ARUP

**Public Water Management Company Srbijavode**

**European Bank for Reconstruction and Development**

# Environmental and Social Impact Assessment, Climate Change Assessment and Technical Assessment for Pambukovica Dam in Serbia

## Emergency Preparedness and Response Plan

Reference: 2025/12

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Job number 303066-00

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# Document Verification

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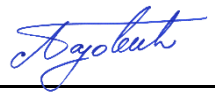
| | | **Signature** | | |  |
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# Abbreviations

| Abbreviation | Full Name |
|---|---|
| ASLL | Averaged Societal Loss of Life |
| EBRD | European Bank for Reconstruction and Development |
| EPRP | Emergency Preparedness and Response Plan |
| EWS | Early Warning System |
| FSL | Full Supply Level (also known as Top Water Level, TWL) |
| ICOLD | International Commission on Large Dams |
| LoL | Loss of Life |
| MAFWM | Ministry of Agriculture, Forestry and Water Management |
| masl | Metters above sea level |
| MoF | Ministry of Finance |
| PAR | Population at Risk |
| PGD | Design for Construction Permit |
| PMF | Probable Maximum Flood |
| PWMC | Public Water Management Company (Srbijavode) |
| ToR | Terms of Reference |
| WMD | Water Management Directorate |

# 1. Background to the Project and Objectives of the Emergency Preparedness and Response Plan

## 1.1 Background to the Project

The European Bank for Reconstruction and Development ("EBRD") is considering providing finance to the Republic of Serbia, represented by the Ministry of Finance ("MoF"). The Loan is expected to finance the construction of a new impoundment dam and reservoir infrastructure at Pambukovica including associated works such as upstream sediment traps, State Road IB no.21 realignment etc. (the "Project"). Proceeds of the loan will also finance project implementation support, supervision of works and front-end fee. The Project will be implemented by the Public Water Management Company Srbijavode ("PWMC" or "Srbijavode"), the national body responsible for water management, including water use and protection from pollution. It is also responsible for management of risks associated with water bodies (such as flood risk). Srbijavode operates under the Water Management Directorate (WMD), which in turn is an administrative authority of the Ministry of Agriculture, Forestry and Water Management (MAFWM).

The Emergency Preparedness and Response Plan (EPRP) has been prepared by Arup as part of the Environmental and Social Impact Assessment, Climate Change Assessment and Technical Assessment for the Pambukovica Dam Assignment (the "Assignment"). It has been developed in line with the requirements set out in the Section 5.6 of the Terms of Reference.

The EPRP has been prepared based on recommendations given in the following documents:

- International Commission on Large Dams (ICOLD), Dam Safety Management, 2017
- United States Federal Dam Safety Commission (US FDSC): FEMA 64 guide for preparation of EPPs for dams, 2013
- Global Analysis of Regulatory Frameworks for the Safety of Dams and Downstream Communities, the World Bank, 2020
- Canadian Dam Association Guidelines for Public Safety Around Dams, 2011
- EBRD Guidance Note - Environmental and Social Guidance Note for Hydropower Projects,
- World Bank – Good Practice Note on Dam Safety, 2021.

## 1.2 Objectives of the Emergency Preparedness and Response Plan

This EPRP provides site specific organizational responsibilities, actions, reporting requirements and the resources available to ensure an effective consistent, and timely management of emergencies that may occur at the Pambukovica Dam. It is expected that the draft EPRP will be finalised during the following phases of design. The EPRP is to be developed in collaboration with and approved by the relevant stakeholders, when the document could be used as a standalone document. The Final EPRP shall be approved at the end of construction and before the reservoir impoundment. Final EPRP is part of the official legislation procedure and is legal requirement.

This draft EPRP sets procedures applicable to all activities performed in various components of the dam during its Operation and Maintenance. It considers all activities involving Srbijavode staff and outlines procedures, actions, and minimum requirements for managing emergency events. The plan provides the required document structure, suggestions for agreed actions, reporting requirements, and necessary resources to ensure effective, consistent, and timely management of emergencies that may occur at Pambukovica Dam. This plan is essential due to the dam's proximity to the town of Ub.

This draft EPRP sets procedures that are applicable to all activities performed in various components of the dam during its Operation and Maintenance (O&M).

# 2. Project Description

## 2.1 Dam Location

It is envisaged that Pambukovica Dam will be constructed on river Ub, approximately 21km upstream from the confluence to Tamnava River, which is 15km west from the town of Ub. Location of the Dam belongs to cadastral municipalities of Pambukovica, Radusa and Gola Glava. Location of Pambukovica dam is shown in Figure 1 below.

