MEMORANDUM OF UNDERSTANDING

ON COOPERATION CONCERNING REGULAR FUNCTIONING AND MAINTENANCE OF THE FLOOD FORECASTING AND WARNING SYSTEM IN THE SAVA RIVER BASIN

Whereas

Protocol on Flood Protection to the Framework Agreement on the Sava River Basin (hereinafter: the Protocol), signed in Gradiška on June 1, 2010, set up the obligation of Bosnia and Herzegovina, the Republic of Croatia, the Republic of Serbia and the Republic of Slovenia (hereinafter: the Parties) to establish a coordinated or joint Flood Forecasting, Warning and Alarm System in the Sava River Basin in coordination by the International Sava River Basin Commission (hereinafter: the Sava Commission),

The Parties fulfilled the obligation to establish the Flood Forecasting and Warning System in the Sava River Basin (hereinafter: the System), in accordance with Article 9, paragraphs 1, 2 and 3 of the Protocol, supported by the Project "Improvement of Joint Actions in Flood Management in the Sava River Basin", Component 2 - Flood forecasting and warning system for the Sava River Basin (hereinafter: the Project),

Montenegro, being non-party to the Protocol, took part in the System establishment on the basis of the Memorandum of Understanding on cooperation between the International Sava River Basin Commission and Montenegro, signed in Belgrade on 9 December 2013, and as a beneficiary of the Project,

Pursuant to Article 9, paragraph 4 of the Protocol, the Parties undertook the obligation to ensure regular maintenance and performance control of the System, as well as regular training of the engaged personnel, with application of joint standards,

In order to fulfil the above obligation, it is required to establish an effective joint operation and maintenance structure and procedures,

Therefore

Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, Ministry of Environment and Energy of the Republic of Croatia, Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia, Ministry of the Environment and Spatial Planning of the Republic of Slovenia, Ministry of Agriculture and Rural Development of Montenegro (hereinafter: Signatories from the countries) and Sava Commission (hereinafter jointly: the Signatories), have reached the following understanding:

I. Purpose

1. The intent of this Memorandum is to set forth provisions for an effective joint operational structure and procedures that will ensure regular maintenance and performance control of the established operational System, as well as regular training of the engaged personnel.

II. Subject

2. The subject of this Memorandum is to jointly decide on duties, responsibilities, mutual rights and obligations, by defining:
   a. Organizational structure for System operation and use
   b. Bodies for evaluation and assessment of work performed for the purpose of System operation and overall monitoring of technical issues
   c. Funding and distribution of costs
   d. Conditions of use of the System.

III. Organizational structure for System operation and use

3. Organizational structure for System operation, at the moment of signing of this Memorandum, consists of the following organizations (hereinafter: Hosting Organizations):
   a. Bosnia and Herzegovina:
      i. Sava River Watershed Agency
   b. Croatia:
      i. Croatian Meteorological and Hydrological Service
   c. Serbia:
      i. Republic Hydrometeorological Service of Serbia
   d. Slovenia:
      i. Slovenian Environment Agency
   e. Sava Commission:
      i. Sava Commission Secretariat.

4. Organizational structure for System use consists of the following organizations (hereinafter: Users):
   a. in Bosnia and Herzegovina:
      i. Federal Hydrometeorological Service
      ii. Sava River Watershed Agency
      iii. Republic Hydro-Meteorological Service of the Republic of Srpska
      iv. Public Institution "Vode Srpske"
   b. in Montenegro:
      i. Institute of Hydrometeorology and Seismology
   c. in Croatia:
      i. Croatian Meteorological and Hydrological Service

   ii. Croatian Waters
  d. in Serbia:
    i. Republic Hydrometeorological Service of Serbia
  e. in Slovenia:
    i. Slovenian Environment Agency
  f. in the Sava Commission:
    i. Sava Commission Secretariat.

5. Roles and responsibilities of Hosting Organizations and Users in the System are provided in Annex A of this Memorandum.

6. Roles and responsibilities of Hosting Organizations will be changed every four years if change is requested by any Signatory and if results of the assessment show that the Hosting Organization of the Signatory that requested the change meets the requirements provided in Annex A. In the case of such request, capacity of the Hosting Organizations will be assessed by external body/experts designated by the Steering Group from paragraph 8 of this Memorandum. The assessment will be done during the third year of System operation in the ongoing four-year cycle. The Sava Commission will decide on the change of roles and responsibilities of Hosting Organizations based on the recommendation of the Steering Group by modification of Annex A of this Memorandum.

IV. Evaluation and assessment

7. In order to ensure evaluation and assessment of the work performed for the purpose of System operation, the following bodies are established:
  a. Steering Group
  b. Technical Group.

Steering Group

8. Steering Group consists of one member per Signatory nominated by each Signatory from the countries as voting members and the Secretary of the Sava Commission – Chairperson – as non-voting member. Each member may have a deputy.

9. Steering Group will assess, evaluate and approve all activities performed for the purpose of System operation, international forecasting and cooperation, including the costs of these activities.

10. Terms of Reference of the Steering Group are provided in Annex B of this Memorandum.

Technical Group

11. Technical Group consists of the chairpersons of International Teams listed in paragraph 12 of this Memorandum and one official of the Sava Commission.

12. International Teams are:

a. International Forecasting Team

b. International Support Team

c. International Development Team.

International Teams consist of one member per Signatory nominated by each Signatory from the countries. The Sava Commission may nominate a member for each International Team, if needed. Each member may have a deputy.

13. Technical Group will perform overall monitoring of technical issues, coordinate System functioning, maintenance and developments for activities at the international level, as well as provide its opinion regarding the costs of activities performed.

14. Terms of Reference of the Technical Group and associated International Teams are provided in Annex C of this Memorandum.

