# Preparation of Implementing Documents for Establishment of the Sava GIS

## *Executive Overview*

Final version

March 25, 2010

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# GLOSSARY OF TERMS

| Term | Meaning |
|---|---|
| **APIs** | Application Programming Interfaces |
| **CAL** | Client Access License |
| **CIFS** | Common Internet File System |
| **CMIS** | Content Management Interoperability Services |
| **CMS** | Content Management System |
| **COTS** | Commercial-of-the self product |
| **CPS** | Coverage Portrayal Service |
| **CRM** | Customer Relationship Management |
| **CS/W or CSW** | OpenGIS Catalogue Service |
| **CTS** | Coordinate Transformation Service |
| **DAM** | Download Accelerator Manager |
| **DM** | Document Management |
| **DMZ** | Demilitarized Zone |
| **ECM** | Enterprise Content Management |
| **EIA** | Enterprise Application Integration |
| **ERP** | Enterprise Resource Planning |
| **FASRB** | Framework Agreement on the Sava River Basin |
| **FTHPIS** | Fault Tolerant High Performance Information Service |
| **FTP** | File Transfer Protocol |
| **GCM** | Generic Conceptual Model |
| **GML** | Geographic Markup Language |
| **GIS** | Geographic Information System |
| **HTML** | HyperText Markup Language |
| **HTTP** | HyperText Transfer Protocol |
| **IE** | Internet Explorer |
| **IMAP** | Internet Message Access Protocol |
| **INSPIRE** | Infrastructure for Spatial Information in the European Community |
| **IPPC** | Integrated Pollution Prevention and Control |
| **IS** | Information System |
| **ISRBC** | International Sava River Basin Commission |
| **JSDOM** | JavaScript Object Model |
| **JSF** | Java Server Faces |
| **KPIs** | Key Performance Indicators |
| **KML** | Keyhole Markup Language |
| **LDAP** | Lightweight Directory Access Protocol |
| **LOB** | Line-Of-Business |
| **MNDNR** | Minnesota Department of Natural Resources |
| **MOSS** | Microsoft Office SharePoint Services |
| **MUI** | Multilingual User Interface |

| Term | Meaning |
|---|---|
| **NTLM** | NT LAN Manager – Microsoft Authentication Protocol |
| **ODBC** | Open Database Connectivity |
| **ODF** | Open Document Format |
| **OEM** | Original Equipment Manufacturer |
| **OGC** | Open Geospatial Consortium |
| **PHP** | Hypertext Preprocessor |
| **POX** | Plain Old XML |
| **REST** | Representation State Transfer |
| **RIA** | Rich Internet Application |
| **RM** | Record Management |
| **ROI** | Return of Investment |
| **RPC** | Remote Procedure Calls |
| **RSS** | Really Simple Syndication |
| **SDK** | Software Development Kit |
| **SLA** | Service Level Agreement |
| **SLD** | Styled Layer Description |
| **SMEs** | Small and Medium Enterprises |
| **SOA** | Service-Oriented Architecture |
| **SoA** | State of Environment |
| **SOAP** | Simple Object Access Protocol |
| **SOC** | Server Object Container |
| **SOM** | Server Object Manager |
| **TCO** | Total Cost of Ownership |
| **ToR** | Terms of reference |
| **TCP/IP** | Transmission Control Protocol |
| **UDDI** | Universal Description, Discovery, and Integration |
| **UMN** | the University of Minnesota |
| **URL** | Uniform Resource Locator |
| **URN** | Uniform Resource Name |
| **UWWT** | Urban Waste Water Directive |
| **VPF** | Vector Product Format |
| **W3C** | World Wide Web Consortium |
| **WCAG** | Web Content Accessibility Guidelines |
| **WCM** | Web Content Management |
| **WCS** | Web Coverage Service |
| **WISE** | Water Information System for Europe |
| **WFD** | Water Framework Directive |
| **WFS** | Web Feature Service |
| **WMS** | Web Map Service |
| **WSS** | Windows SharePoint Services |
| **WSDL** | Web Services Description Language |

| Term | Meaning |
|---|---|
| **XHTML** | Extensible Hypertext Markup Language |
| **XML** | EXtensible Markup Language |

# PREFACE

This document gives an executive level overview of the action accomplished within Project „Preparation of Implementing Documents for establishment of the Sava GIS“. Included are a description of what Sava GIS intend to be, what is needed for the establishment, why it is needed, who will use it and why certain architectural proposal have been made.