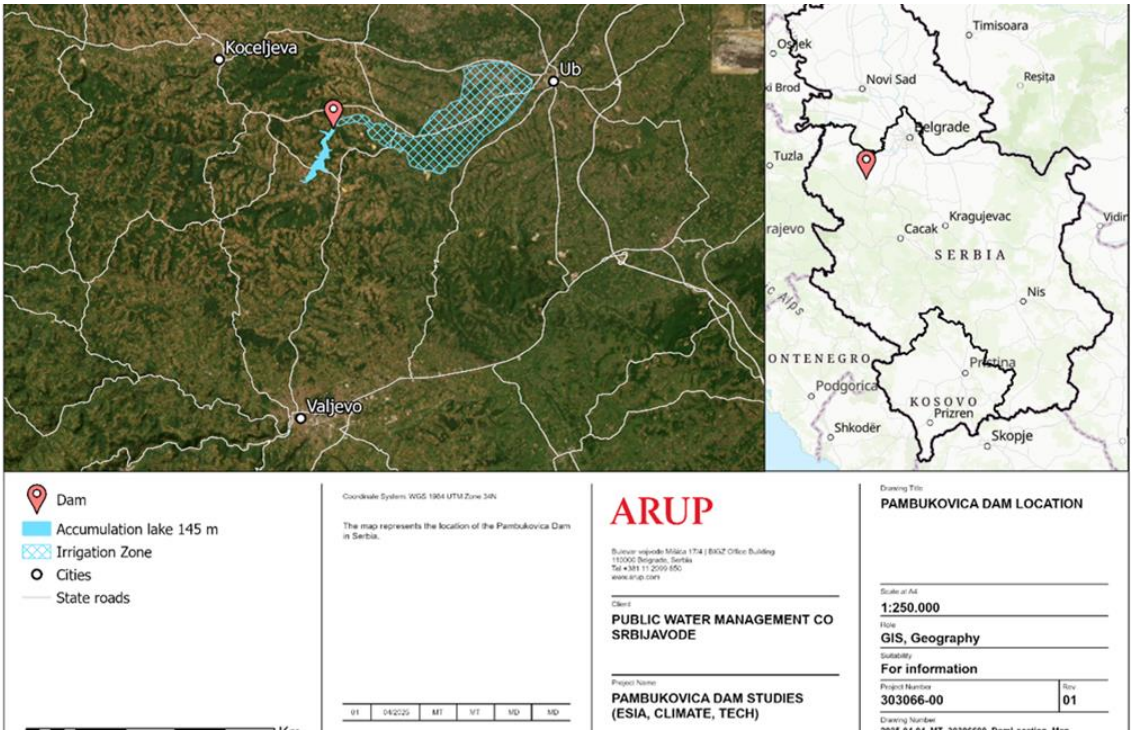


**Figure 1 - Pambukovica Dam Location**

The dam will be a multipurpose dam impounding a total reservoir volume of 8.15 $Mm^3$. Its intended functions are:

- Flood protection,
- Irrigation of about 2,225ha,
- Maintaining a guaranteed ecological flow in reservoir and downstream river,
- Retention of sediments.

Estimated time needed for construction of the dam is two to three years, considering the amount of work and defining the dynamics of execution of work.

The original design of the dam assumed the dam lifetime of 80 years; we will review the dam's lifetime under the present studies.

Construction and preparation of technical documentation for Pambukovica dam is planned in two phases:

- **Phase 1 -** Construction of Pambukovica dam. For construction of the dam, and before impoundment, a 900m long section of the State Road No.21 will need to be raised above the maximum water level of the reservoir, and additional services located in the reservoir footprint relocated. Phase 1 will complete with the impoundment of the river and formation of the reservoir. Design of the dam has been prepared up to the level of Design for the Construction Permit (PGD) as defined in national legislation.

- **Phase 2** - Construction of an irrigation system within Ub Municipality is now planned to begin in parallel with finalisation of Phase 1 works. Irrigation works will involve construction of the key facilities of the irrigation system distribution network which include pump stations, pressure pipelines and the tanks for daily balancing of the inflow. The rest of the distribution network infrastructure is planned to be developed to full capacity in the subsequent two years. Development of the secondary distribution network is planned concurrently with the primary distribution network.

Construction of upstream sediment traps is planned as part of the overall Pambukovica Dam Project. However, at this moment it is not confirmed as part of Phase 1 and will be included in subsequent Phases of the Project.

Primary purpose of Pambukovica dam is floods protection / alleviation. Secondary purpose of the system is to be used for irrigation of surrounding agricultural areas, benefaction of small waters and retention of sediment from upstream areas.

Applying ICOLD dam risk classification based on the assessments provided in the Dam Safety Appendix and Main Technical Report, Pambukovica dam is categorised as a 'Extreme Risk Dam', with a total risk factor of 32, based on capacity 1-120hm3 (1-120Mm3), height (30-45m), and expecting that a dam breach would affect > 1,000 persons downstream and would cause high potential downstream damage.

## 2.2 Principal Data

Pambukovica dam comprises the following elements:

- Earth embankment dam, maximum height 30.5m
- Outflow spillway
- Bottom outlet
- Irrigation water intake tower
- Irrigation pipe
- Ecological flow supply pipes,
- Control building
- Construction of seven sediment traps in the upstream catchment of the dam (not shown on Figure 2)
- Access road

The main elements of the Pambukovica dam are shown in plan in Figure 2 below. A typical embankment cross section (based on Design Drawings) is shown in Figure 3.