V. Financial issues

15. For the purposes of ensuring regular maintenance and performance control of the System, as well as regular training of the engaged personnel, with application of joint standards, the financing will be covered by the Signatories from the countries or other institutions nominated by the Signatories from the countries. The financing may also be ensured by external sources.

16. Annual costs for operating, supporting and development of the System are:
    a. Costs for activities at the national level

    b. Costs for activities at the international level.

17. Costs for activities at the national level are those made by the Users from the countries for their national responsibilities, and these costs will be covered by the Users from the countries directly.

18. Costs for activities at the international level are those made by the Hosting Organizations to enable System operation, and by the Users to enable all necessary activities and cooperation at the international level, and these costs will be covered by the Signatories from the countries or other institutions nominated by the Signatories from the countries.

19. The structure of costs for activities at the international level is provided in Annex D of this Memorandum.

20. The amount for covering the costs of activities at the international level, based on a proposal of the Steering Group, will be determined yearly by the Sava Commission.

21. Signatories from countries will pay annual contributions for the System for the financing of the costs of activities at the international level on an equal basis, with exemption of the Signatory from Montenegro that will contribute half of the annual contribution for the System paid by each other country.

22. The amount for covering the costs of activities at the international level for the first year of System functioning will be determined by the Sava Commission based on the estimation provided in Annex D of this Memorandum.

23. Annual contributions for the System will be paid during the first quarter of the ensuing financial year of the countries and they will be allocated to a separate bank account of the Sava Commission intended exclusively for coverage of costs of System functioning.

24. Real costs of all activities at the international level of the Hosting Organizations and Users, incurred in accordance with the roles and responsibilities within the System provided in Annex A of this Memorandum, at the proposal of the Steering Group, will be paid upon the receipt of invoices approved by the Sava Commission, once per year.

VI. Access to the System

25. The Users will have access to the System following the signing of Conditions of Access to the System, the template of which is provided in Annex E of this Memorandum.

VII. Duration and effective date

26. This Memorandum will come into effect on the day of its signing. This Memorandum may be terminated by mutual consent of all Signatories.

VIII. Rights and Obligations

27. This Memorandum does not create rights or obligations under International Law.

IX. Modification and Disputes

28. This Memorandum may be modified in writing by joint decision of the Signatories.

29. Without prejudice to Article 28, annexes of this Memorandum may be modified by the Sava Commission on the proposal of the Steering Group.

30. Organizations from paragraphs 3 and 4 of this Memorandum may be changed at any time by written notification of the Signatories.

31. Any differences that may arise concerning the interpretation and/or application of this Memorandum should be resolved through negotiations. The foregoing represents the understanding reached among the Signatories on the matters referred to in this Memorandum.

ANNEX A – Roles and responsibilities of Hosting Organizations and Users

ANNEX B – Terms of Reference of the Steering Group

ANNEX C – Terms of Reference of the Technical Group and associated International Teams

ANNEX D – Cost estimation of activities at the international level

ANNEX E – Conditions of access to the System

Roles and responsibilities of
Hosting Organizations and Users

I. Purpose

1. Roles and responsibilities of the Hosting Organizations and Users, defined to facilitate effective operation, maintenance and further development of the System in the implementation period, are related to the following three main groups of activities:
   a. Real-time operation
   b. Support and maintenance
   c. Development and maintenance of consistency.
2. Roles and responsibilities of the Hosting Organizations and Users are also related to several System components which are separated in two groups:
   a. System server components
   b. System client components.
3. This annex defines the organization of each of the above mentioned groups of activities and the System components within the Hosting Organizations and Users, with clear division of roles and responsibilities.

II. Roles and responsibilities of the Hosting Organizations

4. Hosting Organizations listed in paragraph 3 of the Memorandum have the following roles in the System structure:

Organization	Role
Slovenian Environment Agency	Primary System server and Sava HIS-RT
Republic Hydrometeorological Service of Serbia	1st Backup and Testing System server
Sava River Watershed Agency, Sarajevo	2nd Backup System server
Croatian Meteorological and Hydrological Service	3rd Backup System server
Sava Commission Secretariat	Archive and Web System server and Sava HIS

5. Hosting Organizations have roles and responsibilities related to support and maintenance, as well as further development and maintenance of consistency of the following System server components:

System server component	Description
Hardware platform and generic system software	Installed at all Hosting Organizations as the IT infrastructure necessary for System functioning
Master Controller server	Hosted by all Hosting Organizations as the main component of the System which monitors the status of all components and distributes tasks
Forecasting Shell servers	Hosted by all Hosting Organizations, and performing all actual tasks, like importing data, running of models, archive
Database server	Hosted by all Hosting Organizations, and performing tasks of data storing into central database
Webservices server	Hosted by the Sava Commission Secretariat only, and performing tasks of data archive and web services

6. Each of the Hosting Organizations has a Master Controller server installed, and these servers are fully synchronized among each other (except Archive and Web System server), so each of the Users can connect their client applications to the Primary or one of the Backup System servers.

   Synchronization between the System servers under normal conditions:
   a. The Primary System server is the only System server to which all data is imported, and where forecasting models run.
   b. The Backup System servers individually retrieve all data from the Primary via synchronization.
   c. The Primary System server is the only System server allowed to upload configuration data (system updates).
   d. The Users will connect to the Master Controller server at the Primary System server.