## BACKGROUND OF THE ASSIGNMENT

As part of the obligation resulting from the Framework Agreement on the Sava River Basin (FASRB), and Sava GIS Strategy that aims to establish an effective and efficient (geo) information system and spatial data infrastructure to support a wide range of water management planning activities of the ISRBC, the Secretariat initiated Project entitled “Preparation of the Implementing Documents for Establishment of Geographic Information (Sava GIS)” in May 2009.

The overall challenge of the Sava GIS establishment is to provide seamless, platform-independent, timely, and open access to integrated data, products, information, services and tools with sufficient accuracy and precision in order to address important water management issues in the Sava River Basin.

Primarily, Sava GIS should provide a good communication channels for the ISRBC community for sharing and disseminating knowledge about water resources, an effective and efficient river basin management and planning in the Sava River Basin. A second major goal of the Sava GIS is creation of a technical context and establishment of environment in which ISRBC parties will be able to work according to open and interoperable principles and criteria.

A key deliverables of the Project are the data specifications, specification of a set of tools that will access information published through a distributed water data infrastructure to deliver future Sava River Basin water resources assessments. This “enduring asset” is to be known as the Sava Geo Information System (Sava GIS) and the proposal on it architecture is on of the most important output of the project.

The preparation of the implementing documents comprises tasks that can be grouped as follows:

1. **Capture of the User Requirements** – an investigation on what Sava GIS users ‘needs (individual, expert groups) including the thematic content, functionality these users might require or expect, and standards to be adopted and followed.
2. **Design of the System Architecture** – describing the proposed technical architecture for Sava GIS.
3. **Proposal for Sava Content Management System** (CMS) - describing an efficient way for managing electronic files, images, documents web content and archiving documents.
4. **Assessment on the investment and preparation of the Action Plan** – describing the approach on establishment of Sava GIS/Sava GeoPortal that will enable ISRBC users to discover and access water related information along with indicative funding requirements.

Beside, the ToR for data refinement/ validation and establishment of the Sava GeoPortal has been proposed. The objectives of the ToR are the cornerstones for enabling information flow between ISRBC Parties in a seamless way as well as the framework for planning and for securing financial and other needed resources supporting continuous, long-term investment into Sava GIS operation and maintenance.

## PROJECT OUTCOMES

Key outcomes of the Project are as follows:

- ✓ Templates for acquiring detailed requirements from the Secretariat of the ISRBC and expert groups.
- ✓ List of the Sava GIS information products, tools and web services with a brief description for each product/tool and service.
- ✓ Standards to be use for Sava GIS.
- ✓ Sava GIS common naming rules and codes.
- ✓ List of the Sava GIS themes, data sets and objects.
- ✓ Sava GIS geodata model and architecture
- ✓ Proposal for the Sava CMS.
- ✓ Action plan for the Sava GIS.
- ✓ Terms of Reference for the establishment of the Sava GIS.
- ✓ Final Reports on the Steps toward Implementing Sava GIS Strategy.
- ✓ Workshops material.
- ✓ Reports: Inception report, reports on Project tasks and Final report.

## CRITICAL SUCCESS FACTORS

Implementation of Sava GIS is important step for Sava Commission not only due ongoing activity on the preparation of the Sava River Basin Management Plan rather to ensure continuous support to the current and future activities by ensuring that spatial information are available and of adequate quality. It may be expected implementation of Sava GIS will have an adequate degree of success if following would be provided:

- Maintained support from Sava Commission, expert groups, users, other international bodies and organisations (European Commission and other);
- Data delivery, use as well as data capture, update and storage;
- Been patient, having implemented slowly with a focus of making spatial information accessible to the users rather than building GIS application, tools and services on a project by project basis;
- Assembling a dedicated staff who continue to put the ISRBC and Sava GIS success in the first plan;
- Keeping the Sava Commission and international community aware of our progress, both successes and setbacks;
- Making the Sava GIS it spatial information management the target, not only map production;
- Adopted common Sava GIS and information products that meets the majority of the ISRBC needs.