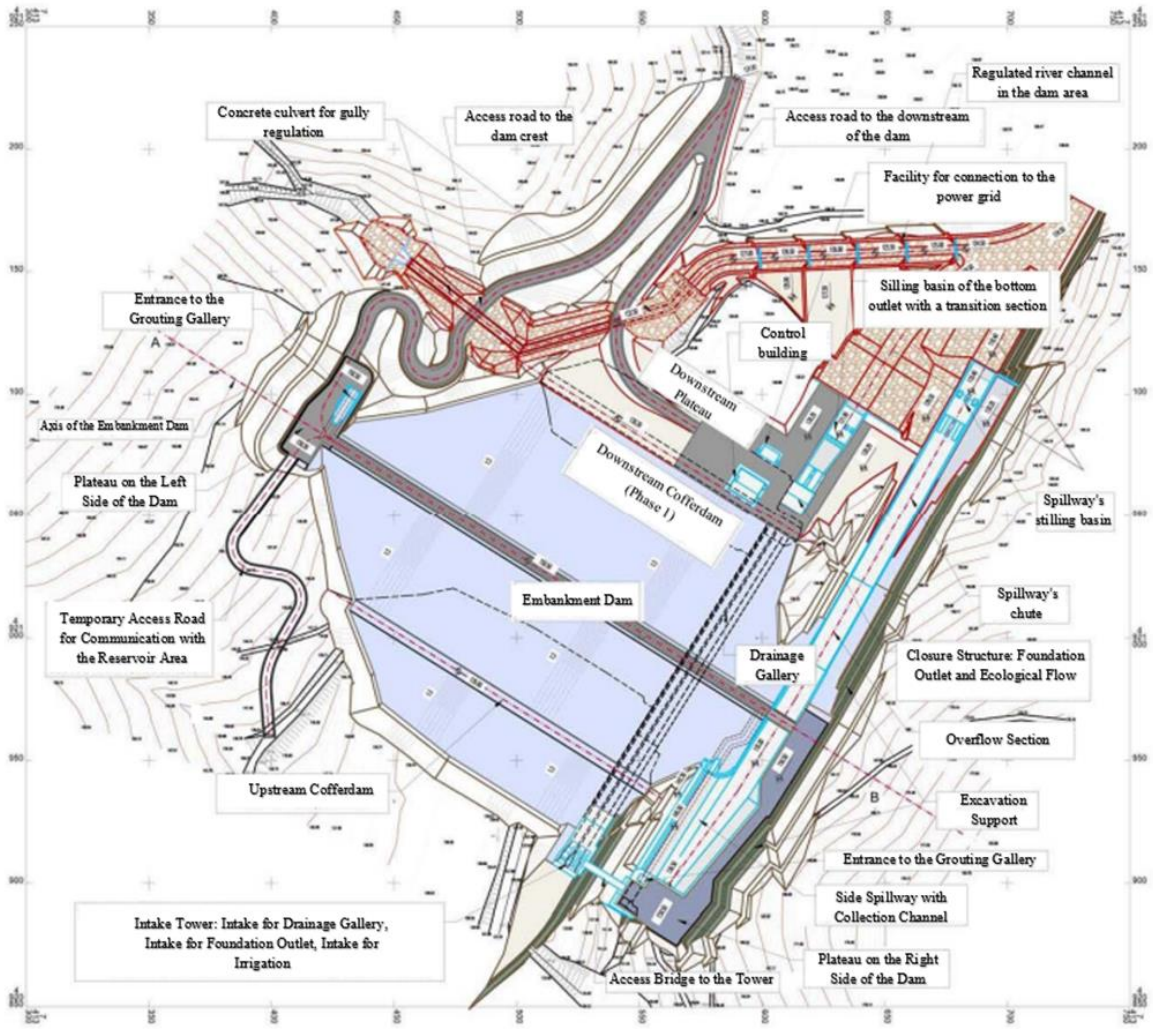


**Figure 2 - Layout of Pambukovica Dam (Source – Design for Construction Permit)**

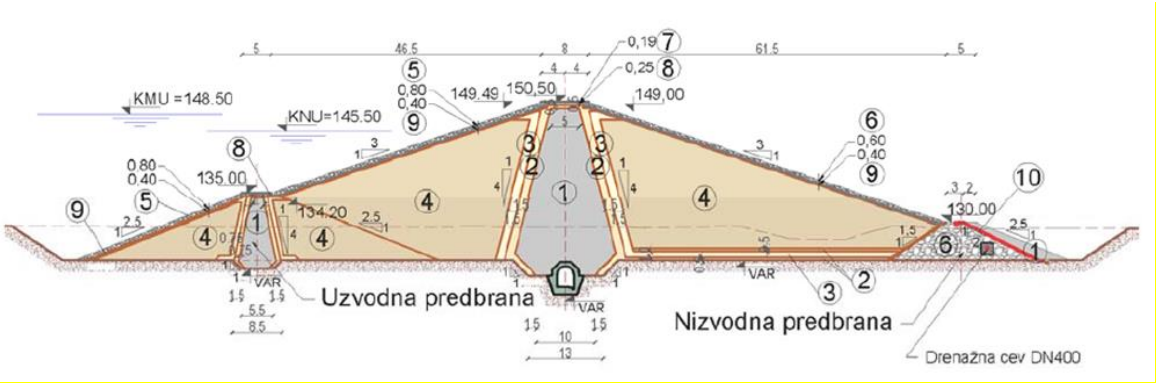


**Figure 3 - Typical cross section of Pambukovica Dam (Source – Design for Construction Permit)**

The main dam will be an earth embankment with a crest elevation of 150.50 masl, a crest length of 212.6m, and a maximum height of 30.5m. The embankment will have upstream and downstream slopes of 1(V):3(H), constructed from alluvial material and protected with rock armour. The central core will be made of compacted clay with filters on both sides. The downstream shoulder will have a drainage toe with a perforated drainage pipe.

Floods will be managed by a free overflow spillway located to the right of the dam, comprising of a side channel weir, chute and a stilling basin, and by a bottom outlet, controlled by an upstream penstock and a radial gate at the base of the dam. Two diversion galleries will protect against a 1:20yr flood during

construction, with one converted to a "dry" gallery for irrigation post-construction and the other converted to the bottom outlet.

Below is a summary of the principal data of the for the Pambukovica Dam (Table 1).

**Table 1 - Pambukovica Principal Data**

| | |
|---|---|
| **Dam Crest Level** | **150.50 masl** |
| **Maximum Dam Height (from channel bed downstream)** | 30.5 m |
| **Dam Embankment Length** | 212.6 m |
| **Embankment Slopes** | 1(V):3(H) |
| **Reservoir Volume** | 8.15 million $m^3$ |
| **Top Water Level (weir level)** | 148.5 masl |
| **Bottom Outlet Discharge Capacity** | 96 $m^3/s$ |
| **Limit to Bottom Outlet Capacity to Limit Damage to town of Ub** | 50$m^3/s$ |

## 2.3 Dam Breach Modelling

A dam breach study was performed for the dam of Pambukovica, following international guidelines (ICOLD 111, DSO 99-06, etc), to establish the hazard risk categorisation of the dam and obtain inundation maps. Dam breach modelling has adhered to international guidelines and standards, evaluating scenarios such as instantaneous breach, overtopping, and internal erosion. The findings highlight the extreme hazard posed by the dam, with a significant population at risk and potential societal loss of life in the event of a failure. To mitigate these risks, it is imperative to apply recommended design and safety check standards for high hazard dams, ensuring the safety and integrity of the structure. The hydraulic results, presented through GIS maps, illustrate flood zones and identify areas and structures within the inundation space, providing crucial information for emergency response planning and risk assessment.

The comprehensive analysis and mapping of potential breach scenarios underscored the importance of proactive safety measures and preparedness to safeguard lives and infrastructure. This data serves as an essential tool in identifying populations at risk, classifying potential loss of life, and deriving failure probabilities, thereby facilitating informed decision-making and effective emergency response strategies.

This documents has been structured based on the findings of the full dam breach modelling.

# 3. Potential Failure Models and Inundation Maps

## 3.1 Introduction

A dam breach study was performed for the dam of Pambukovica, following international guidelines (ICOLD 111, DSO 99-06, etc), to establish the hazard risk categorisation of the dam and obtain inundation maps.

Three scenarios were considered, instantaneous breach, overtopping and internal erosion. For each of the scenarios, the generated breach wave propagation was modelled using HEC-RAS model. The population at risk (PAR) and averaged societal loss of life (LoL) was then estimated, using the most conservative case. The results are summarised in the table below.

