▪ Location and extent of roadway slide |

**The output from the climate vulnerability process of the guidelines will be identification of priority requirements and locations within the road network. This information needs to be incorporated into the RAMS to be prioritised and planned as part of the overall roads maintenance, with funds allocated on an agreed and shared basis.**

Integration can occur on various levels, depending on resources, status of the existing RAMS, capacities and policy decisions:

- **Full integration:** in the highest case scenarios, RAMS will be extended by ability to model Return of Investment ROI from climate risks and derive unified prioritization list
- **Quasi integration:** it is also possible to mark locations identified by the natural hazard risk assessment as “mandatory” for interventions under RAMS, where module within RAMS will have to include it in consideration and final list of interventions

- **Fusion:** alternatively, PESR should amend the list prioritized by RAMS with the prioritization list from climate assessment. Often some interventions will overlap.

Independent on the level of integration, the custom made solution for the vulnerability assessment module would need to be developed and example presented in figure 7.

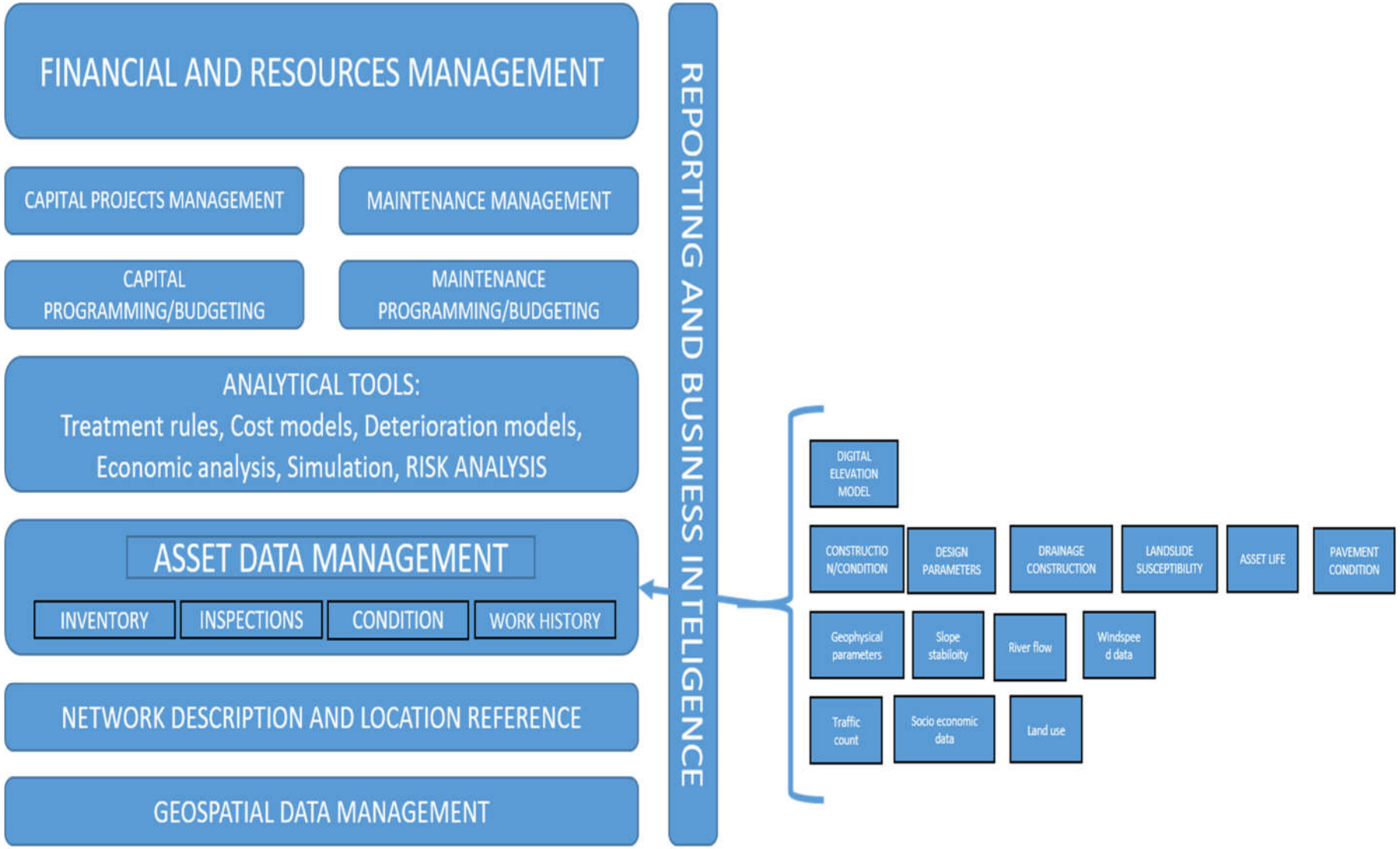



**Figure 7 Example of data sets for climate change analysis and its integration with the overall management system**

According to recent report of Conference of European Directors for Roads on climate resilience[10], implementation of climate-related data to RAMS means updating of existing RAMS architecture by two modules:

- **Risk Assessment Module:** The Risk Assessment Module provides an assessment of climate change risks based on asset vulnerability, climate variables and the consequences of failure. This is calculated for damage pattern categories. This module enables the current and future risk levels for different road asset/hazard combinations to be compared regarding projected changes in climate
- **Cost-Benefit Module:** The Cost-Benefit Analysis Module calculates the costs (direct and indirect) for possible adaptation actions for given asset object. Cost comparison between do-nothing scenario and adaptation actions is presented as an outcome.

These modules provides various functions for data analysis. The user can select:

- Asset type (i.e. concrete pavement surface)
- Damage pattern category (i.e. rain damages and restrictions)
- Time period (for climate projections)
- Appraisal time period (for the Cost-Benefit Analysis)
- High or low greenhouse gas emission scenario

CEDR has introduced IT tool for adaptation costs as summarized in Box 1 below.

[10] Decision support tools for embedding climate change thinking on roads, CEDR Transnational Research Program, March 2019

Depending on the selected analysis criteria and based on pre-calculated risk assessment the CEDR's tool provides:

- An interactive thematic layer with the calculated risk level for the selected asset type related to selected damage pattern category (shown on the map)
- Additionally the system will provide information like i.e.: location, road name, vulnerability factors

The user selects the relevant asset object on the map and the tool shows the result from the cost-benefit calculation of adaptation measures. Information such as location, adaptation measure type, costs, impact on relevant asset indicators are shown to the user. Three adaptation measures and to-do-nothing scenario can be displayed for a selected asset (with the most cost-effective highlighted), as shown below.