Implementation of Sava GIS will require substantial investment in hardware, software, training, supplies, and staffing. However, with realistic expectations and support provided on establishing Sava GIS, it will be certainly proved that benefits are much greater than investments.

Certain considerations of data longevity, data capture, personnel hiring, etc. are the practical concerns important for the Sava GIS implementation. The longer term implications, such as hardware/software maintenance and replacement, should also be considered almost immediately. The acquisition of geoinformation technology can not be done without seriously considering the way in which GIS will interact with data providers and users. The proposal for Sava GIS architecture is based on common and optimal technology platform i.e. ESRI ArcGIS.

Nonetheless, even with the Sava GIS in hand, a properly structured and systematic planning will be required in the future for the successful operation and further enhancement of the system. The Sava GIS action plan addressed the technical, financial, and institutional considerations important for the moment of it development. However, planning process should follow Sava GIS growth and its user needs therefore re-planning should be done on yearly basis.

Further stages could be used to expand functionality, increase the user-base and also enable consultation with those who have indicated they would be willing to pay for access to some functionality, to establish what would be needed, in line with what the geospatial system is capable of delivering.

# INTRODUCTION

## GENERAL

### *Drivers*

Architecture of Sava GIS is largely driven by:

1. Use of service oriented architecture (SOA) in order to provide real time access to distributed data sources and information via web-services as the user requires.
2. Adoption of interoperable standards for sharing geospatial information resources.
3. Development of infrastructural components that enable upload and register of (meta-) data, or metadata harvests, as well ensure that spatially and temporally enabled catalogue of registered services allow custodians of water information in the ISRBC countries to make their data available for sharing via standards based web services ,
4. Development of server side tool components that are specific for the Sava GIS toolset (mapping services, report tools etc) and contributor.