The high PAR and ASSL (over 10) would place the reservoir at the highest consequence class based international practice.

| Pambukovica is categorised as **EXTREME HAZARD** dam. |
|---|

Therefore, it is recommended that the design and safety check standards recommended as recommended for high hazard dams is used for the design of Pambukovica.

- Design Flood – 1-in-10,000 year Return Period,
- Safety Check Flood – Probable Maximum Flood (PMF).

## 3.2 Potential Failure Modes and Dam Breach Scenarios

### 3.2.1 Potential Failure Modes

The following failure modes we considered credible scenarios based on the known history and composition of the dam. Credible scenarios are considered physically possible even though they might be extremely unlikely to occur. All of the events listed could lead to a collapse of the embankment.

**Table 2 - Potential Failure Modes A- Internal Threats**

| Potential Failure Modes | Initiation (threat) | Progression (failure mode) | Dam Break Scenario |
|---|---|---|---|
| Internal erosion through dam or foundation | Deterioration of dam or foundation | Internal erosion of dam or foundation. | Internal Erosion |
| Deterioration of body of dam leads to collapse | Deterioration of body of dam and/or use of unsuitable construction material for dam | Flow through crack in watertight element and/or suffusion leads to slope instability | Internal Erosion |
| Leakage along outside of pipe(s) passing through embankment or along outside of spillway wall | Deterioration of contact between pipe/structure and embankment leading to seepage / leakage through embankment dam. | Seepage increases causing internal erosion to embankment fill | Internal Erosion |
| Leakage from pipe(s) leads to internal erosion along interface between structure and embankment | Deterioration of contact between pipes and embankment leading to seepage / leakage through embankment dam | Seepage increases causing internal erosion to embankment fill | Internal Erosion |

**Table 3 - Potential Failure Modes B - External Threats**

| Summary Description | Initiation (threat) | Progression (failure mode) | Dam Break Scenario |
|---|---|---|---|
| Overtopping of crest in flood conditions, leading to erosion of downstream face. | Flood | Overtopping of crest causing scour and erosion of downstream face | Overtopping |
| Spillway out of bank flow, leading to erosion of mitre, downstream face of the embankment and or toe of the embankment. | Flood | Overtopping of spillway causing scour and erosion of downstream face and embankment toe. | Overtopping |
| Intense rain saturates downstream slope or crest overtops during a flood leading to slope instability. | Intense rainfall event / flood | Saturation of fill on downstream face | Overtopping /Instant Breach |
| Seismic event leading to slope instability, foundation settlement or loss of embankment stability | Earthquake | Embankment damage reducing stability or function | Instant Breach |
| Rapid refill (or drawdown) | Uncontrolled operation | Change in pore pressure in fill leading to slope instability and watertight element fracture | Internal Erosion |

From the above likely failure modes an assessment was made that the most rapid failure modes would be most critical for the estimation of potential damages and loss of life, as there would be least amount of time to issue warning and complete evacuation.

From the **internal threats** a rapid/sudden or sudden collapse can modelled as the sunny day scenario with the assumption that no flood and no warning is issued.

From **external threats** an overtopping event leading to the dam erosion and breach is considered in an even with the highest probability to release the largest quantities of water and therefore the most critical failure mode.

## 3.3 Dam Break Scenarios

The following flow scenarios under which failure of the dam can occur were considered in the analysis:

- Instant Breach, where the failure occurs under unusual circumstances such as earthquake, that lead to the loss of stability of the dam (e.g. triggering liquefaction of the fill material).
- Piping Failure where the failure occurs under normal flow conditions (not associated with a flood event) and at the normal operating head water levels (water level at spill level).
- Overtopping Failure where the failure of the dam is associated with the occurrence of a flood of a given return period and at head water levels above normal operating levels.

From the internal threats an internal erosion (case A.1 in Table 2) can be modelled as the Internal Erosion scenario with the assumption that no flood and no warning is issued.

From external threats an overtopping event (case B.1 in Table 3**Error! Reference source not found.**) leading to the dam erosion and breach is considered in an event with the highest probability to release the largest quantities of water and therefore the most critical failure mode.

## 3.4 Model Results

For each scenario a flood range, water depth, water velocity and flood arrival time were calculated.

Dam breach analysis contains maps for each scenario were produced covering flood range, water depth, water velocity and flood arrival time.

Based on flood range main settlements and receptors at risk have been identified.

**Table 4 – Municipalities at Risk**

| Municipality Ub | Municipality Obrenovac |
|---|---|
| • Town of Ub<br>• Gunjevac<br>• Milorci<br>• Pambukovica<br>• Sovljak<br>• Stublenica<br>• Takovo<br>• Tvrdojevac<br>• Crvena Jabuka<br>• Cucuge<br>• Sarbane<br>• Brgule<br>• Zvizdar | • Piroman<br>• Brovic<br>• Veliko Polje |

The population requiring evacuation in the entire affected area amounts to approximately 4359-5,550 individuals, with 11-13 public object, depending on the breach scenario. Length of roads to be flooded is up to 41.5km (i.e. IB 21, IIB 341, IIB 340, IIA 140, IIA 141). The sensitive population that is affected by flood zone are in the city of Ub, and include one secondary school, one primary school, and one kindergarten (to be confirmed in the final version or the EPRP approved by relevant authorities).

## 3.5 Proposed Mitigation Activities

The risk of dam breaches poses severe threats to communities, ecosystems, and infrastructure. To address these risks effectively, a collective approach involving social measures is essential. This plan outlines recommends measures aimed at mitigating dam breach risks.

- Early Warning System (EWS)
  - Installation of automated sirens and water level sensors linked to alarm thresholds.
  - Integration with mobile alert systems and local radio broadcasting.
- Communication Systems
  - Use of mobile networks (A1, Yettel, MTS) and radio systems for emergency coordination.
  - Backup communication protocols in case of network failure.
- Evacuation Planning
  - Development of community-specific evacuation routes and assembly points.
  - Coordination with local authorities for transportation and shelter logistics.
- Community Awareness and Training
  - Public education campaigns on dam safety and emergency procedures.
  - Regular drills involving local residents, schools, and emergency services.
- Institutional Coordination

  - Establishment of a multi-agency emergency coordination group.
  - Clarification of roles and responsibilities across municipal, provincial, and national levels.

- Infrastructure Resilience
  - Identification of critical infrastructure within the inundation zone for potential reinforcement or relocation.
  - Assessment of alternative access routes in case of road network disruption.