   Synchronization between the System servers if the Primary System server fails or goes offline:
   e. The 1st Backup System server (or next active Backup System server) becomes the temporary Primary System server and starts producing forecast data.
   f. If the primary system for observed data provision Sava HIS-RT hosted at the Primary System server also fails or goes offline, Sava HIS hosted at the Archive and Web System server becomes the temporary system for observed data provision.
   g. The other Backup System servers individually retrieve all data from the temporary Primary System server, and the synchronization channels change automatically.
   h. The Primary System server is no longer allowed to upload configuration data (system updates), and it is recommended not to make changes in configuration during this situation.
   i. In extraordinary cases, the temporary Primary System server is allowed to upload configuration data (system updates). These updates will be synchronized to other Backup System servers and to the Primary once it is up again.
   j. In the rare case that the 1st Backup System server also goes down, the responsibility for running forecasts shifts to the 2nd Backup System server and goes on until there are no more Backup System servers available.
   k. Once the Primary System server or the Backup with a "higher role" comes back online, the responsibility for running forecasts shifts back again. Also, the forecast data and configurations that were produced on the temporary Primary System server (1st Backup, 2nd Backup, 3rd Backup) will be synchronized back automatically.
7. Hosting Organizations are responsible for keeping the System up and running continuously without interruption. Hosting Organizations have adequate in-house experience and skills (such as server, database, and web applications management) to organize and manage administration of their IT system in accordance with the following requirements:
   a. Regular support and maintenance of the System server components and data services shall be provided by internal staff of the Hosting Organizations keeping the System up and running continuously.
   b. Optionally, support and maintenance may be provided by external IT companies (third party support), and for such action the Hosting Organizations will formalize

arrangements with a third party support and inform all other Hosting Organizations through the Sava Commission Secretariat. Hosting Organizations that involve third party support will be responsible for arrangements of the contractual agreements.

c. Continuous internet connection bandwidth shall be provided: for the Primary System server a bandwidth of at least 1 Gbit/s and for the Backup System servers at least 200 Mbit/s (available to the System). It is preferred that there is a backup internet connection available.

d. IT infrastructure of the Hosting Organizations shall be equipped with UPS and backup-power generator to prevent severe power outages.

e. IT support team of the Primary and 1st Backup System servers shall be available to support System operation with the required availability as specified in 24/7 and to meet the response time requirements.

f. Response times, defined as maximum duration to start actions to solve a failure of a System server component after notification received, are 2 hours for the Primary and Backup System servers and 72 hours for the Testing and Archive/Web System servers.

g. System server of one Hosting Organization will be accessible to all other Hosting Organizations for the purpose of full synchronization.

h. Additional requirements may be proposed by the Technical Group and approved by the Steering Group.

8. With respect to support and maintenance of the System server components hosted on their IT infrastructure, all Hosting Organizations will regularly provide:

a. Monitoring and maintenance of data supply to the System server (observed data, meteorological and hydrological forecasts, radar and satellite based imagery), including small configuration changes on the data supply.

b. Monitoring and maintenance of hardware platform and generic system software (Oracle Java JRE, Apache Active MQ, Apache Tomcat, PostgreSQL, Installed Forecasting Shell Software, FTP Scripts).

c. Maintenance of the servers and software components, including the System software security.

d. Performing regular software updates.

e. Support to the National Forecasting Coordinators regarding the access of System client components to System server.

f. Coordination of the third party IT support if provided.

In addition, the Hosting Organization for the Primary System server will provide:

g. Monitoring of the real-time meteorological and hydrological data transmission to the Sava HIS-RT,

h. Monitoring of the scheduled runs of hydrological models.

i. Monitoring and troubleshooting of Back-up System servers and Archive/Web System server data synchronization,

j. Monitoring, under flood conditions, of forecast dissemination systems (System Web Reports, System PI Web Service, System WaterML2 Service) and archive module operating,

k. Support to the National Support Coordinators regarding the hardware platform and generic system software (Oracle Java JRE, Apache Active MQ, Apache Tomcat, PostgreSQL, Installed Forecasting Shell Software, FTP Scripts).

9. Given that the System is a single software system that runs in a distributed mode, using the server and client components at various hardware platforms in the countries, in case an issue of support and maintenance cannot be solved at the level of Hosting Organizations, it must be raised to the international level. To facilitate international cooperation of support and maintenance, the following roles are assigned:

a. Support Officers, within each of the Hosting Organizations, who are responsible for the System server components, including to bring remaining issues that cannot be solved to the international level. Several Support Officers for the System server components may be on duty within each IT support team of the Hosting Organizations; however, given the international responsibilities, all Hosting Organizations will have the following personnel available:

Role	Support Officers
Primary System server and Sava HIS-RT	4
1st Backup and Testing System server	2
2nd Backup System server	1
3rd Backup System server	1
Archive and Web System server and Sava HIS	1

b. National Support Coordinators, within each of the countries, who are responsible for the coordination of the support and maintenance process at the national and international level. This role is assigned to one person within a country at a time. National Support Coordinators form a distributed International Support Team that remains in close contact on matters related to coordination of the maintenance process. Tasks of the International Support Team coordinated by the International Support Coordination Officer are described in ANNEX C of the Memorandum.

10. An overview of the required availability at the national and international level with respect to the various tasks for support and maintenance is provided in the following table:

Task Description	Normal conditions	Flood conditions		
		other country	nat. scale	int. scale
Support Officer for the System client	office hrs..	office hrs.	24/7	24/7
Support Officer for the Primary server	office hrs.	office hrs.	24/7	24/7
Support Officer for the 1st Back-up server	as needed	24/7	24/7	24/7
Support Officer for the 2nd&3rd Back-up server	as needed	/	/	office hrs.
Support Officer for the Archive/Web server	office hrs.	office hrs.	office hrs.	office hrs.
National Support Coordinator	as needed	office hrs.	24/7	24/7
International Support Coordination Officer	as needed	24/7	24/7	24/7

11. Support Officers within each of the Hosting Organizations will be regularly trained through national IT system management refresher trainings, in order to keep the knowledge at the required level to effectively support, maintain and troubleshoot the System. The refresher courses will be provided by experienced Support Officers within the IT team of each of the

Hosting Organizations. In the case when new members join the IT support team, or when new software developments are operationalized, additional trainings will be organized.