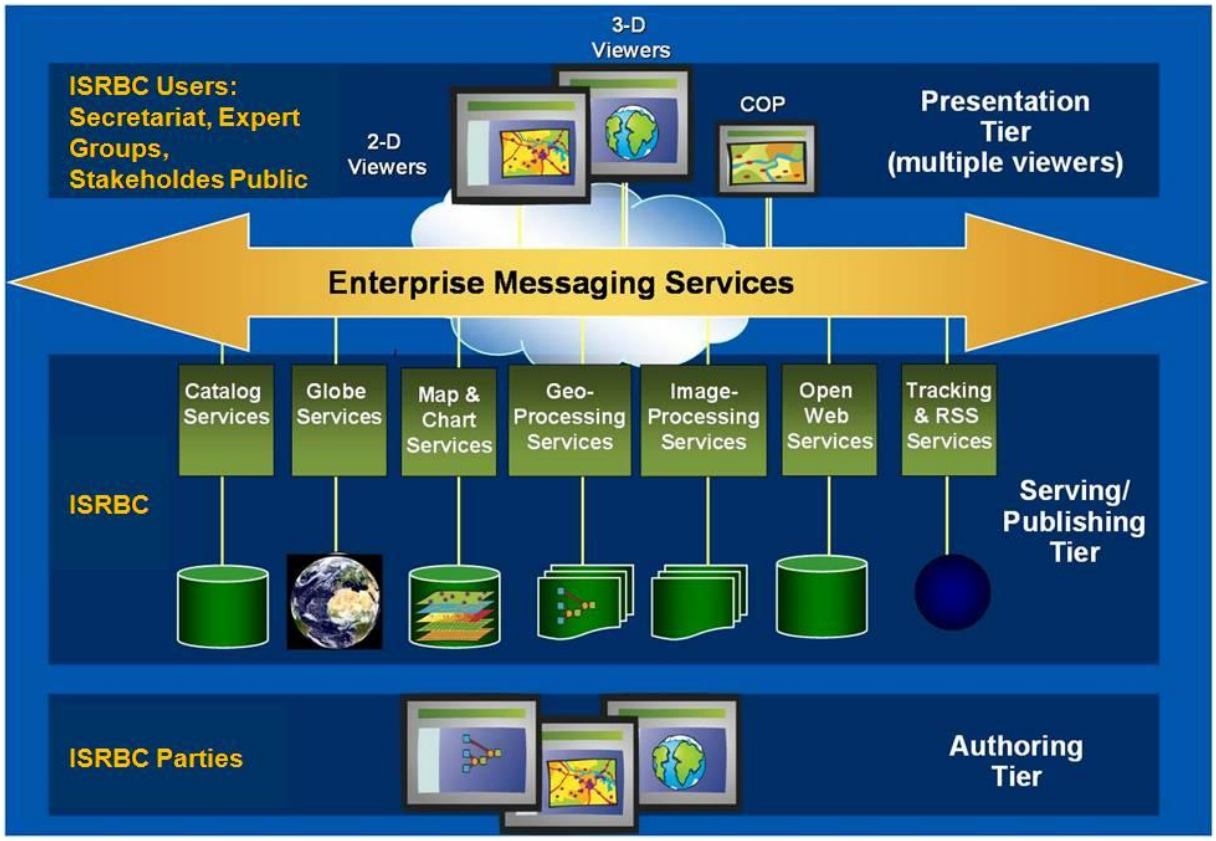



**Figure 1: SOA concept implemented on Sava GIS Architecture**

## *Sava GIS Purpose and Principles*

The primary purpose of Sava GIS is to provide the International Commission for Sava River Basin with a baseline picture on a range of water management and resource issues. Implementation of Sava GIS has been regarded as a needful step that will play an important role in facilitating data handling and providing information flow for the preparation of the first Sava RBM plan, as well as a creating a tool for informing wide public on the undertaken planned actions.

The FASRB defines three key goals of the process of Sava River Basin cooperation:

- Establishment of an international regime of navigation on the Sava River and its navigable tributaries.
- Establishment of sustainable water management.
- Undertaking measures to prevent or limit hazards.

Nevertheless FASRB and WFD, as the most important framework documents that cut across many same information issues, specific goals defined in line with water and navigation safety and regime, as well as organisational and technical goals, make uniqueness and extraordinarily of the ISRBC work.

## *Key Implementing issues*

The following issues are encountered as of high importance:

- Sava GIS will be a distributed database system and set of interoperable web-mapping-based interrogation tools.
- Sava GIS tools and the infrastructure will form a “permanent asset”, which is sustainable and scalable to deliver products and services which may have an extended set of data and functional requirements.
- The infrastructure will be open and accessible to third party tools.
- Any work will be build upon the foundations laid by related projects, notably coordinated by the ISRBC.

For ensuring successful establishing of common Sava GIS framework and being based on INSPIRE interoperability components, following need to be afford:

- All ISRBC Parties and institutions start from different positions in terms of data organisation and description. Due to different political, economic and organisational drivers, it would not be possible to achieve total harmonisation across every country. Therefore, a mechanism that provides technical and conceptual interoperability to support ISRBC needs is required.
- The aim toward integration of geographic information into the information and technology mainstream is of highest importance for Sava GIS.
- The main challenge is to achieve interoperability through harmonised data product specifications on the Sava River Basin level rather than harmonisation of the underlying conceptual models (and restructuring the associated data sets). Any requirements to change the existing data models should be kept to a minimum.

In the context of data harmonisation, requirements have to be considered on different levels:

- Specification level (use of common data specifications independent of the specification of the source data in the ISRBC Parties and participating water management institutions)
- Metadata level (provision of metadata according to a common metadata profile)
- Data level (e.g. edge and content on the edge matching in border areas should be subject of bilateral consolidation between the Parties).

## *Objectives*

Sava GIS will be primarily composed of contributing GIS systems of the Parties, ranging from primary data collection systems to systems that make use of creation and distribution of information products. Sava GIS and Sava GeoPortal will ensure smooth data flow between Parties aiming collectively to achieve the FASRB objectives as service-based communication will evolve.

The information technology objectives of the Sava GIS are to:

- Enable Sava GIS, based upon user requirements and building on existing geo-information systems, to define components for Sava GeoPortal in order to consolidate a view on water management issues by promoting a use of standards and references, intercalibration, and data integration.
- Enable Sava GIS to define and update common rules and interoperability arrangements to which ISRBC Parties agree to adhere, including data specifications for collecting, processing, storing, and disseminating shared data, metadata and products.
- Enable Sava GIS to facilitate Sava River Basin-wide data/information management and common information services by promoting data sharing principles respecting relevant international recommendations and instruments.