- Monitoring and Maintenance
  - Routine inspection and maintenance of dam safety instrumentation.
  - Periodic review and update of the EPRP based on new data or operational changes.

- Post-Emergency Recovery Planning
  - Framework for rapid damage assessment and prioritisation of rehabilitation works.
  - Pre-identification of contractors and suppliers for emergency mobilisation.

These options are not exhaustive and will be subject to stakeholder consultation, technical feasibility assessments, and alignment with national emergency management protocols during the finalisation of the EPRP.

# 4. Risk Management

It is recommended to develop a comprehensive Risk Register for the Project to achieve the following objectives:

- identify risks associated with the life cycle of the Project, i.e. design, construction, commissioning, operation & project management;
- Rank the risks based on likelihood and consequence;
- Identify risk mitigation measures and estimate residual risks;
- Identify the residual risks and undertake mitigation actions;

The Risks shall be identified and ranked into the following categories, based on likelihood and consequence:

- Low (L),
- Medium (M);
- High (H);
- Extreme (E);

**Table 5 - Risk Matrix**

| **Consequence** | | | | | | |
|---|---|---|---|---|---|---|
| **Likelihood Matrix** | **1.Insignificant** | **2.Minor** | **3.Moderate** | **4.Major** | **5.Extreme** | **6.Catastrophic** |
| **A Almost Certain** | **L** | **M** | **H** | **E** | **E** | **E** |
| **B Likely** | **L** | **M** | **H** | **E** | **E** | **E** |
| **C Possible** | **L** | **L** | **M** | **H** | **E** | **E** |
| **D Unlikely** | **L** | **L** | **L** | **M** | **H** | **E** |
| **E Rare** | **L** | **L** | **L** | **L** | **M** | **H** |
| **F Extremely Rare** | **L** | **L** | **L** | **L** | **L** | **M** |

After the risk ranking, the mitigation measures shall be identified. After applying the risk mitigation measures, the “residual risks” shall be ranked.

It is recommended that the Risk Register is reviewed on a regular basis during design, construction, first impoundment to FSL and during the dam operations. The reviews of the Risk Matrix shall be reflected in the EPRP, if necessary.

# 5. Alarm Levels, Notification Procedures and Response Matrix

## 5.1 Alarm Levels

Typically, the Alarm Levels are as follows:

- **Minor deficiencies** – Level 1: mobilise personnel and equipment to deal with minor deficiencies,
- **Serious deficiencies**- Level 2– Local public officials have to be informed to be prepared for action if the situation gets worse,
- **Very serious deficiencies-** Level 3 – as for Level 2,
- **Alarming deficiencies** – Level 4 – Special Mobile Force, police and local public to be alarmed; radio broadcasting to be interrupted to warn the population; the population to be evacuated.

## 5.2 Notification Procedures and Response Matrix

This section describes notification procedure and the response matrix for Pambukovica Dam.

Notification procedures are varied for each of the four Alarm Levels described above, and the response to the emergencies is escalated from Srbijavode to district, provincial and national level.

**Minor deficiencies – Response Level 1.**

The Srbijavode Branch Manager has the primary responsibility to identify and remedy any minor defects identified during routine inspections. If the Branch Manager considers the remedial works to be beyond the capability of their office, they will inform the Main Coordinator for flood defence from Srbijavode. The Main Coordinator for flood defence will mobilize the necessary resources and remedy the defects.

**Serious and very serious deficiencies – Response Level 2 & 3**

Once the deficiency at this level is identified by the Branch Manager and Main Coordinator in Srbijavode will be immediately alerted to the situation. The following agencies will be alerted, and their assistance sought by Srbijavode.

- Public Water Management Company “Srbijavode” - Main Manager and Managers in Water Areas.
- Ministry of Agriculture, Forestry, and Water Management, Republic Directorate for Water - Main Coordinator,
- Ministry of Internal Affairs, Sector for Emergency Situations - Republic and City Notification Center.
- General Staff of the Defence System Operations Centre.
- For emergency works to eliminate the consequences of flood Institute of Water Resources Jaroslav Cerni.

**Alarming deficiencies – Response Level 4**

The notification procedure for this level of deficiency is similar to that of Level 2 and 3 up to the point where Srbijavode head office is made aware of the alarming deficiency.

Srbijavode will inform the relevant ministries as listed above but in parallel to this effort will inform the following agencies to facilitate declaration of state of disaster as per Law on Disaster Risk Reduction and Emergency Management (OG of Republic of Serbia no. 87/2018), which provides legal basis for disaster management, including the procedures for declaring a state of emergency and responsibilities of different government bodies.

Ministry of Internal Affairs, Sector for Emergency Situations is responsible for coordinating emergency response, including issuing notification and organizing evacuations.

During flood defense operations, the Republic Hydrometeorological Institute of Serbia plays a crucial role by providing daily hydrological and meteorological reports from stations defined by the national operational plan by 8:30 AM. Additionally, they ensure water level forecasts for designated gauging stations in the affected water areas by 11:30 AM. These reports and forecasts are disseminated to several key institutions, including the Ministry of Agriculture, Forestry, and Water Management (Republic Directorate for Water), the Provincial Secretariat for Agriculture, Water Management, and Forestry of the Autonomous Province of Vojvodina, Public Water Management Companies “Vode Vojvodine” and “Srbijavode,” the Ministry of Internal Affairs (Sector for Emergency Situations), and the General Staff of the Serbian Armed Forces (Defense System Operations Center).

The process for declaring and revoking flood defense involves issuing orders to the Ministry of Agriculture, Forestry, and Water Management (Republic Directorate for Water), the Provincial Secretariat for Agriculture, Water Management, and Forestry of the Autonomous Province of Vojvodina, Public Water Management Companies “Vode Vojvodine” and “Srbijavode,” the relevant legal entity conducting flood defense, the Republic Hydrometeorological Institute of Serbia, and the Ministry of Internal Affairs (Sector for Emergency Situations). The Republic Notification Center is responsible for delivering warnings about high and flood waters to potentially endangered cities and municipalities, as well as notifications about the declaration of regular and emergency flood defense on first-order waters to the affected cities and municipalities.

# 6. Notification Flowchart

## 6.1 Introduction

This section describes notification procedure and the response matrix for Pambukovica Dam.