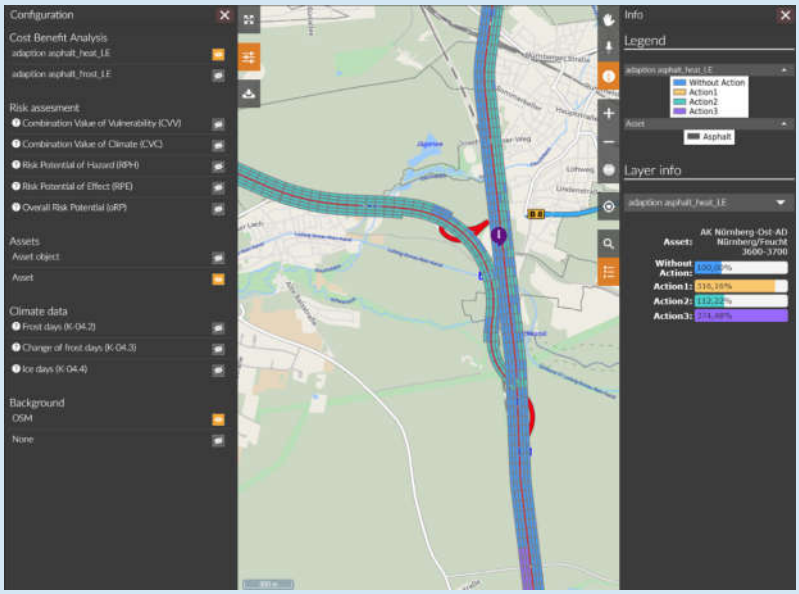



**Figure 8 Sample of CEDR's IT tool**

The adaptation costs consist of two elements: direct costs and indirect costs. The total cost over the analysis period is calculated based on the number of failures over the analysis period, the traffic flow, the delay time, number of accidents. Costs for the action "do-nothing" scenario are calculated, together with three adaptation actions. The user is able to set the calculation criteria as well as define unit process, discount rates and other relevant criteria, so that it reflects their own PESR's requirements and experience.

**Box 1 CEDR IT tool**

## 2.8 ROUTINE MAINTENANCE AND OPERATIONS

Adapting operation and maintenance programs is largely about improving capability rather than a major technology development and deployment initiative. Many of the technology elements used to support safety, congestion mitigation, and traveler information objectives should be in place or at least identified (i.e. Road Weather Information Systems - RWIS, cameras, and other roadside infrastructure).

To adapt to climate change then, PESR needs to consider how these existing capabilities need to evolve to meet the new and emerging requirements of a changing climate. These should include strengthening the communication links or rethinking the siting of these detection systems. Similarly, other existing processes for supporting safety and reliability need to be reviewed and supplemented to account for climate change.

A phased implementation approach will enable PESR to adapt their operation and maintenance programs to climate change in a planned and systematic manner. For this to occur, it is necessary to incorporate the needs of climate change and extreme weather events into the routine policy and practice of operations and maintenance.

Preventive works may be a part not only of planned structural maintenance but also routine maintenance and operations. **This requires PESR to precisely define the maintenance catalogue with the technical standards both for roads and bridges routine maintenance and for the contractors.** Achieving adequate resilience to climate change should be based on preventive actions through routine maintenance which should be improved by the introduction of maintenance catalogue with the relevant standards that should be met by the maintenance contractor.

As the greatest risk for road network management is hazards associated with floods and landslides in the specific regions and even in specific locations, PESR may consider introducing such standards starting from the hot spots indicated in the guidelines.

These standards may be applied as demonstrated in the table 3 below (examples for further consideration by PESR):

**Table 6 Potential standards to be applied to Maintenance Supplier**

| Category | Requirement | Standard |
|---|---|---|
| Potholes repairs | The contractor will repair each and every pothole which is ≥ 3 cm in not more than 48 hours from detection or notification | 100% of the pavement does not have potholes ≥ 3 cm |
| Landslides (hot spots) | • The contractor will carry out routine inspection of landslides hot spots and implemented measures once a week<br>• The contractor will make additional inspections if rainfall is forecasted<br>• The contractor will prepare appropriate equipment to recover the basic service level (road passabiity) in case of rainfall is forecasted<br>• The contractor will secure appropriate road section in case of landslide or rock falls within 2 hours from detection or notification<br>• The contractor will recover the minimum service level (road passability) in max. 24 hours | • Inspections according to the requirement<br>• Report to the PESR after inspection<br>• Report to the PESR confirming equipment readiness<br>• Road secured in given timeframe<br>• Minimum service level (passability) recovered in given timeframe |

| | | |
|---|---|---|
| Drainage system | The contractor is responsible for completeness of drainage system and its functionality | Elements of drainage system are complete, have no damage, no leaks, cracks, and the system fully fulfills the function of dewatering the road body |
| Culverts | • The contractor is responsible for the cyclic inspections of the culverts and its cleaning from 1st May up to 15th of June<br>• The contractor is responsible for cleaning the culvert if its throughput is ≤ 90% | Between the planned cleaning the culverts throughput is ≤ 90% |
| Vegetation | • Mowing I (full) with the implementation period from April 24 to May 15 each year,<br>• Mowing II (full - the whole section of the road) with the period from 9 to 30 June each year,<br>• Mowing III (partial - ditches) with the implementation period from 10 to 31 August each year,<br>• Mowing IV (full - the whole section of the road) with the period from 10 to 31 October each year | Works accomplished in the given periods |
| Bridges surroundings | • The contractor is responsible for cyclic cleaning the debris from the bridges surroundings<br>• The contractor will carry out additional inspection of the bridge surroundings in case of heavy rainfalls forecasts and/or flash floods | No debris in the bridge surroundings on 300 meters distance from the bridge on the both sides |
| | The contractor is responsible for mowing grass and weeds:<br>• mowing I from April 24 to May 15 of each year,<br>• mowing II with the implementation period from 9 to 30 June each year, | Works accomplished in the given periods |

| | | |
|---|---|---|
| | • mowing III with the period from 10 to 31 August each year,<br>• mowing IV with the period from 10 to 31 October each year | |
| Bridges drainage system | Cleaning of bridges drainage system<br>Cyclic inspections of bridges drainage system | Bridges drainage system is clean in 100% |

The implementation of detailed technical standards will also require the implementation of a customer's control system. It will also require the implementation of incentives/penalties system for the contractor.

## 2.9 RESPONSE – EMERGENCY MAINTENANCE

### PROCURING EMERGENCY MAINTENANCE

To provide the required support for emergency response and repairs, PESR should put in place a series of framework contracts with suppliers to provide:

1. emergency clear up and response;
2. emergency repairs and maintenance;
3. consulting engineering support for specification, supervision and certification of works.

Works resulting from items 2 and 3 in these contracts should be funded from the emergency maintenance fund. These contracts can be produced through 2 or 3 frameworks, or 3 different lots within a single framework, depending upon the most efficient mechanism for PESR and respecting existing arrangements.