## *Benefits*

Sava GIS will be primarily focused to support realisation of water management issues of regional, basin-wide scale and on water sector applications, whilst also enhancing a national water management information systems that are focused on water sector-specific needs.

In this context, investments in national GIS systems already yield substantial societal benefits, but those benefits will be increased through the collective actions enabled by Sava GIS.

Sava GIS will improve knowledge sharing, reduce duplication of effort, direct ISRBC community toward the best available data, and improve the overall quality of geospatial data and information at Sava River basin level.

Implementation of Sava GIS will be focused in following benefit areas (see ***Figure 1***):

1. Integrated River Basin Management
2. Flood Management
3. Accident Prevention and Control
4. Navigation Safety Management
5. Sediment Management

Spreading and reporting of data gathered for the implementation of FASRB goals and subsequently displaying under SAVA GIS will be used in the water management assessments as performance indicator.

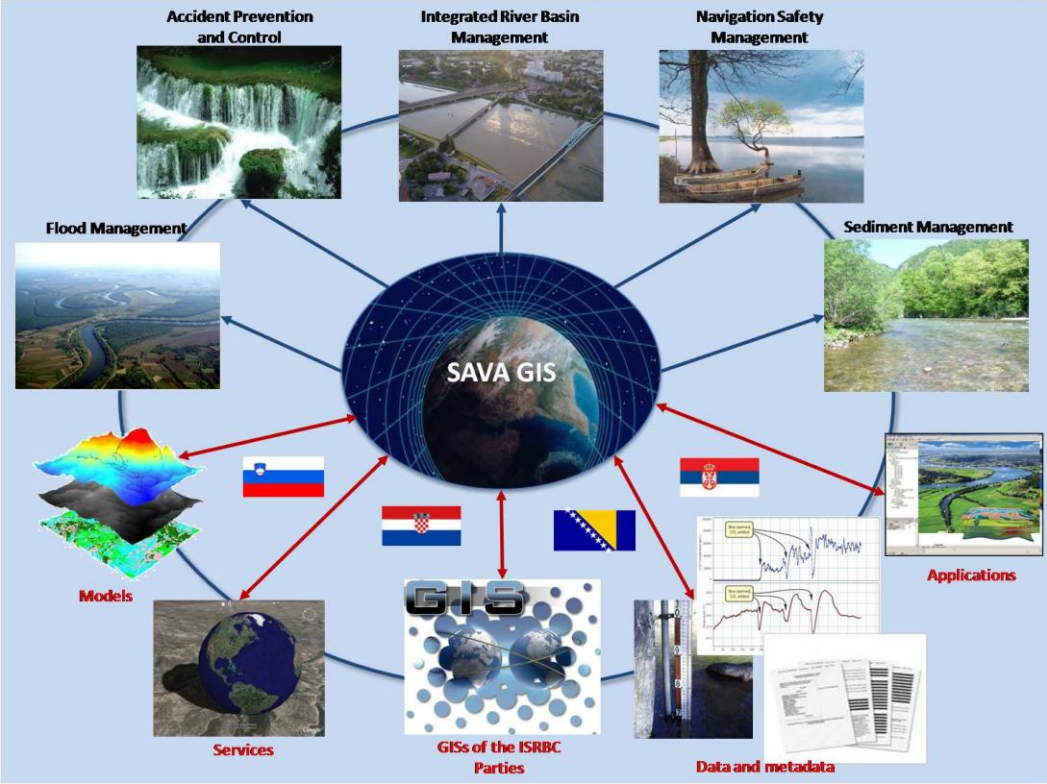



**Figure 2: Sava GIS Benefit Areas**

## *Opportunities*

Sava GIS will provide easier and faster discovery of, access to and sharing of nationally consistent water resources data and information over time, thereby providing better understanding of the water resources data and information that are discovered at Sava River Basin level.

Sava GIS will create also the following opportunities:

- **To deliver more for less**: Sava GIS will offer a greater efficiencies in a more nowadays constrained economic environment;
- **For sharing information internally and externally***:* Sava GIS will offer new opportunities for sharing information internally within ISRBC community and externally with international community and public by running in interoperable environment;
- **For flexible learning**: ISRBC Parties and institutions will benefit of Sava GIS development processes that will continuously keep pace with changing ICT requirement.
- **For sharing services**: Sava GIS will enable Parties and Secretariat to operate in coherent, consistent information environment by sharing Web GIS services.