12. International Support Team will be regularly trained through annual international IT system management exercises, in order to maintain and repeatedly strengthen the capacity of the Support Officers and coordination of the National Support Coordinators. Based on this type of exercises, communication procedures are to be tested and improved as well.

13. National Support Coordinators are responsible for organization of national IT system management refresher trainings (regular and additional), while the International Support Team is responsible for organization of annual international IT system management exercises.

14. International Support Team will regularly prepare the annual training program in accordance with the following recommendations concerning the required training duration with respect to various tasks for support and maintenance:

Task Description	Trainings
Support Officer for the System client	3 days/year
Support Officer for the Primary server	6 days/year
Support Officer for the 1st Back-up server	6 days/year
Support Officer for the 2nd&3rd Back-up server	4 days/year
Support Officer for the Archive/Web server	3 days/year
National Support Coordinator	1 day/year

III. Roles and responsibilities of the Users

15. Organizational structure for System use consists of the following Users organizations:

Country	Organization	Roles
Bosnia and Herzegovina	Federal Hydrometeorological Service	Forecaster/Developer/Viewer
	Sava River Watershed Agency	Forecaster/Developer/Viewer
	Republic Hydro-Meteorological Service of Republic of Srpska	Forecaster/Developer/Viewer
	Public Institution "Vode Srpske"	Forecaster/Developer/Viewer
Montenegro	Institute of Hydrometeorology and Seismology	Forecaster/Developer/Viewer
Croatia	Croatian Meteorological and Hydrological Service	Forecaster/Developer/Viewer
	Croatian Waters	Forecaster/Developer/Viewer
Serbia	Republic Hydrometeorological Service of Serbia	Forecaster/Developer/Viewer
Slovenia	Slovenian Environment Agency	Forecaster/Developer/Viewer
Sava Commission	Sava Commission Secretariat	Developer/Viewer

16. Each of the Users has equal roles in the System (forecaster/developer/viewer) except the Sava Commission (developer/viewer) in accordance with the national responsibilities, and the System is configured to support the execution of the individual national responsibilities in normal or drought conditions.

17. Each of the Users may access and use the System and the password protected web access to the following System client components, desktop and web applications:

System client component	Description
System Operator Client (Sava OC)	Desktop application connected to one of the System servers through https over the internet
System Configuration Manager (Sava CM)	Desktop application connected to one the System servers through https over the internet
System Testing (Sava Test OC and Test CM)	Desktop applications connected to the Testing System server through https over the internet
System Stand Alone (Sava SA)	Desktop application not connected to the System servers
System Web Reports	Password protected web application available at: http://ffws4.savagis.org/sava/reports/
System PI Web Service	Password protected web application available at: http://ffws2.savagis.org/FewsPiService
System WaterML2 Service	Password protected web application available at: http://ffws2.savagis.org/FewsPiServiceRest/

18. Each of the Users, responsible for preparing adequate forecasts and disseminating them to national authorities for flood and emergency management (and when applicable to other Users), has its own forecasting team that will use the System client components in accordance with the following principles and requirements:

   a. One person responsible for access to the System client components will be nominated by each of the Users.

   b. The responsible person of each of the Users may nominate person/persons for access to the System client components for various user categories.

   c. The responsible person of each of the Users may enable access to certain System client components to the national authorities for flood and emergency management (hereinafter: Partner Users). The Partner Users will not be able to run the System themselves, but may receive the System client components: System Web Reports, System PI Web Service, and System WaterML2 Service, tuned to their specific needs. In case that the Users would enable access to the System client components which include data and products of another country(s), that will be possible only upon prior request and consent of the related User(s). The request should precisely and unambiguously define which System client component is required and by whom, including details of the exact purpose. The User(s) will respond to all requests within 30 days of receiving a written request. In case no response of the User is provided within 30 days, it will be presumed that access is granted.

   d. The list of Users' responsible and nominated persons, and the list of Partner Users, will be available to Hosting Organizations and Users at the Sava Commission Secretariat.

e. Each of the Users will have IT support (single points of contact) for the communication between the forecasting team and the National Support Coordinator related to support of the System client components.

f. The System client component, related to the real-time operation (Sava OC), will be used in line with the System User and Technical Reference Manual.

g. The forecasting workflows will be accessible by each of the Users to run for own area of responsibility and for the basin as a whole.

h. All data and products (observed hydrological and meteorological data, forecasted hydrological and meteorological data, numerical weather prediction models, radar and satellite imagery, hydrological models and input data, hydraulic models and input data, configuration data) will be accessible by each of the Users for the official duty only.

i. Possible editing of the real-time observed data will be performed only for telemetry stations that are located in own area of responsibility.

j. Possible editing of models will be performed only for models that are located in own area of responsibility.

19. Each of the Users, responsible for the meteorological and hydrological monitoring and modelling, has its own developers available that will use the System client components to deal with the needs and requirements that will be developed over time (e.g. implementation of new: observation points, numerical weather prediction and radar products, hydrological and hydraulic models, etc.). In order to integrate and operationalize any new developments in the System, the Users have the following roles and responsibilities:

a. All nominated persons from each of the Users will have access to the complete configuration of the System through the System Configuration Manager (Sava CM).

b. Planned developments in the System that may affect other countries will be communicated up front with all Users through the International Development Team.

c. The System client components, related to the developments and maintenance of consistency (Sava CM, Sava Test OC&CM, and Sava SA), will be used in line with the System User and Technical Reference Manual.

d. Develop the standalone configuration updates (using Sava SA application) to integrate new developments and store the updates in the shared configuration (code) repository system.

e. Adequately test new developments in standalone mode and in the testing platform (using Sava Test OC and Sava Test CM application).

f. Report on configuration updates once successfully completed, and share with other Users.

g. Before uploading new or adjusted configuration to the System server (using Sava CM application), it is necessary to do a download first, to make sure new files uploaded by other users are incorporated in the local Data Store.