Each framework will enable PESR to quickly procure the support it needs.

Element 1 should be structured as a performance based contract, with contracting terms against a defined set of levels of service (LOS). These LOS could include response times to identified events, or measures of the proportion of time that a given road section is open to traffic.

Based upon plans to achieve the identified LOS, contractors would need to put in place equipment and personnel schedules to ensure that key resources are available in given locations. It would be expected that these contracts would be area based, allowing the opportunity to regionally based and small contractors to compete for contracts.

Element 2 should be structured as an input based contract, based upon agreed rates for different aspects of work. This could be done by PESR specifying the rates that it will pay (these being the same for all contractors), or by different contractors competing for a place on the framework based upon tendered rates.

The latter could reflect the additional costs of providing support in more remote or difficult to reach regions. In the former case, the decision on which contractors to give frameworks to, could be made purely on quality grounds. In the latter case, a more complex QCBS (Quality Cost Based Selection) approach will be necessary to ensure value for money.

The works to be included under this framework should include repairs to essential infrastructure, particularly to ensure levels of safety, repairs to ensure passability of a road section, and elements of emergency maintenance such as cleaning and maintenance of drainage.

The procurement of works would need to be undertaken on the basis of agreed rates, to a specification produced by either an independent consultant (see element 3), or a PESR engineer.

In this case, 3 suitably qualified contractors would be invited to tender for specified works, using tendered rates (or lower rates if they wish, but not higher).

Element 3 should be structured as an input based contract, although an output based contract could be formulated. This should incorporate agreed rates for different grades of staff, based upon tendered rates.

The main area of work required of these consultants would be to undertake rapid site assessments at landslide and flooding sites, to enable the selection of suitable contractors.

A database of qualified consultants, either from firms or independents, would be maintained by PESR, with agreed fee rates. Currently PESR has this database of consultants and should be used as a base. From this database, a suitable engineer would be selected based upon criteria such as: specific skills (e.g. bridge assessments), location (allowing for regionally based consultants) and availability.

The appointed consultant would then be responsible for the specification of required works, supervision of the selected contractor and certification of works for payment

## FINANCING EMERGENCY MAINTENANCE

Within its overall maintenance budget, PESR should identify an amount to be reserved for emergency response and maintenance. This amount should be calculated based upon past records of the costs of these works, with an additional allowance for increasing requirements due to climate change over time, to ensure that the amount reserved is adequate to cover a typical year (it is estimated that around 15% of the total budget is currently used for emergency maintenance, in any given year).

This amount should be set aside at the beginning of each budget year, in a reserve account that can only be accessed under certain conditions. These conditions should include responding to declared emergencies, funding immediate works to maintain operability of the network, and providing for immediate safety critical repairs to the road asset.

The costs of funding predictable, routine maintenance, such as snow clearance or the costs of locating response equipment at known locations, should not be taken from this fund. This funding will enable a more efficient overall maintenance programme, by removing the need to alter the routine maintenance programme, to accommodate emergency maintenance, at short notice.

Where this money is not spent, say in a drier year, it should remain in the reserve account. By saving this money, it will be possible to build up a fund over time, that can be available to cover costs in a wetter year, when emergency maintenance requirements are greater. The fund will need to be protected by regulations, to ensure it cannot be taken to cover other items. These regulations will need to set out the responsibility for management of the fund, clear guidelines on the use of the money, and a transparent disbursement mechanism.

# 3 SUMMARY OF NON-ENGINEERING MEASURES

| Data and monitoring | | | | |
|---|---|---|---|---|
| | **Adaptation measure** | **Short-term ( 1 year)** | **Mid-term (3 to 5 years)** | **Long-term (5 and more years)** |
| 1 | Expand asset inventory with climate resilience relevant data and information | | | |
| | Integrate the landslide and flood susceptibility maps with all the data included in them, update the data with the field surveys as per the workshop under this TA | | | |
| 2 | Expand asset inventory with elements of roads, bridges and tunnels (eg. culverts) | | | |
| | This is especially important for the identified hotspots based on the CVRA methodology | | | |
| 3 | Integrate climate scenarios module into existing RAMS | | | |
| | The output from the climate vulnerability and risk assessment will be identification of priority needs and locations within the road network. This needs to be brought into the RAMS to be used as prioritization and planning tool as part of the overall roads maintenance, with funds allocated on an agreed and shared basis. Integration can be on various levels, depending on resources, status of the existing RAMS, capacities, and policy decisions as described in the section 2.1.2. | | | |
| 4 | Hydrological-Meteorological monitoring | | | |
| | Request the improvement of the existing meteorological monitoring system:.<br>• Installing new automatic meteorological stations<br>• Installing new automatic rain stations | | | |
| 5 | Develop and track performance metrics related to extreme weather (i.e. number/duration of weather-related road closure) | | | |
| | Weather and climate are key influences on the triggering of landslides and of course floods and climate change models indicate the potential for such events to become more frequent and/or more severe. Accordingly, the proactive detection of debris flows, rockfalls, increased water levels and similar, by means of rainfall monitoring forms a vital part of the longer term management strategy to reduce the exposure of the road. Flood and Water Level Monitoring Sensor offers real time capability and transparency with high water and level alerts. One of the major benefits of this technology is that it can be used as part of a large network of sensors to measure water levels and inform users. This then gives the potential to enable detection, notification and even some actions to be undertaken prior to the events. Specific recommendations to action this include the following:<br>a) The tentative trigger threshold that should be developed and tested against future observations to validate its use prior to introduction. In a view of the effort and the events-based data required to undertake this validation process, a period of five years is considered likely to be needed prior to its formal introduction to the management of the road network. | | | |