Notification procedures are varied for each of the four Alarm Levels described above, and the response to the emergencies is escalated from Srbijavode to district, provincial and national level.

Notification Flowchart should be produced, which should clearly show, for each level of emergency, who is to be notified, and who is responsible for notifying which owner representative(s) and/or public official(s), and in what priority.

The Notification Flowchart should include individual names and position titles, office and home telephone numbers, and alternate contacts and means of communication; they should be easy to follow under emergency conditions, and normally limited to one page for each failure mode.

Copies of flow chart should be readily available to each individual having responsibilities thereon.

## 6.2 Notification Flowchart (Outline)

At the moment, PWMC Srbijavode is yet to align its organizational structure with the capacity needed for the operation of the Pambukovica Dam. Capacity Assessment will be undertaken to inform about current capacity and propose recommendation for structuring of required capacity for operation. As part of the Capacity Assessment relevant managers and heads of departments will be interviewed.

Based on the capacity assessment the Notification Flowcharts are to be developed to reflect the mode of operation of the Srbijavode. The flow charts will be shared with the stakeholders and their input reflected in the final version of this document (to be produced by Srbijavode, prior to start of operation). The flow charts offer guidance on the following:

**Flowchart 0** – The nature of relationship between various private and government agencies

**Flowchart 1** – Notification chart for Level 1 – Minor events

**Flowchart 2, 3** – Notification chart for Level 2,3 – Serious and very serious deficiencies

**Flowchart 4** – Notification chart for Level 4 – Alarming deficiencies.

Based on the capacity assessment and previously identified relevant stakeholders, the position of the contact person and their contact details in the PWMC Srbijavode and other relevant agencies / stakeholders are to be recorded. It should be noted, that relevant contacts might change and this contact list will need to be constantly updated.

**Table 6 - Contact list -PWMC Srbijavode (internal – to be confirmed once roles and responsibilities are defined and assigned)**

| No. | Position | Contact Person | Contact Details |
|---|---|---|---|
| **A** | **Internal Contact** | *TBC* | *TBC* |
| *TBC* | *TBC* | *TBC* | *TBC* |
| *TBC* | *TBC* | *TBC* | *TBC* |

### 6.2.1 Level 1


**Figure 4 - Level 1 Response Matrix**

### 6.2.2 Level 2 and 3

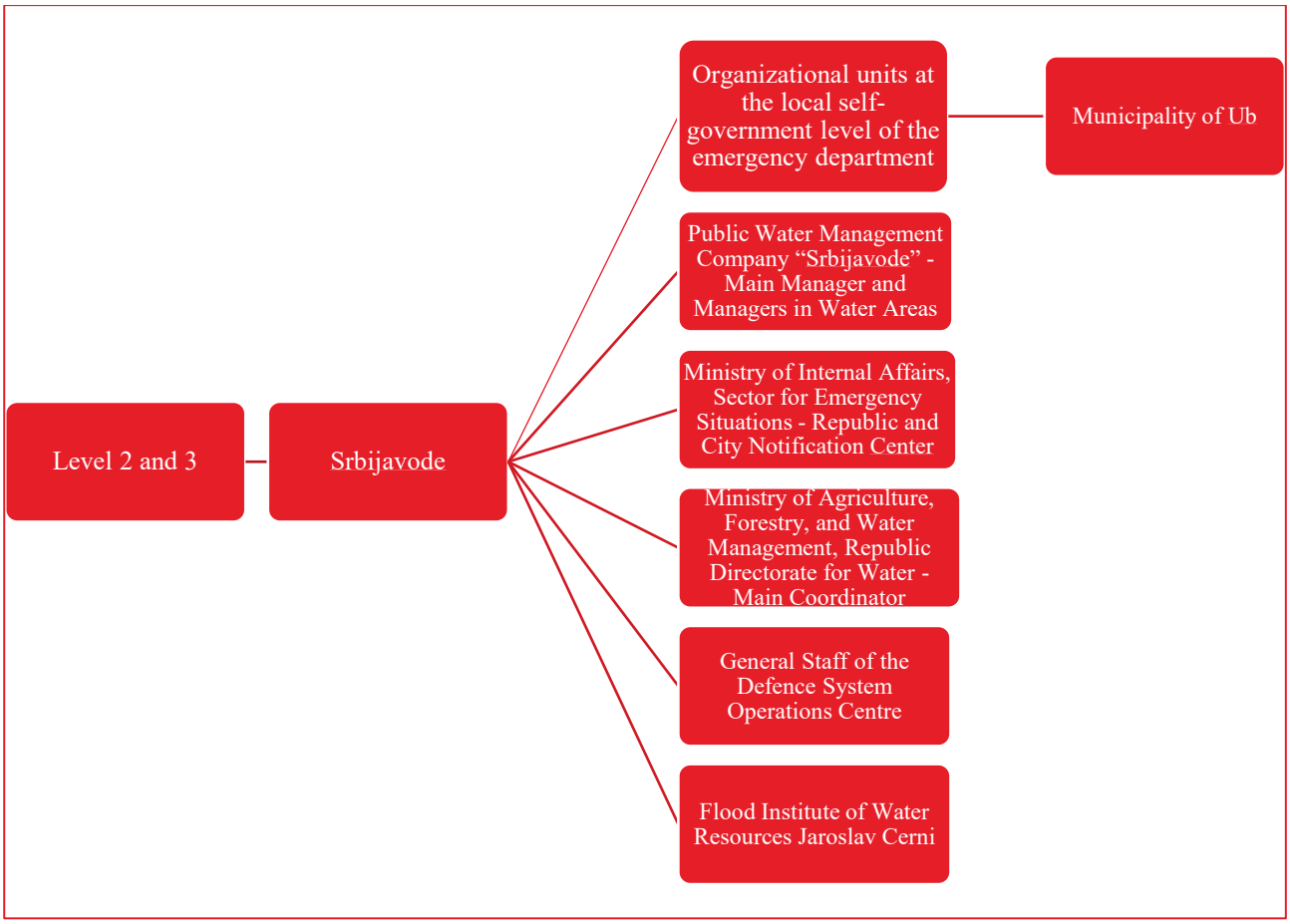


**Figure 5 - Level 2&3 Response Matrix**

Once information is shared with the Sector for Emergency Situation further responsibility for dissemination of information and coordination of public response is under the jurisdiction of the Sector for Emergency Situation.