20. In order to avoid any unnecessary consequences of the System operating, as well as to maintain the consistency of daily operation and development of the System and to ensure that the System remains in sync with national and international forecasting requirements, coordination and communication between the Users is organized through the following assigned roles:

a. Duty Forecasters and System Developers, rotating within a forecasting team of each of the Users. Each User will nominate at least 2 Duty Forecasters and 1 System Developer.

b. National Forecasting Coordinators, within each of the countries, are responsible for coordination of real-time forecasting process at the national and international level. They are not responsible for providing actual real-time forecasts, unless they are the 'forecaster on duty'. This role is assigned to one person within a country at a time.

c. National Forecasting Coordinators form a distributed International Forecasting Team that remains in close contact on matters related to coordination of the real-time forecasting process. Tasks of the International Forecasting Team, coordinated by the International Forecasting Coordination Officer, are described in ANNEX C of the Memorandum.

d. National Development Coordinators, within each of the countries, are responsible for coordination of development process at the national and at the international level. This role is assigned to one person within a country at a time.

e. National Development Coordinators form a distributed International Development Team that remains in close contact on matters related to coordination of the development process. Tasks of the International Development Team coordination by the Sava Commission Secretariat as the International Development Coordination Officer are described in ANNEX C of the Memorandum, while implementation of developments is the responsibility of the Users and Hosting Organizations.

21. An overview of the required availability at the national and international level with respect to the various tasks for real-time operation, development and maintenance of consistency is provided in the following table:

Task Description	Normal conditions	Flood conditions		
		other country	nat. scale	int. scale
Duty Forecaster	office hrs.	/	24/7	24/7
National Forecasting Coordinator	office hrs.	office hrs.	24/7	24/7
International Forecasting Coordination Officer	as needed	24/7	office hrs.	24/7
System Developer	as needed	/	as needed	as needed
National Development Coordinator	as needed	as needed	as needed	as needed
International Development Coordination Officer	as needed	as needed	as needed	as needed

22. Duty Forecasters and System Developers of each of the Users will be regularly trained through national refresher trainings, in order to learn how to operate the System client components, but also how to run through the complete forecasting process and procedures in configuring new features and how to operationalize them in the System. The refresher courses will be provided by experienced Duty Forecasters and Developers within a forecasting team of each of the Users. In case new members join the forecasting team, additional trainings will be organized.

23. International Forecasting and Development Teams will be regularly trained through annual international exercises, in order to maintain and repeatedly strengthen the capacity of the forecasting teams of each User to operate the System during major floods as well as the capacity of the National Forecasting and Development Coordinators to practice how to

effectively exchange information and communicate. Based on this type of exercises, communication procedures are to be tested and improved as well.

24. National Forecasting and Development Coordinators are responsible for organization of the national refresher trainings (regular and additional), while the International Forecasting and Development Teams are responsible for organization of annual international exercises.

25. International Forecasting and Development Teams will regularly prepare joint annual training program in accordance with the following recommendations concerning the required training duration with respect to various tasks for real-time operation, development and maintenance of consistency:

Task Description	Trainings
Duty Forecaster	6 days/year
National Forecasting Coordinator	1 day/year
International Forecasting Coordination Officer	1 day/year
System Developer	4 days/year
National Development Coordinator	1 day/year
International Development Coordination Officer	1 day/year

Terms of Reference of the Steering Group

I. Purpose

1. The Steering Group is established for the general purpose of monitoring, evaluating and coordinating the work of the jointly established Flood Forecasting and Warning System in the Sava River Basin (hereinafter: the System).

2. These Terms of Reference (ToR) define the membership, mandate and methodology of work of the Steering Group in taking actions in the subject areas described below.

II. Membership

3. Members of the Steering Group are:
   a. One member nominated by each Signatory from the countries;
   b. The Secretary of the Sava Commission – Chairperson – as a non-voting member.
4. Each member may have a deputy.

III. Tasks

5. Responsibility of the Steering Group is to carry out the following tasks:
   a. Perform the overall monitoring of the System, evaluate and assess joint work performed for the purpose of System operation, international forecasting and cooperation, including the costs for activities performed by the Hosting Organizations and Users based on the proposals and recommendations of the Technical Group.
   b. Provide recommendations to the Sava Commission regarding approval of the joint work performed for the purpose of System operation, international forecasting and cooperation, including the costs for activities performed by the Hosting Organizations and Users.
   c. Review of issues encountered during System operation, while ensuring that required approvals and direction for System operation are obtained for each group of activities (real-time operation; support and maintenance; development and maintaining consistency).
   d. Once per year, report to the Sava Commission real costs of all activities at the international level of the Hosting Organizations and Users performed in accordance with the roles and responsibilities within the System, and propose approval of the related invoices.
   e. Provide recommendations to the Sava Commission regarding modifications of the roles and responsibilities of the Hosting Organizations.
   f. Report to the Sava Commission and the Signatories on its work, overall functioning and progress of the System, with proposals and recommendations.

IV. Working arrangements

6. The meeting of the Steering Group will be held at least once per year.

7. Steering Group's decisions, recommendations and proposals to the Sava Commission will be adopted by consensus at the meeting. In the case of absence of a member, conference call can be organized and/or a vote can be given in writing.

8. In the case when a consensus cannot be reached, the opinion shall be delivered to the Sava Commission by the majority of votes. Dissenting opinion shall also be submitted to the Sava Commission for final decision.

9. In such case, the Steering Group members shall be invited to participate in the respective part of the Sava Commission's session.

10. Additional experts may also participate in the meetings of the Steering Group should their specific expert knowledge be needed or requested. Participation of such experts needs to be announced to the Sava Commission's Secretariat by a member of the Steering Group, at least one week prior to the meeting.