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| | b) A system to allow the 'real-time' capture and analysis of appropriate water level, rainfall data, including forecast rainfall data, should be developed to enable the forecast of potential hazard events. It is recommended that this work be taken forward in collaboration with the Met Office.<br>c) Once confidence in the threshold has been established simulations of its use should be undertaken. This will enable to lower thresholds for 'Wake-Up' and 'Warning' thresholds to be set, as well as enabling firm rules for the use and operation of the threshold to be set. | | | |
| 6 | Create after-event reports with clear recommendations for improvement following extreme events | | | |
| | Build capabilities of the road sub-sector PESRs to better assess options for enhancing resilience both in the long-term perspectives assessing the efficacy of design standards and engineering measures and in the processes of preparation for disasters. Build database of these recommendations. | | | |
| 7 | Implement Early Warning System | | | |
| | Expand both coverage and quality of fixed and mobile monitoring capabilities within PESR. Use all available sources of data to obtain accurate and current information concerning hot spots. The system should allow the "real-time" capture and analysis of appropriate water level rainfall data, including forecast rainfall data. Should be developed to enable the forecast of potential hazard events. The system may consist of:<br>- Regular inspections of hot spots by maintenance and supervision companies, especially on hotspots identified by the national scale hazard mapping<br>- The implementation of a systematic landslide patrols approach<br>- ITS modules like Road Weather Information Systems and/or CCTV<br>- Using drones for early detection of signs for flooding and landslide hazards: There is an increased use of Unmanned Ariel Vehicles (UAV/Drones) with camera installed for the survey of structures, buildings and large geological features. They can either be used by experts in situ or the film returned for analysis to a central location<br>- Rainfall monitoring forms<br>- Flood and water level monitoring sensors<br>o Tentative trigger threshold should be developed and tested against future observations to validate its use prior to introduction<br>o Carry out simulations of established thresholds to set "Wake-Up" and "Warning" thresholds<br>- Implement Variable Message Signs for landslide specific and flood specific requirements or install vertical signalization on the road to indicate the beginning, extent and end of sites of significant landslide/flood hazard ranking. These may include flashing lights for period of higher likelihood of the climate event<br>- Consider need for landslide and flooding gates at locations where physical closure may be deemed necessary<br>- Provide information signs in lay-bys, rest areas and at entry points to high risk zones<br>- Phone number and/or application dedicated to users and stakeholders<br>- Improve the communication with road users, including increasing the knowledge on reaction to hazards<br>- Invest in communication systems for interagency communication (PESR, MoTC, UHMR, Crisis Management Center(CMC)and Police)<br>- Invest in data servers for centralized historic information | | | |
| 8 | Use remote sensing technologies for monitoring | | | |
| | Some of the monitoring data could be obtained by remote sensing technologies using free access data from Landstat 8 satellite high resolution images (for detection and analysis of floods, torrential floods and wild fires), or by using Sentinel 1,2 satellite radar images (subsidence, landslides and other depletion | | | |

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| | zone) for monitoring. Free access to those data and continuous screening of the land surface with climate data could help in analysis of triggers and occurrence defining thresholds for climate related road hazard. | | | |
| 9 | Build appropriate relations, common plans and programmes with stakeholders and other public entities | | | |
| | Initiate a strategy for dealing with land management issues in the light of debris flow potential should be considered in consultation with i.e. Ministry of Agriculture, Forestry and Water Economy. Dialogue with this Ministry will be required also in terms of forestry practices which can have a significant impact on the stability of hillsides. | | | |
| 10 | The GIS-based assessment | | | |
| | The GIS-based assessment should be completed on all hotspots identified from the National Scale Hazard Assessment Maps.<br>They should be revisited in 2 years to take account of:<br>a) New and improved data sets.<br>b) New and improved technologies for handling such data sets.<br>Once the GIS-based assessment and interpretation has been revisited, the sites themselves should be reassessed to take account of changes in land-use and other anthropogenic factors, as well as any short-term geomorphological processes. It is recommended that those sites in high hazard risk areas, should also be subject to the site-based reassessment exercise. The combination of revisiting the GIS-based assessment, interpretation and site-specific reinspection after the interval suggested, should ensure that the appreciation of landslide and flood hazard to the network remains soundly based in future years. | | | |
| 11 | Incorporating MCA Criticality in RAMS | | | |
| | Socio-economic criticality: similarly the database on socio-economic criticality should be added to the RAMS. Either as simple number linked to the road asset and fed from external source (e. transport model) or by compiling more comprehensive database that will include all relevant socio-economic data. | | | |
| | **Maintenance practice** | | | |
| | **Adaptation measure** | **Short-term (up to 1 year)** | **Mid-term (3 to 5 years)** | **Long-term (5 and more years)** |
| 12 | Define maintenance catalogue with the technical standards for hot-spots routine maintenance | | | |
| | Decide about output and/or outcomes which must be provided by the maintenance company(ies) within their routine maintenance practices on the road. These outputs and outcomes should be focused on the elements of the road relevant from the landslides and floods risk perspective (drainage systems, culverts, bridges) and on hot spots as described in section 2.1.3. | | | |
| 13 | Initiate the strategy for building capabilities of maintenance company | | | |
| | There are two ways of approaching this. The strategy would be the natural continuation of defining the technical standards for routine maintenance, as given above.<br>Define the limited types of works which will be in the responsibility of Makedonia PAT. The rest should be contracted within comprehensive maintenance contracts. Other possibility is to define the limited network/sections under the responsibility of Makedonia PAT with or without limited types of works. The rest should be contracted within comprehensive maintenance contracts.<br>First contracts are to be input-based where actions, treatment and its frequency may be detailed. This will support market building and will provide certainty for PESR to deliver the expected and required results. More: section 2.2.1. | | | |

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| 14 | Stockpile materials and equipment and store them in strategic areas prior to events | | | |
| | Apart from technical standards concerning relevant roads' elements (eg. culverts) put clear requirement for the maintenance company(ies) to have all appropriate equipment and material collected close to the hot spots to ease the response to extreme weather events. | | | |
| 15 | Implementation of mixed maintenance strategy (proactive, predictive, preventive, reactive) | | | |
| | Carry out scenario analysis on the best maintenance strategies for the assets under PESR supervision to examine long-term consequences of focusing on rehabilitation of deteriorated sections only.<br>Prepare report for the Ministry of Transport concerning consequences of maintenance needs for deteriorated and not deteriorated assets using functionalities of RAMS. | | | |
| 16 | Expand technical condition indicators | | | |
| | Apart from roughness implement other technical factors for the network condition assessment of climate related infrastructure | | | |
| **Resources and funding** | | | | |
| | **Adaptation measure** | **Short-term (up to 1 year)** | **Mid-term (3 to 5 years)** | **Long-term (5 and more years)** |
| 17 | Improve of tracking of maintenance expenses and operational disruptions including their cause and severity and incorporate that information into budgeting processes over time | | | |
| | Require from maintenance company(ies) and from engineers supervising these companies to report to the PESR about the costs incurred for responses to extreme weather events.<br>Build database of these costs related to types of events, assets and road section/region | | | |
| 18 | Implement climate-related data for budget setting | | | |
| | After integration of climate impact indicators and parameters into RAMS, supplement the report for the Ministry of Transport presenting the realistic funding requirements for planned maintenance and additional costs related to climate impact mitigation measures. | | | |
| 19 | The Field inspection as form of site-specific inspection programme should be extended through 2019 and subsequent years. A programme for 2020 should be in place by the end of 2019 | | | |
| 20 | Introduce emergency fund in the maintenance budget forecast to account for dealing with potential extreme weather related damages of the road network | | | |
| | It is estimated that around 15% of the allocated maintenance budget is currently used for emergency maintenance as a result , in any given year. This should be a separate line in the Maintenance Budget. | | | |
| **In-house and outsourced workforce** | | | | |
| | **Adaptation measure** | **Short-term (up to 1 year)** | **Mid-term (3 to 5 years)** | **Long-term (5 and more years)** |
| 21 | Establish framework contracts for emergency maintenance | | | |
| | Prepare contracts for: emergency clear up and response; emergency repairs and maintenance; consulting engineering support for specification, supervision and certification of works | | | |