**Table 7 – Contact list for Level 2 and 3 Response Matrix (external contacts – to be confirmed in the final version of the EPRP)**

| Stakeholder | Contact Details |
|---|---|
| Organizational units at the local self-government level of the emergency department | 014/411-622 |
| Ministry of Agriculture, Forestry, and Water Management, Republic Directorate for Water | 011/201-33-60 |

| Stakeholder | Contact Details |
|---|---|
| Ministry of Internal Affairs, Sector for Emergency Situations - Republic and City Notification Center | 011/2282-927<br>011/2282-928 |
| General Staff of the Defence System Operations Centre | 011/2063-901 |
| Flood Institute of Water Resources Jaroslav Cerni | 011/61 76 600 |
| Municipality of Ub | 014/411-622 |

### 6.2.3 Level 4

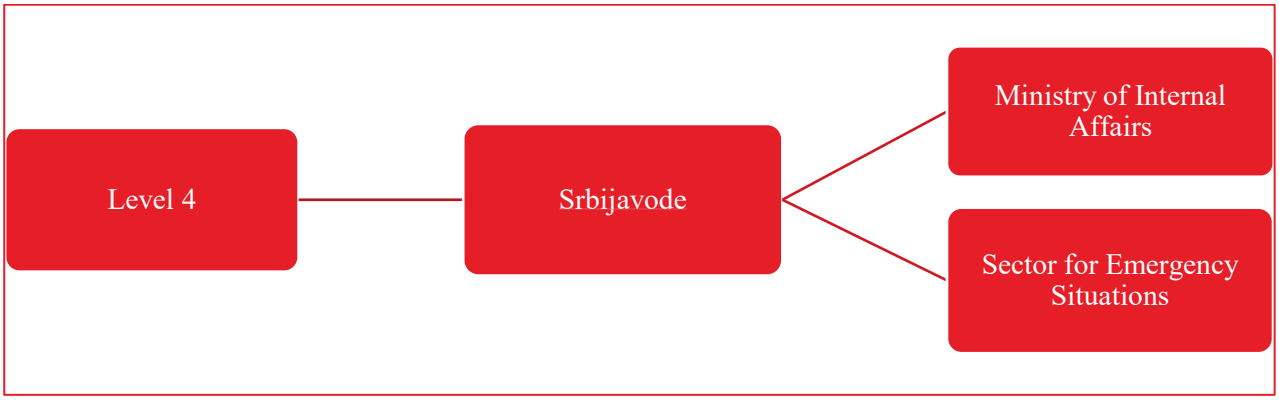


**Figure 6 - Level 4 Response Matrix**

Once information is shared with the Sector for Emergency Situation further responsibility for dissemination of information and coordination of public response is under the jurisdiction of the Sector for Emergency Situation.

**Table 8 – Contact list for Level 2 and 3 Response Matrix (external contacts – to be confirmed in the final version of the EPRP)**

| Stakeholder | Contact Details |
|---|---|
| Ministry of Internal Affairs | **1985** |
| Sector for Emergency Situations | 011/228 29 16 |