# OVERVIEW OF PERFORMED TASKS

## CAPTURE OF THE USER REQUIREMENTS

The focal question and main concern to be addressed while preparing Sava GIS implementation documents was: ***What ISRBC users do really need****?*

The activities undertaken during the inception phase were focused therefore on:

- Understanding users and capture their requirements to be supported by the Sava GIS.
- Preparation of the list of information products, tools and services to be established.
- Assessment on the standards to be used to create consistent and harmonised information environment.
- Identification of the thematic, water management data sets for Sava GIS.

The user requirements were captured using combined technique:

- Initial definition of the user requirements. This was developed by reviewing WISE, Danube GIS, INSPIRE and other user requirements of systems, tools and products that have some similarity to Sava GIS. These were combined with the results on the user requirements defined during the "Analysis and Assessment of GIS Capabilities of the FASRB Parties and the ISRBC Secretariat" in 2007.
- Interviews and consultations with Secretariat and members of the Ad-hoc GIS Expert Group. During consultation, interviewees were asked to specify what ISRBC groups need and what expect to be delivered via Sava GIS. These requests were validated, edited and added to the initial list of requirements.

All collected information were assembled, consolidated and grouped to provide the list of the information tools, products and serviced Sava GIS should provide.

User assessment needs showed that main ISRBC providers of water management data are created own specifications for data sets with similar content, due to a similar legislation and practice in the past, but with different level of details.

## SPECIFICATION OF SAVA GIS INFORMATION PRODUCTS, TOOLS AND SERVICES TO BE DEVELOPED

ISRBC users declared that Sava GIS should provide facilities related to water resources planning and management and link to functionalities such as: publish and provide access to metadata and data, delivery, viewing and analysis. Although establishment of Sava GIS has been seen as a complex task which requires further consultation with potential user-base in order to gain a more detailed insight, particularly into required advanced analytical functionality, user stated that initial stages should provide core functionality via Sava GeoPortal and facilitate preparation of the River Basin Management Plan as much as possible.

ISRBC users' network and Sava GeoPortal are seen as the most important Sava GIS products. Sava GeoPortal will be a place where members of the Sava Commission will share their information and experience striving to realise common Sava River Basin water management goals. Sava GeoPortal should provide feedback for the refinement of the information for all interested Parties also wanting to be part of this network.

Sava GIS should support preparation of maps needed for Sava RBM Plan and that are in line with WFD requirements as defined in ***Annex 1***.

It should be highlighted that if ISRBC Parties and institution would not be able to provide data via services, both core and reporting themes need to be uploaded, stored and managed in the database of the Sava GIS, which will be operating in the Secretariat of the ISRBC.

Nevertheless, ISRBC Parties may have similar or different structures of datasets and GIS layers, it will not be required to make any changes in existing dataset structures, rather to define optimised approach and tools to provide reporting data according to agreed schemas with minimum efforts wherever is possible.

## THEMATIC DATASETS FOR SAVA GIS

List of thematic dataset (see ***Annex 2***) has been defined in accordance with the FASRB and "Strategy on implementing FASRB", ISRBC Protocols, needs expressed with regard to the implementation of the Water Framework and Flood Directives, recommendations expressed in the INSPIRE Data Specification Methodology, GIS Guidance and Guidance for reporting under WFD and taking into account information technology capabilities of the ISRBC institutions responsible for data creating and publishing.

Sava GIS datasets are generally divided into following categories:

1. **Core datasets** - the most commonly used.
2. **RBM datasets –** specified in line with FASRB and WFD.
3. **Derived**[1]**- RBM specific datasets** - special reporting datasets derived from core, RBM and other dataset according to agreed criteria, rules and algorithms.
4. **Navigation Safety Management datasets –** specified inline with FASRB and "Protocol on the Navigation Regime".
5. **Accident prevention and control datasets** - specified inline with FASRB.
6. **Flood Management datasets –** specified in line with FASRB and Flood Directive.
7. **Sediment Management datasets –** specified inline with FASRB and "Draft Protocol on the Sediment Management".
8. **Supporting dataset –** topographic and statistical datasets**.**

All dataset will contain the groups of attribute that represent the qualitative or quantitative variable of a dataset.