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| 22 | Train existing personnel on the potential impacts of climate change and how this may affect their roles and responsibilities | | | |
| 23 | Determine the right level of workforce requirements and capabilities (especially for hot-spots) for all types of maintenance | | | |
| | Clarify the requirements for the maintenance company(ies) - as with the stockpile of equipment, materials and technical standards – to allocate appropriate quantity of employees in case of threat of extreme events | | | |
| 24 | A strategy for dealing with land management | | | |
| | A strategy for dealing with land management issues in the light of debris flow potential should be considered by PESR in consultation with other stakeholders such as the Ministry of Agriculture, Forestry & Water Economy | | | |

# 4 REVIEW OF THE CURRENT LEGISLATIVE PROCESS AND REQUIREMENTS

## 4.1 INTRODUCTION AND METHODOLOGY

The aim of this task is to review the current legislative process and requirements (in particular bottlenecks) for the Public Enterprise for State Roads in North Macedonia (PESR) to work on landslide reconstructions, such as required design approvals, processes for environmental permits, land acquisition procedures and etc.

It is also worth mentioning that in conducting the legal framework analysis the Consultant investigated the gaps in the transport resilience system, as presented in the cycle of Pre-disaster risk assessment & management, emergency response & risk reduction and post disaster recovery & reconstruction.

Moreover, the road asset management system was looked at from a legal perspective, as there is not clear understanding what is the current state of play with reference to the normative provisions of the Law on Public Roads. Therefore, a special focus in the analysis is given to the Law on Public Roads.

Regarding transport EU Acquis communautaire, there is no specific EU directives with reference to transport resilience on climate change, however, the Consultant shall put into the final recommendations how the general EU Common transport policy and the common principles of a resilient TEN-T network, are or could be addressed in the context of North Macedonia.

The following laws and bylaws are relevant during the process of the road designing and most relevant for this task:

1) Law on Public Roads (Official Gazette of RM n.84/2008; 52/2009; 114/2009; 29/2010, 124/2010; 23/2011; 53/2011; 44/2012, 168/2012, 163/2013, 187/2013, 39/2014, 42/2014, 166/2014, 44/2015, 116/2015, 150/2015, 31/2016, 71/2016 and 163/2016) and the subsequent bylaws:
   - Rulebook on measures for road maintenance, the manner and timeframe for their implementation, as well as the type and manner of carrying out regular, winter, periodic and emergency maintenance**.** (Official Gazette of RM No.152)
   - Rulebook on the technical elements for the construction and reconstruction of public roads and objects along the roads (Official Gazette of RM n.110/2009, 163/2009; 26/20210; 1603/10; 9420/11; 146/2011 and 9/2017).
2) Law on Construction (Official Gazette of RM n.130/2009, 124/2010, 18/2011, 36/2011, 49/2011, 54/2011, 13/2012, 144/2012, 25/2013, 79/2013, 137/2013, 163/2013, 27/2014, 28/2014, 42/2014, 115/2014, 149/2014, 187/2014, 44/2015, 129/2015, 217/2015, 226/2015, 30/2016, 31/2016, 39/2016, 71/2016, 103/2016,132/2016, 35/2018, 64/2018 and 168/2018) and the subsequent bylaws:
   - Rulebook on the content of the designs, the designation of the design, the manner of verification of the design by the responsible persons and the manner of the use of electronic records (Official Gazette of RM n.24/201, 68/2013, 81/2013, 219/2015 and 52/2016)

- Rulebook on standards and norms for design (Official Gazette of RM n.60/2012, 29/2015, 32/2016 and 114/2016).

3) Law on Public Procurement (Official Gazette of RM No. 24/19)

4) Law on Expropriation (Official Gazette of RM No. 95/2012, 131/2012, 24/2013)

5) Law on Spatial and Urban Planning (Official Gazette of RM n.199/2014, 44/2015, 193/2015, 31/2016, 163/2016, 90/2017, 64/2018 and 168/2018),

After analysis of the:

- *Law on Road Safety* (Official Gazette of RM n.169/2015, 226/2015, 55/2016, 11/2018, 83/2018 and 191/2018), and the
- *Law on Crisis Management* (Official Gazette of RM no. 29/05, 41/2014, 104/2015),

the Consultant concluded that these Laws do not pertain relevant provisions for these Guidelines.

## 4.2 ANALYSIS

Even though several legal acts regulate different aspects of the landslide, there is no specific law (or bylaw) dealing with landslide management in an overall and comprehensive way, including assessment and modeling of the areas susceptible to landslides, as well as planning and carrying out measures and activities for prevention of damages and losses on transport and related infrastructure, especially in cases of long precipitation and snow melting.

While the focus on the analysis is given on the landslides' management, as per the requirements of the ToR in respect to this Task 2, most of the recommendations presented here comprise overall emergency interventions in road transport, so they are applicable to the overall emergency events/occurrences, i.e climate disaster events affecting road transport.

## 4.3 LAW ON PUBLIC ROADS AND CORRESPONDING BYLAWS

The Law on public roads (Official Gazette of RM n.84/2008; 52/2009; 114/2009; 29/2010, 124/2010; 23/2011; 53/2011; 44/2012, 168/2012, 163/2013, 187/2013, 39/2014, 42/2014, 166/2014, 44/2015, 116/2015, 150/2015, 31/2016, 71/2016 and 163/2016) regulates the conditions and the manner of management, planning, construction, reconstruction, rehabilitation, maintenance, protection, financing, and supervision of public roads.

The chapters that are elaborated in it are the following: concession on public roads; managing of public roads, planning, designing, construction and reconstruction of public roads; maintenance of public roads; assessing the impact of safety on the road; protection on public roads; traffic mode on public roads; financing of public roads and procedure for provision of authorization for road assistance.

The analysis of this Law, which even though is lengthy and had undergone many changes, shows that only few provisions are indirectly relevant for the landslide reconstruction, while some more pertinent provisions are contained in a Rulebook stipulating the closer conditions for maintenance of roads. An extract from the Law on Public Roads linking it to the purpose of the Activity 2 of the Project and referring to the legislative requirements for landslide reconstructions is presented below.

Section IV, Article 25 of the Law on Public Roads prescribes that the public roads are designed, built and reconstructed in accordance to their purpose, allowing for safe and uninterrupted transport and

protection of the environment, and in line with this Law and the legal provisions for designing and constructing.