11. The Steering Group may decide on rules of procedure, if necessary.

V. Costs

12. Meeting expenses of the Steering Group members (travel and accommodation) shall be paid by the Signatories.

VI. Methodology of distribution of documents

13. Communication of the Steering Group meeting-related documents and materials will be done in the most convenient manner, in electronic form in principle, and at least one week before the opening of the meeting. Only the comments concerning already circulated documents and logistic information will be sent after that deadline.

14. The Secretariat of the Sava Commission shall provide unrestricted access on the Sava Commission's web site to the related materials and documents for the Steering Group members.

VII. Reporting obligations

15. Reports on the work of the Steering Group, overall functioning and progress of the System with the proposals and recommendations, shall be regularly submitted to the Sava Commission by the Chairperson.

Terms of Reference of the Technical Group and associated International Teams

I. Purpose

1. The Technical Group and associated International Teams are established for the general purpose of overall monitoring of technical issues related to System functioning, providing opinions regarding the costs of activities performed by the Hosting Organizations and Users, and coordinating the System operation, support, maintenance and developments concerning activities at the international level.

2. This annex defines the Terms of Reference, membership, mandate and methodology of work of the Technical Group in taking actions in the subject areas described below.

II. Composition

3. Technical Group consists of the following teams:
   a. International Forecasting Team
   b. International Support Team
   c. International Development Team.
4. Each team consists of 5 experts - national coordinators, nominated by the Signatories from the countries.

5. Each team has a chairperson – Coordination Officer, and the first chairperson of each team will be selected among the members of the team at its first meeting.

6. The term of office of the chairpersons shall last two years, and it shall be rotated following the English alphabetical listing of their countries.

7. Tasks of each team are defined under Item IV.

III. Membership

8. Members of the Technical Group are:
   a. Representatives of the Signatories from the countries
      i. International Forecasting Coordination Officer – chairperson of the International Forecasting Team
      ii. International Support Coordination Officer – chairperson of the International Support Team
      iii. International Development Coordination Officer – chairperson of the International Development Team
   b. Official of the Sava Commission.

IV. Tasks

9. In addition to the particular tasks described below, the chairpersons of international teams within the work of Technical Group are responsible for compiling the reports of the international teams and for reporting to the Steering Group, once per year, real costs of all activities at the international level of the Hosting Organizations and Users performed in accordance with the roles and responsibilities within the System.

10. **International Forecasting Team** is formed by the National Forecasting Coordinators, defined in ANNEX A of the Memorandum, and it remains in close contact on matters

related to coordination of the real-time forecasting process. International Forecasting Team is organized and coordinated by the International Forecasting Coordination Officer – chairperson of the Team, which is a rotating role taken by one of the National Forecasting Coordinators from the countries, with the following main tasks:

a. Coordination and organization of work processes in the System that have an international aspect, in particular with respect to the following activities:
   i. Basin-wide real-time data transfer within the Sava HIS-RT;
   ii. Basin-wide weather prediction models, radar and satellite imagery operation;
   iii. Basin-wide hydrological and hydraulic models' functioning.
b. Coordination of international communication procedures related to real-time forecasting and data transfer.
c. Coordination of post-event evaluations for floods with an international dimension;
d. Coordination and preparation of annual training program jointly with the International Development Team.
e. Coordination and organization of annual international exercises jointly with the International Development Team.

11. International Forecasting Team will report to the Technical Group once per year on the activities performed by the national forecasting coordinators and duty forecasters, based on reports with invoices provided by the Hosting Organizations and Users.

12. **International Support Team** is organized as the point of contact for the National Support Coordinators, defined in ANNEX A of the Memorandum and coordinated by the International Support Coordination Officer. The International Support Coordination Officer is a rotating role between and adopted by one of the National Support Coordinators, with the following main tasks:

a. Coordination of the 2nd line support to the National Support Coordinators for use of the applications; even when floods are expected at a national scale in other riparian countries, 24/7 availability is required.
b. Coordination of the 3rd line support to the National Support Coordinators to be provided by external organizations (third party support).
c. Coordination of software upgrade and licensing.
d. Coordination of hardware maintenance.

13. International Support Team will report to the Technical Group once per year on the activities performed by the national support coordinators and support officers for the System client and server, including the costs.

14. **International Development Team** is formed by the National Development Coordinators, defined in ANNEX A of the Memorandum, and it remains in close contact with the National Forecasting Coordinators and the National Support Coordinators on matters related to coordination with respect to development and maintenance of consistency. International Development Team is organized and coordinated by the Sava Commission Secretariat as the International Development Coordination Officer with the following main tasks:

a. Coordination of basin-wide data product development.
b. Coordination of basin-wide model(s) development.

c. Coordination of basin-wide forecasting product development.
d. Coordination of developments in Sava HIS and Sava HIS-RT that have an impact on the System.
e. Coordination of maintenance of consistency of the System.
f. Communication protocol development with respect to real-time forecasting, and support and maintenance.
g. Planning and coordination of System developments.
h. Coordination and preparation of annual training program jointly with the International Forecasting Team.
i. Coordination and organization of annual international exercises jointly with the International Forecasting Team.
j. Coordination of maintenance of live system testing and staged release platform.
k. Coordination of fundraising for support and development.

15. International Development Team will report to the Technical Group, once per year, on the activities performed by the national development coordinators and the System developers, including the costs.

V. Working arrangements

16. Meetings of international teams will be held in accordance with real needs, upon invitation of their chairpersons.

17. Meetings of the Technical Group will be held at least twice per year.

18. Technical Group's proposals will be adopted by consensus at the meeting. In the case of absence of a member, conference call can be organized and/or a vote can be given in writing.

19. Members of the International Teams, as well as additional experts, may also participate in the meetings of the Technical Group should their specific expert knowledge be needed or requested.