### 6.2.4 Communication Chart of the Sector for Emergency Situations

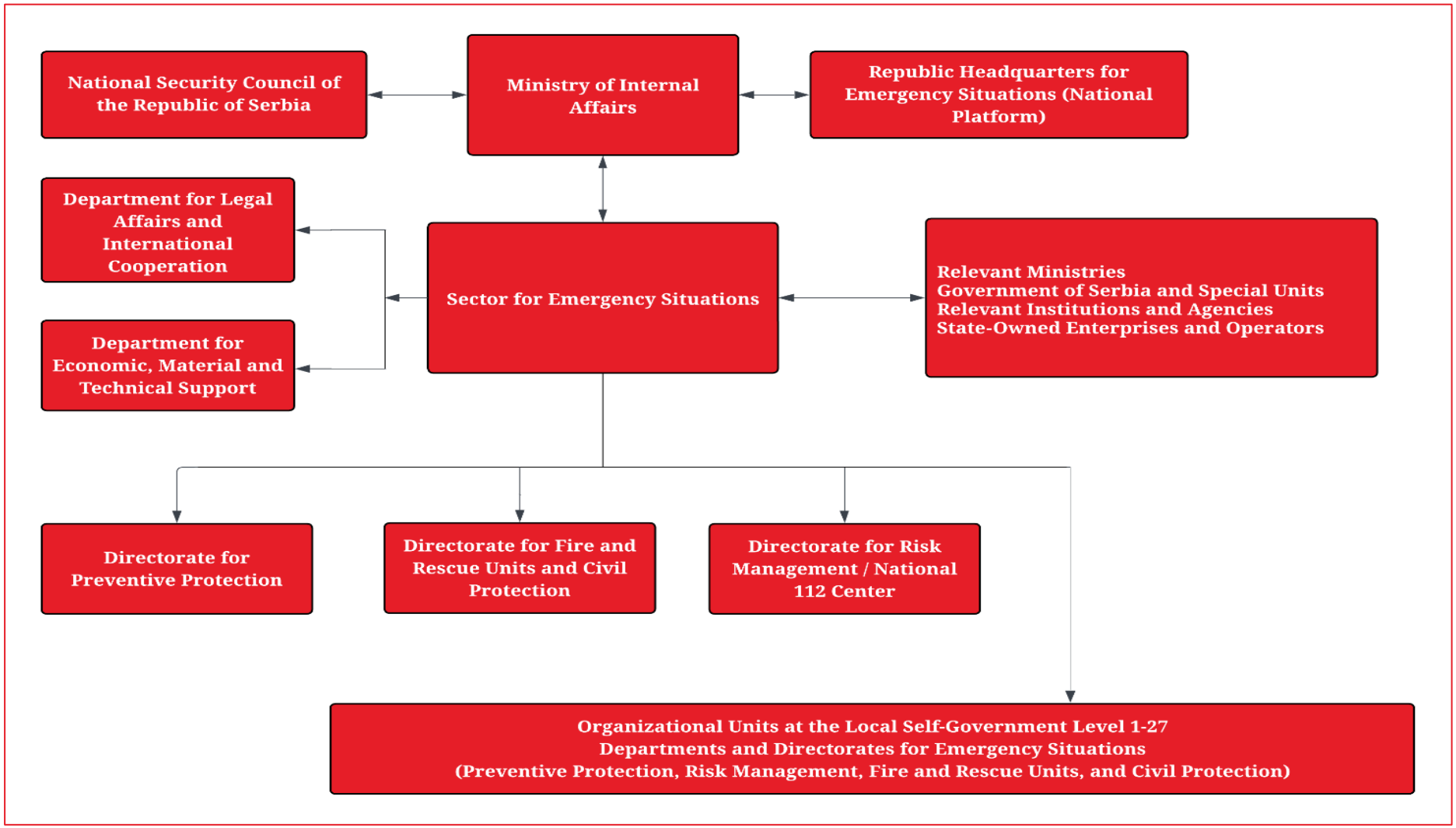


**Figure 7 - Organisational Scheme for Sector for Emergency Situations and communication between relevant institutions**

# 7. Early Warning System

The Early Warning System (EWS) will include the following:

- Dam monitoring instruments,
- Warning equipment (sirens etc),
- Communication system by radio, landline telephone or mobile telephone.

In addition to the EWS it is recommended to have the following dam safety equipment and material at site:

- Hand tools for routine maintenance and repair works,
- Sandbags, stockpile of fill material, fuel
- Transport to the dam for the supervisor, eg small motorbike

## 7.1 Instrumentation and monitoring

It is proposed that the following monitoring is undertaken:

- reservoir level,
- seepage,
- vertical movements,
- water pressure in the dam body and foundations.

### 7.1.1 Reservoir Level

It is proposed to take daily readings of reservoir level from a staff gauge; the readings are to be taken manually.

It is recommended to provide a simple water level warning system which gives an alarm, such as a siren, when the water level over the spillway exceeds a certain depth. The alarm would alert villagers to the possibility of overtopping and give warning time for evacuation if necessary. It is obviously essential that the system is well maintained and protected from vandalism, and the local population is given a clear understanding of what it does for each **Alarm Level**.

### 7.1.2 Seepage

The measurement of seepage requires seepage collection and a measurement system. Once collected seepage will be measured in a flume or V notch weir and will be recorded manually. The seepages shall be linked to the **Alarm Levels.**

### 7.1.3 Vertical Settlements

It is recommended that vertical movements of the embankment are recorded on survey monuments installed on the dam crests. Settlements should be monitored at approximately 6 month intervals by means of an accurate level survey of surface monuments. Where they are not already provided the monuments should be constructed at 50m centres on both the upstream and downstream edge of the dam crest and on the downstream berm.

The level surveys require a high level of skill and the dam owner should assign this task to a dedicated team of surveyors with access to modern equipment.

The vertical movements shall also be related to the **Alarm Levels**.

### 7.1.4 Pore Water Pressures

It is recommended that piezometers are installed in the embankment and foundations at the deepest section of the embankment and flanks. The piezometer readings will be linked to the **Alarm levels**.

# 8. Update, Maintenance, Exercise and Correction of EPRP

## 8.1 Update

The EPRP must be reviewed by the Operator at least once a year, and updated, where necessary. Updating encompassed the following tasks:

- Adaptation of the content to reflect any changes in the emergency response organisation or modification of the communication and alarm equipment,
- update of the names of the individuals in table 5.1
- verification of the hazard identification and risk analysis in order to identify any changes, and where necessary adaptation to the changed situation
- verification of interfaces with the emergency management authorities
- update if changes in the national emergency regulations.

## 8.2 Maintenance

All alarm and communication equipment that is at disposal of the Operator during an emergency must be adequately maintained. Function tests must be carried out at least quarterly.

The means of communication are maintained as follows:

- internal telephone network – at least monthly function control
- mobile phones – always in use, immediate replacement for defects
- radio: monthly check by the Control and instrumentation Engineer and IT Officer with information of the emergency coordinator.

## 8.3 Exercise

As a rule, every five years the operator conducts an internal exercise with simulation of an emergency to drill the Operator's personnel involved in the implementation of the EPRP. The relevant emergency management authorities are informed of this exercise. The purpose of the exercise is:

- check proper working of the alarms and other systems
- check Operator's personnel state of training and readiness or key personnel responsible for actions during an emergency
- Making sure the procedures and actions to be taken are known, understood and followed
- Test the notification procedures
- Check if corrections to the EPRP are needed

The Emergency Exercise are documented in the Emergency Response Dossier (Appendix A.1).

Exercise and sensitization of the authorities' emergency management personnel, communities and population remains the responsibility of the designated emergency authorities on district or provincial level

# A.1 Emergency Response Dossier

The Emergency Response Dossier is an essential document that encapsulates all information related to the internal exercises and simulations conducted by the Operator (Srbijavode).

This dossier includes detailed reports, observations, and corrective actions identified during the emergency simulations, and will be finalised and confirmed for the final version of the Emergency Preparedness and Response Plan, to be approved by the relevant authorities. This Chapter outlines proposed content of the dossier.

## A.1.1 Exercise Documentation

Each exercise is thoroughly documented to ensure a comprehensive record of the procedures, outcomes, and areas for improvement. The documentation includes:

- Details of the exercise scenario and objectives,
- List of participating personnel and their roles,
- Evaluation of alarm and system functionality,
- Assessment of personnel training and readiness,
- Notification procedures and their effectiveness,
- Identified gaps and corrective actions for the EPRP.

## A.1.2 Evaluation and Recommendations

After each exercise, a meticulous evaluation is conducted to analyse the performance of systems and personnel. Recommendations for enhancements and updates to the EPRP are meticulously documented to ensure continuous improvement in emergency preparedness.

## A.1.3 Community and Authorities Engagement

While Srbijavode is responsible for internal exercises, engagement with district and provincial emergency authorities is crucial. These entities are tasked with sensitization and training of their personnel, as well as informing communities and the population about emergency procedures. Collaborative drills and information sharing ensure a cohesive and coordinated response to any potential emergencies.

## A.1.4 Inundation Maps

The dossier also includes inundation maps. These resources are vital for anticipating the impact of potential breaches and planning effective evacuation and response strategies. The maps provide a visual representation of areas at risk, aiding in swift decision-making during emergencies.