The technical elements for construction and reconstruction of the public roads, as well as of the objects on the road are prescribed by the Minister in charge for transport and communications, upon positive opinion issued by PESR.

The priorities in the construction and reconstruction of the public roads are determined according to a Strategy for development and maintenance and on the basis of feasibility studies, a feasibility study being a basic document for selection of an optimal economic solution of the design option. (Article 24).

In the Chapter V, Article 34, the Law defines the road maintenance as works related to regular, winter, periodic and emergency maintenance. These works may be delegated by PESR onto legal entities registered for carrying out such works.

## 4.4 RULEBOOK ON MEASURES FOR ROAD MAINTENANCE, THE MANNER AND TIMEFRAME FOR THEIR IMPLEMENTATION, AS WELL AS THE TYPE AND MANNER OF CARRYING OUT REGULAR, WINTER, PERIODIC AND EMERGENCY MAINTENANCE

The specific activities for each type of maintenance are stipulated in a Rulebook on measures for road maintenance, the manner and timeframe for their implementation, as well as the type and manner of carrying out regular, winter, periodic and emergency maintenance**.** (Official Gazette of RM No.152 from 5.12.2008).

Using World Bank's operational guidance[11], the following explanations of maintenance are provided which could be reflected across the national legislation accordingly:

Routine maintenance, which comprises small-scale works conducted regularly, aims "to ensure the daily traffic circulation and safety of existing roads in the short-run and to prevent premature deterioration of the roads" (World Road Association- PIARC 1994). Frequency of activities varies but is generally once or more a week or month. Typical activities include roadside verge clearing and grass cutting, cleaning of silted ditches and culverts, patching, and pothole repair.

Periodic maintenance, which covers activities on a section of road at regular and relatively long intervals, aims to preserve the structural integrity of the road. These operations tend to be large scale, requiring specialized equipment and skilled personnel. They cost more than routine maintenance works and require specific identification and planning for implementation and often even design. Activities can be classified as preventive, resurfacing, overlay, and pavement reconstruction. Resealing and overlay works are generally undertaken in response to measured deterioration in road conditions.

Urgent maintenance is undertaken for repairs that cannot be foreseen but require immediate attention, such as collapsed culverts or landslides that block a road.

Pavement rehabilitation shall be defined as resurfacing, restoration, and rehabilitation work consisting of structural enhancements that extend the service life of an existing pavement and/or

[11] Transport Note TRN-4, "Why maintenance is important and how to get it done" , World Bank, 2005

improve its structural capacity. Rehabilitation techniques include restoration treatments and/or structural overlays.

It seems that even though different institutions and states use different terminology, when it comes to rehabilitation and periodic maintenance, these two terms can be used as synonyms, because the activities undertaken under rehabilitation coincide with what is defined under the periodic maintenance. In this respect, the Macedonian legislation and practice are aligned, as the legislation recognizes only the term periodic maintenance, whereas in practice the engineers use rehabilitation as a more common term.

The requirements relevant to the Project's subject are elaborated below in the subsequent excerpts from the Rulebook.

As stipulated by Article 6, paragraph 2, item 2, of the mentioned Rulebook, the landslide remediation is one of the measures carried out as a periodic maintenance. All the measures listed as periodic maintenance are undertaken in time intervals of few years, through which a continuation of the user value of the road infrastructure and the safety equipment is ensured, and/or measures which enable the road to sustain the increased axle loads or increased speeds.

Even though the Law on Public Roads and the abovementioned Rulebook consider the landslide remediation as a periodic maintenance (i.e rehabilitation, as referred to it colloquially, not a legal term), the Consultant is of an opinion that the emergency maintenance should be also looked at and considered further in the next phases of the Design, given the fact that according to the Rulebook, the emergency maintenance under specific circumstances could indirectly touch upon landslide remediation.

Although the legislation does not explicitly mention landslides, it seems that when referring to earthquakes, floods and other ecological disasters in Articles 17 and 38, it supposes that if due to these events a landside occurs, then it is first treated as an emergency intervention (Article 38) and then Article 39 from the Rulebook fully applies which means the works for regular maintenance are being deployed if necessary.

It is very important to note that according to the Article 18, paragraph 2, these activities for periodic maintenance are foreseen with the Plan for maintenance of the public roads and they are carried out on the basis of Basic Design prepared in line with the standards, provisions and technical elements for road construction stemming from the Law on Construction and subsequent bylaws which are legally in force

As far as the emergency intervention goes, the activities include PESR and implementation of works and traffic regulation beyond the regular Maintenance Plan and working hours. In cases of unexpected events (ecological, earthquake, climate or traffic accident), the contractor in charge for regular maintenance needs to be informed from the inspection and control bodies, physical person or information media.

Provided that the extraordinary event could not be mitigated with actions for regular maintenance, or longer time period is needed for remediation, the Contractor prepares a proposal for complete or partial closure of the road, or for limiting the traffic. Once an approval is received for this proposal, relevant signs for traffic alterations should be placed by the Contractor. *The Rulebook doesn't precisely put which body is responsible for issuing the approval.*

After an extreme event, an extreme control should be performed and a report to be prepared

accordingly, not later than one month after it has been performed (Article 17). *The Rulebook doesn't precisely put which body is responsible for the control.*

A special own fund within the PESR budget should be envisaged for urgent road interventions caused by landslide occurrences or any extraordinary event/disaster, and this is to be managed through so-called Framework contracts, as per the provisions of the Law on Public Procurement and as recommended in the chapter Recommendations. This will enable a prompt reaction and immediate intervention in order to ensure normal traffic conditions and prevent further damage of the road, without unnecessary delays which could be experienced if the regular procedure for public procurement of works is to be carried out.

## 4.5 PROGRAMME FOR ROAD MAINTENANCE AND ROAD MAINTENANCE PLAN

The 'emergency interventions' are foreseen within the maintenance programme out of the regular and periodic maintenance in a separate budget line.

In general terms, the maintenance of the state roads is performed on the basis of a Road Maintenance Plan, as part of the Annual Programme for construction, reconstruction, maintenance and protection of the public roads. (Article 8 of the Rulebook)

The Plan should contain at the least, the following information (Article 9):

- Condition of the road at the beginning of the year
- Goals and standards to be achieved
- Investments and financial plan
- Feasibility of the designs for periodic maintenance
- Conditions projected for the end of the year with applying investment options

The Plan stipulates measures for implementation, with detailed description for each planned maintenance, location, type of works, costs and financial resources with deadlines for implementation (Article 10)

## 4.6 LAW ON CONSTRUCTION AND CORRESPONDING BYLAWS

The Law on Construction (Official Gazette of RM n.130/2009, 124/2010, 18/2011, 36/2011, 49/2011, 54/2011, 13/2012, 144/2012, 25/2013, 79/2013, 137/2013, 163/2013, 27/2014, 28/2014, 42/2014, 115/2014, 149/2014, 187/2014, 44/2015, 129/2015, 217/2015, 226/2015, 30/2016, 31/2016, 39/2016, 71/2016, 103/2016,132/2016, 35/2018, 64/2018 and 168/2018) is a basic law which defines the standards of design that are required to be undertaken for a project. Law does not foresee a requirement to provide Climate Resilience of the road network in the design and do not take into account the climate change predictions that have been established when the designs are prepared.