20. The Steering Group may decide on rules of procedure of the Technical Group, if necessary.

VI. Costs

21. Meeting expenses of the Technical Group members (travel and accommodation) shall be paid from the System budget.

VII. Methodology of distribution of documents

22. Communication of the International Teams and Technical Group meeting-related documents and materials will be done in the most convenient manner, in electronic form in principle, and at least one week before the opening of the meeting. Only the comments concerning already circulated documents and logistic information will be sent after that deadline.

23. The Secretariat of the Sava Commission shall provide unrestricted access on the Sava Commission's web site to the related materials and documents for the Technical Group members.

VIII. Reporting obligations

24. Technical Group will report to the Steering Group.

Cost estimation

of activities at the international level

I. Purpose

1. The cost estimation for the activities at the international level associated with operation, support and maintenance, as well as further developments of the System, and in accordance with the roles and responsibilities of the Users and Hosting Organizations defined in the Annex A of the Memorandum, has been prepared following the standard *EU CIS Guidance Document N° 1 - Economics and the Environment - The Implementation Challenge of the Water Framework Directive*, and it includes the following:

   a. Operating costs: all costs to use and keep the System running
   b. Maintenance costs: all costs needed to regularly maintain the System servers
   c. Capital costs: all costs of new investments (new hardware, models, etc.) and costs of replacing infrastructure
   d. Administrative costs: all costs related to coordination activities
   e. Other direct costs.

2. This Annex defines the estimation of manpower and costs with respect to the required activities necessary to facilitate the effective operation, maintenance and further developments of the System. Real costs of all activities at the international level of the Hosting Organizations and Users incurred in accordance with roles and responsibilities within the System, based on a proposal of the Steering Group, will be determined by the Sava Commission, once per year.

II. Overview of required activities

3. Detailed description of activities is provided in the following table:

Cost Element / Description	Responsibility
1. Operating costs	
Real-time forecasting	
Monitoring of basin-wide real-time data transfer within the Sava HIS-RT	Primary System and Archive&Web Server
Monitoring of basin-wide weather prediction models, radar and satellite imagery operation	Primary System Server
Monitoring of basin-wide hydrological and hydraulic models' functioning	Primary System Server
Coordination and organization of work processes in the System that have an international aspect	International Forecasting Team
Coordination of international communication protocols related to real-time forecasting and data transfer	International Forecasting Team
Coordination of post-event evaluations for floods with an international dimension	International Forecasting Team
System developments	
Planning and coordination of the System developments	International Development Team
Coordination of development in basin-wide data products and model(s)	International Development Team
Coordination of developments in Sava HIS-RT	International Development Team
Coordination of international communication protocol related to development with respect to real-time forecasting, and support and	International Development Team

maintenance	
Coordination of maintenance of live system testing	International Development Team
System hosting rotation	
Coordination of assessment of the technical capacities of the Hosting Organizations	International Support Team
Assessment of the technical capacities of the Hosting Organizations	Third party
Hosting replacement	Third party
2. Maintenance costs	
Support & maintenance	
Monitoring of data supply to the System (observed data, NWPs, radar and satellite based imagery)	All Hosting Organizations
Monitoring of hardware platform and generic system software	All Hosting Organizations
Maintenance of the servers and software components	All Hosting Organizations
Performing regular software updates	All Hosting Organizations
1st line support to the National Forecasting Coordinators regarding the System client components	All Hosting Organizations
Monitoring of data acquisition systems and transmission of observed data streams to and from the Sava HIS-RT	Primary System Server
Monitoring of meteorological and hydrological forecasts generated by other systems	Primary System Server
Monitoring of data retrieval via synchronization with Back-up System servers and Archive/Web System server	Primary System Server
Monitoring of the forecast product dissemination systems and archive operating	Primary System Server
Monitoring of the System software components (Delft-FEWS, Sava HIS-RT, models)	Primary System Server
1st line support to the National Support Coordinators regarding the hardware platform (including generic system software)	Primary System Server
Coordination of the 2nd line support to the National Support Coordinators regarding the hardware platform (including generic system software) and the System client components	International Support Team + Primary System Server
Coordination of 3rd line support to the National Support Coordinators regarding the hardware platform (including generic system software) and the System client components to be provided by external organizations	International Support Team + Third party support
Software upgrade and licensing	International Support Team + Third party support
Hardware upgrade	International Support Team + Third party support
Sava HIS-RT maintenance	
Preventive control	Primary System and Archive&Web Server
Monitoring of generic system software	Primary System and Archive&Web Server
Maintenance of the software components (regular and corrective)	Primary System and Archive&Web Server + Third party support
Coordination of the 3rd line support to be provided by external	International Support Team

organizations	+ Third party support
Delft-FEWS support contract	
Helpdesk	Third party support
Call handling	
Configuration support	
Deployment of new releases	
Bug-fixing and Patches	
Mike11 license & support contract	
License Purchase	Third party support
Helpdesk	
Software updates	
3. Capital costs	
Hardware replacements and IT infrastructure	
IT Equipment Purchase	Third party support
Development of new products and models	
Expert Services	Third party support
4. Administrative costs	
International coordination meetings	
Travel and accommodation costs	All Hosting Organizations and all Users
Administration and management	International Development Team
Trainings and exercises	
Trainers and materials	Third party support
Venue and subsistence	Third party support
Travel and accommodation costs	All Hosting Organizations and all Users
Administration and management	International Development Team
5. Other costs	

III. Estimation of required manpower

4. The costs are estimated based on information about the manpower required to operate, support and develop the System, taking into account necessary engagement of the third parties. An overview of annual number of manpower hours that are estimated to be required for each of the roles identified in Annex A of the Memorandum is provided in the following table:

Task Description	BA				HR		ME	RS	SI	
	FHMZ	AVP SAVA	RHMZ RS	JUVS	DHMZ	CW	ZHMS	RHMZ	ARSO	ISBRC Secr.
Real-time forecasting										
Ntl. forecast. coordinat.	40	40	80		80		40	80	90	
Interntl. forecast. coordinat.		40			40		40	40	50	20
Support & maintenance										
Support officer	80	160			160			310	310	
Ntl. support coordinat.		80			80		40	80	95	40
Training	24	48	24	24	40	20	20	48	48	24
System development										
Ntl. develop. coordinat.		136		136	136		136	136	136	192
Totals										
User organization	**144**	**504**	**104**	**160**	**536**	**20**	**276**	**694**	**729**	**276**
Real-time forecasting	40	80	80		120		80	120	140	20
Support and maintenance	104	288	24	24	280	20	60	438	453	64
System Development		136		136	136		136	136	136	192

IV. Estimation of costs

5. The overall annual cost estimation for System functioning is EUR 160,000.

6. The cost estimation for the first period of System functioning is subject to the following conditions and assumptions:
   a. Only the Primary, 1st Backup and Archive and Web System servers need full financial support, which results in reduction to 25% for the 2nd and 3rd Backup System servers.
   b. Third-party software contracts are reduced to 25%, since software updates will not be part of the contract.
   c. The budget for international coordination meetings is reduced to 50% because most of these costs are needed for coordination of developments which are not expected to be huge during the first year.
   d. It is not expected that major updates in IT infrastructure would be needed already in the first year; reservation for new hardware is therefore reduced to 50%.

7. The cost estimation for the first period of System functioning is EUR 70,000 per year.

Conditions of use of the System

**Agreement on conditions of use
of the Flood Forecasting and Warning System in the Sava River Basin**

between

/Signatory of Memorandum from the Country/

and

/User/

<Template>

1. The Flood Forecasting and Warning System in the Sava River Basin (hereinafter: the System), is established within implementation of the Protocol on Flood Protection to the Framework Agreement on the Sava River Basin. Effective joint operational structure and procedures of regular maintenance and performance control of the System are regulated by the provisions of the Memorandum of Understanding on cooperation concerning regular functioning and maintenance of the Flood Forecasting and Warning System in the Sava River Basin (hereinafter: Memorandum) of */date/*.

2. This Agreement regulates conditions of use of the System by */User/* (hereinafter: the User).

3. The System consists of the following data and products:
   a.   Observed hydrological and meteorological data;
   b.   Forecasted hydrological and meteorological data;
   c.   Radar and satellite imagery;
   d.   Hydrological models;
   e.   Hydraulic models;
   f.   Digital elevation model(s) and other static data;
   g.   Configuration data.
4. The System is configured within several System components, separated into two groups:
   a.   System server components;
   b.   System client components.
5. It is the responsibility of the User to use the System in accordance with the restrictions set out in this document.

6. It is the responsibility of the User to understand the limitations of data and products available in the System.

7. The User activates the System through System client components, defined in the System User and Technical Reference Manual, which connects to System server components over the Internet.

8. The User may access and use the System in accordance with the following requirements:
   a.   The User must respect the System User and Technical Reference Manual.
   b.   The User may edit only those data and products in the System that are within its area of responsibility.
   c.   The User may integrate new developments only after:
     i. Successful testing in standalone mode;
     ii. Successful testing in the Testing System server;
     iii. Reporting on configuration updates and sharing with other Users; and
     iv. Downloading the existing configuration before final upload to the Primary server.

9. The User may use all data and products contained in the System, but retains solely ownership rights concerning its own data and products.

10. The User may disseminate information based on data and products contained in the System to all relevant authorities or offices and general public in its country.

11. The User will nominate one person responsible for access to the System. This responsible person may nominate person/persons for user categories (forecaster/developer/viewer).

12. The User may enable access to the following System client components: Web Reports, PI Web Service, WaterML2 Service to the national authorities for flood and emergency management (hereinafter: Partner Users), who will not be allowed nor able to run the System itself, but may receive only forecasting products tuned to their specific needs.

    In case that the User intends to enable access to the System components which include data and products of another country(s), that will be possible only upon prior request and permission of the User(s). The Request should precisely and unambiguously define which System client component is required and by whom, including details concerning the exact purpose. The User(s) will respond to all such requests within 15 days of receiving a written request. If no response is delivered within 15 days, it will be presumed that permission of access and use of data and products is given.

    Transfer of data and products of other country(s) contained in the System to the Partner Users is prohibited in any case.

13. The User will inform the Secretariat of the International Sava River Basin Commission of nominated persons and Partner Users that have any kind of access to the System.

14. All intellectual property rights related to data and products contained in the System belong to and shall be retained by entities involved in the provision of data and products. Nothing in this Agreement indicates or implies transfer of said rights to the User or any third party.

15. The User acknowledges that data and products contained in the System are not provided with any warranties and in particular there are no warranties that data and products contained in the System will be free from errors or omissions and that such errors or omissions can be rectified. No warranty of any kind is made, given or implied as to the sufficiency or fitness for use of the System whatsoever.

16. The User acknowledges its own responsibility for any direct or indirect loss or damage of material or immaterial nature arising from its access to, use of or decision taken based on data and products contained in the System and neither Signatories of the Memorandum nor Hosting Organizations of the System will be held liable for any of them.

17. The User will ensure that all its employees with access to the System are aware of and comply with the obligations contained in this Agreement.

18. By signing of this Agreement, the User accepts to respect and act in accordance with all User-related provisions of the Memorandum.

19. /*Signatory of Memorandum from the Country*/ will deliver a copy of this Agreement to the Secretariat of the International Sava River Basin Commission.

Signed on_____ at_____ in two originals, one to be retained by each Signatory.

<u>Signatories</u>

For the /*Signatory of Memorandum from the Country*/   For the /*User*/

………………………….   …………………………..