- Rulebook on the technical elements for the construction and reconstruction of public roads and objects along the roads (Official Gazette of RM n.110/2009, 163/2009; 26/20210; 1603/10; 9420/11; 146/2011 and 9/2017).
- Rulebook on the content of the designs, the designation of the design, the manner of verification of the design by the responsible persons and the manner of the use of

electronic records (Official Gazette of RM n.24/201, 68/2013, 81/2013, 219/2015 and 52/2016)

- Rulebook on standards and norms for design (Official Gazette of RM n.60/2012, 29/2015, 32/2016 and 114/2016).

At the state level, it is necessary to adopt rulebooks for unifying the positions and preparing Bill of Quantities-BoQ, rulebooks or a manual for designing of the junctions and connections on a level or off the level, rulebooks or manuals for dimensioning the pavement structure, rulebooks or a manual for designing a local road, rulebooks or manual for road drainage, rulebooks or manual for geo-mechanical and hydrological research, rulebooks or manuals for the design of round a bound junctions, rulebooks or manual for road safety equipment etc.

However, according to the relevant rulebooks, depending of the position of the terrain and hydrology, appropriate drainage systems are designed in order to prevent obstruction of the roads during floods. Concerning the road network resilience from the earthquakes, the legislation does not foresee anything in this regard, so this represents a gap which could be tackled through a separate Rulebook.

Climate resilience of the road network is not regulated within the relevant legislation except for the structures (bridges, culverts etc.) in terms of hydrology.

Even in the ToR's prepared by PESR for request for designing there is no demand for climate network resilience since it is not foreseen in the legislation and it is not compulsory except for the structures, explained above.

The problem with the landslides is the procedure of obtaining construction permit in terms of time and that is the main reason why PESR treats the landslides like periodic maintenance (rehabilitations) since for the rehabilitations the construction permit is not necessary to obtain (as prescribed in the Law on construction).

As the Law on Public Roads and Rulebook on maintenance elaborated above refer to the Law on Construction, relevant extracts from this Law are quoted in an annex to the law. Namely, since the activities for periodic maintenance, including for landslide remediation are undertaken on the basis of prepared Basic Design, the focus is on the related provisions accordingly.

Pursuant to Article 43 of the Law on Construction, the design may be, according to the level of preparation:

1) pre-construction activities design;
2) basic design;
3) draft design;
4) as-built design, and
5) design for use and maintenance of the construction.

Unlike the periodic maintenance (rehabilitation) for which allegedly PESR do not undergo a procedure for obtaining a construction permit, for reconstruction, such permit is needed. The Law on Construction requires design for reconstruction in such cases. According to Article 48 the basic reconstruction design shall contain a design of the existing condition and a reconstruction design.

The design of the existing condition shall contain footage of the existing condition and control of the fulfilment of the basic requirements for the construction.

The reconstruction design, depending on the type of the reconstruction and the purpose of the construction, shall contain the necessary individual designs referred to in Article 43 paragraph (3) of this Law.

Regarding the construction permit, Article 56 stipulates that building of the constructions may commence with the issuance of the construction permit that is legally valid in the administrative procedure.

Even though it seems that according the established practise in PESR, the landslide remediation and the rehabilitations, as colloquially referred for the periodic maintenance, do not require a construction permit, the legislative evidence does not prove and correspond to such statements. Namely, the landslide remediation requires a detailed design, and the Law on Construction does not explicitly list them in the Article 73 as constructions for which construction permit is not necessary.

## 4.7 LAW ON PUBLIC PROCUREMENT

The new Law on Public Procurement (Official Gazette No. 24/19) has entered into force just on April 1st, 2019 , and it is completely new law, repealing the previous versions of this law.

The Article 57 is relevant for the procurements of PESR practiced thus far with regards to the road maintenance, including maintenance addressing landslides. According to this Article, the Contracting authority (PESR) is allowed to conclude framework agreement for works for a period of no longer than 5 years, whereas the separate contracts for public procurement are granted on the basis of that framework agreement. In the case the framework agreement is concluded with more than one economic operators, the separate contracts can be granted even without collection of offers again, provided that all the conditions for carrying out of the works are determined in the framework agreement, along with objective conditions for selection of one of the economic operators which are parties to the framework agreement, and which had been listed in the tender documentation for concluding the framework agreement.

A possible setback of the new Law could be the provision that foresees that the public procurement contract or framework agreement could be amended without undergoing a new procedure for public procurement provided that the total amount of the changes in the contract or the framework agreement are not 20% above the value of the original contract/framework agreement (Article 119, paragraph 2). The Consultant is on opinion, that this possibility of amending the contracts without running another public procurement procedure could be better utilized for higher threshold (30%).

Another possibility that could be used for speeding up the procedure of procurement of works in cases of extreme climate events is foreseen in the provisions from Article 55 regarding the negotiating procedure without publishing a call for procurement of goods, services or works, which could be applicable in cases of extraordinary emergency, caused by circumstances which the contracting authority could not foresee. In such cases, the contracting authority is obliged to obtain a positive opinion from the Public Procurement Bureau, but in the cases when the life, health, safety and security of people are endangered, the contracting authority can commence the negotiating procedure without public call even without such prior opinion.

## 4.8 LAW ON EXPROPRIATION

With regards to other relevant provisions pertaining to legislation on expropriation, after the analysis of the Law on expropriation, it is concluded that there is no legal basis for expropriation procedure

since the landslides are not treated in the law on construction or by laws, they are not foreseen to be a part of the Infrastructure Plan which is a precondition for an expropriation process. If the landslide is on a private owned land, the contractor is arranging access to site and financial compensation with the owner of the land and the contractor's obligation is to build access roads to the landslide location.

That said, and given the fact that PESR confirmed that one of the main drawbacks in their practice is the provision from the Article 26 of the Law on Expropriation stipulating that one of the documents required to be attached to the proposal for land expropriation in concrete case is the Infrastructure Plan, the Consultant proposes to eliminate such provision, so that the procedure for expropriation does not withhold the urgent interventions for landslide management.

## 4.9 OTHER RELATED LEGAL ASPECTS

A special law on soil protection in North Macedonia, does not exist. Permanent monitoring, i.e. systematized measurement, monitoring and control of the state, quality and changes in soil as an environmental media in North Macedonia does not exist. There is a need to treat soil as environmental medium from different points of view have been recognized.

With reference to data and information on the status and processes of soil degradation in the Republic of North Macedonia, there is erosion map in a 1:50 000 scale produced in 1992 (most likely by, or for the purposes of the Ministry for Environment and Physical Planning), but its digital version was finalized in 2002.

According to Landslide inventories in Europe and policy recommendations for their interoperability and harmonization[12], North Macedonia has a landslide cadaster created in 1979, with irregular occurrence of updates, and with time period of landslide events covered 1979 – 2010. The inventory is owned by the Ministry of Economy (sector for mineral resources), and unless there is an updated version of that one, this could represent one of the bottlenecks for setting an appropriate and well-defined landslide management system.

[12] JRC Scientific and Policy reports, Landslide inventories in Europe and policy recommendations for their interoperability and harmonization, Joint Research Center, EC, 2012

# 5 LEGAL CONCLUSIONS AND RECOMMENDATIONS

## 5.1 CONCLUSIONS

The following conclusions are drawn from the analysis of the legislation closely related to road transport sector, and road construction, accordingly:

1. Landslide remediation is considered as a periodic maintenance. The activities for periodic maintenance are foreseen with the Plan for maintenance of the public roads and they are carried out on the basis of Basic Design prepared in line with the standards, provisions and technical elements for road construction which are legally in force (i.e the Law on Construction).
2. Nowhere across the current existing legislation in North Macedonia, there is a legal definition of landslide and construction activities for landslide remediation. In fact, none of the major laws- Law on Construction, Law on Public Roads, Law on Crisis Management have a single reference to the landslides as such and that could put a real question on how this grey area is further treated in practice, leaving uncertainties and room for voluntary interpretations.
3. The Law on Construction and subsequent secondary legislation do not treat explicitly neither the landslide remediation, nor the other emergency and climate disaster events. The constructions related to landslides are not explicitly mentioned in the Law under any of the divisions of types of constructions and this represents clear gap, as there is no legal certainty on many aspects of the construction process accordingly.
4. Another clear gap is the definition of rehabilitation which is nowhere determined as a legal term even though widely used in the transport and construction engineer practice.
5. Finally, there is a legislative gap concerning the climate resilience in general. Neither the law nor the secondary legislation prescribes guidance for construction which will have considerations for climate resilience and any climate aspects embedded within the legal provisions.

## 5.2 RECOMMENDATIONS

The following recommendations are issued upon the above analysis with respect to further regulating and/or amending existing legislation closely related to road transport sector, and road construction, respectively:

1. The definition of emergency maintenance (interventions) should be made more precise in order to determine if landslide remediation could be treated also as an emergency intervention, and in general the procedure and actions in the cases of extraordinary events could be elaborated in a clearer and more precise fashion.

   The following could be considered:

   - Article 36 from the Law on Public Roads should remain as it currently reads:

(1) "The works for regular maintenance are all activities for continuously enabling functional road conditions and safe traffic

(2) The works for winter maintenance are all activities carried out for ensuring traffic in winter conditions

(3) The works for periodic maintenance are all activities undertaken occasionally for extension of the life cycle of the road infrastructure

(4) The works for emergency maintenance of roads are activities undertaken for removing the damages caused by unforeseen occurrences and for enabling uninterrupted and safe traffic

(5) The type of the activities for the works from the paragraphs (1), (2), (3) and (4) of this article and the manner of performance are prescribed by the minister of transport and communications."

- A new paragraph (6) and (7)to be added to Article 36 reads:

(6) "For the works for emergency maintenance of roads from the paragraph (4) of this article, a special reserve fund is earmarked within the Annual Programme for construction, reconstruction, rehabilitation and maintenance of the state roads adopted by the Public Enterprise "State Roads" (PESR) in accordance to Article 4."

(7) "For the purposes of effective disaster management, the funds for emergency interventions from paragraph (6) of this article, are immediately deployed upon an emergency event through framework contracts of PESR concluded with legal entities registered for carrying out works for maintenance of roads in accordance to the article 34, paragraph 2 and the Law on Public Procurement".

- Article 18, paragraph 1, item 5 from the Rulebook on measures for road maintenance, the manner and timeframe for their implementation, as well as the type and manner of carrying out regular, winter, periodic and emergency maintenance should be amended and read:

  "- protection from erosion of embankments, ***landslides*** and rocks downfall, and placing appropriate systems for protection"

- A new paragraph (2) to article 18 should be added and reads:

  "Due to the nature of the activities foreseen in paragraph 1, item 5, which are undertaken as to prevent immediate dangerous impact on the road users, they shall be considered and treated as priority interventions for periodic maintenance in accordance to the Law on Construction.

2. There needs to be a clear provision that allows for the rehabilitations including the landslide constructions to be carried out without construction permit and infrastructure design. This is important for an efficient and fast track procedure for concluding these constructions.

- Under the heading 9.*Constructions for which construction approval is not necessary* from the Law on Construction, in article 73 , paragraph (1), after the words "supporting walls", the words "and other elements of landslides remediation" are added.

- Article 45, paragraph (1) from the Law on Construction to be amended and reads:

"Infrastructure design shall be prepared for linear infrastructure constructions, with exception for constructions related to landslide remediation. The design shall contain a technical solution for the infrastructure with all of its elements containing text and graphic parts and shall show the track of the infrastructure."

3. A correct categorization of the landslide constructions will enable correct provisions to be applied with regards to the services for designing, audit and supervision, for appropriate inspection, issuing corresponding company licenses etc.

   - In the Article 57 from the Law on Construction, in paragraph (1) related to first category constructions, after the words "state roads", to add the words "constructions intended to remediation of landslides".

4. A distinction is proposed in the Law on expropriation with regards to the procedure for expropriation in cases where the land is privately owned, so that this process does not withhold the road intervention upon landslide occurrences

   - In the Article 26, paragraph 1: " Along with the proposal for expropriation, the following is submitted:", the item 1) :"excerpt from the act for physical planning or approved Infrastructure design" to be deleted.

5. The legislator could allow for greater level of flexibility when it comes to the changes of the framework contracts with the economic operators (in this case of PESR with its Contractors), as well as a better usage of the existing framework contracts in line with FIDIC rules.

   - The Article 119, paragraph 2 from the Law on Public Procurement, should be changed and reads:

     "…the total amount of the changes in the contract or the framework agreement is not allowed to go above 30% of the value of the original contract or framework agreement…"

6. A special law on soils to enable permanent monitoring, i.e. systematized measurement, monitoring and control of the state, quality and changes in soil as an environmental medium in North Macedonia has been recognized.


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