### *Geodatabase Schema*

Formal description of the data structure is prepared using UML and in conformance with the Generic Conceptual Model. Overview of the Sava GIS geodatabase scheme is provided in ***Annex 3***.

## STANDARDS TO BE ADOPTED AND IMPLEMENTED

### *Data Specification*

In accordance with Art. 8(2) and 8(4) of the INSPIRE Directive and the requirements spelt out in the INSPIRE Generic Conceptual Model, data specifications for SAVA GIS will conform to ISO 19131.

Based on ISO 19101, two representations of spatial objects types and their properties will be used for:

- Sava GIS application schema[2]

[1] Derived dataset is resulting dataset processed by performing numerical calculations on attributes of the one ore more elementary datasets. In case of spatial data, spatial operation (such as union, intersection, clipping etc.) is performed on geometry, whilst numerical calculations is applied on non-spatial attributes.

[2] Application schema is conceptual schema for data required by one or more application (ISO 19101)

- Sava GIS feature catalogue[3].

The application schema specifies the types of spatial objects and their properties (attributes, association roles, operations) as well as constraints. It is indispensable whilst turning data into usable information. Feature catalogue will be translated in the ISRBC official languages, whilst application schema will be managed only in English.

### *Metadata Profile*

Metadata is the information and documentation, which makes data understandable and shareable for users over time. WFD GIS working group recommends the application of the rules based on **ISO 19115** and **INSPIRE metadata editor** has been made available through the INSPIRE Community Geoportal.

It was recommended to use INSPIRE metadata profile based on ISO 19115 and ISO 19119 standards.

The INSPIRE Metadata Editor allows the capture of INSPIRE-compliant metadata using ESRI ArcCatalog.

### *Integration and Interoperability Standards*

Proposed standard software will support Sava GIS integration, compatibility and interoperability is ESRI ArcGIS. ArcGIS supports multiple approaches to interoperability:

- **Web—**SOAP, XML, REST, JavaScript, KML, Virtual Earth.
- **OGC—**GML, WFS, WMS, WCS
- **Enterprise Integration—**SOAP, XML, EJB, SQL
- **Application Content—**CAD, Image, PDF.

The ArcGIS product family supports several leading OGC Web standards: Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS), metadata and catalogue services, and Keyhole Markup Language (KML).

### *Common Spatial Reference System*

The agreement on a common reference system that will be used by the Parties and institutions while reporting to the ISRBC, as INSPIRE recommended, will allow seamless distribution of spatial data.

For the horizontal component, INSPIRE mandated the use of the European Terrestrial Reference System 1989 (ETRS89) for the areas within the geographical scope of ETRS89. The International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS shall be used in areas that are outside the geographical scope of ETRS89. Compliant with the ITRS means that the system definition is based on the definition of the ITRS and there is a well established and described relationship between both systems, according to ISO 19111:2007 Geographic Information – Spatial referencing by coordinates.

## SAVA GIS ARCHITECTURE

### *Conceptual Modelling*

The “INSPIRE Generic Conceptual model” proposal which tries to follow a “keep it simple” approach to developing rules for the wide thematic range of INSPIRE data specifications, has been adopted for Sava GIS model. Simplicity has been in the focus in particular for two aspects:

[3] A feature catalogue supports the styling of the application schema into textual presentation, which is friendlier for the human.

a) The processing and use of INSPIRE data (it is assumed that INSPIRE data will typically be accessed through download services which are assumed to provide direct access to spatial objects) should be as simple as possible for users and their software applications.
b) For data providers the publication of their existing spatial data sets as INSPIRE conformant spatial data sets should be as simple as possible.

Information systems related to water resources in the member countries of the International Sava River Basin Commission have been developed in the form of Geographic Information System and are based on ESRI ArcGIS technology. Data models have been developed using ArcGIS methodology. The data structure is almost identical in all countries. This allow directly download the GIS and metadata from national GIS systems with some need for harmonisation of the content but without data conversions.

Spatial layers, alphanumeric data and metadata can be stored with one-way replication on database server in ISRBC using principles of GEODATA services and then published on the web GIS portal of Commission. ***Figure 2*** describes existing GIS basis and network architecture in the data contributors' institutions on which basis SAVA GIS shall be established.

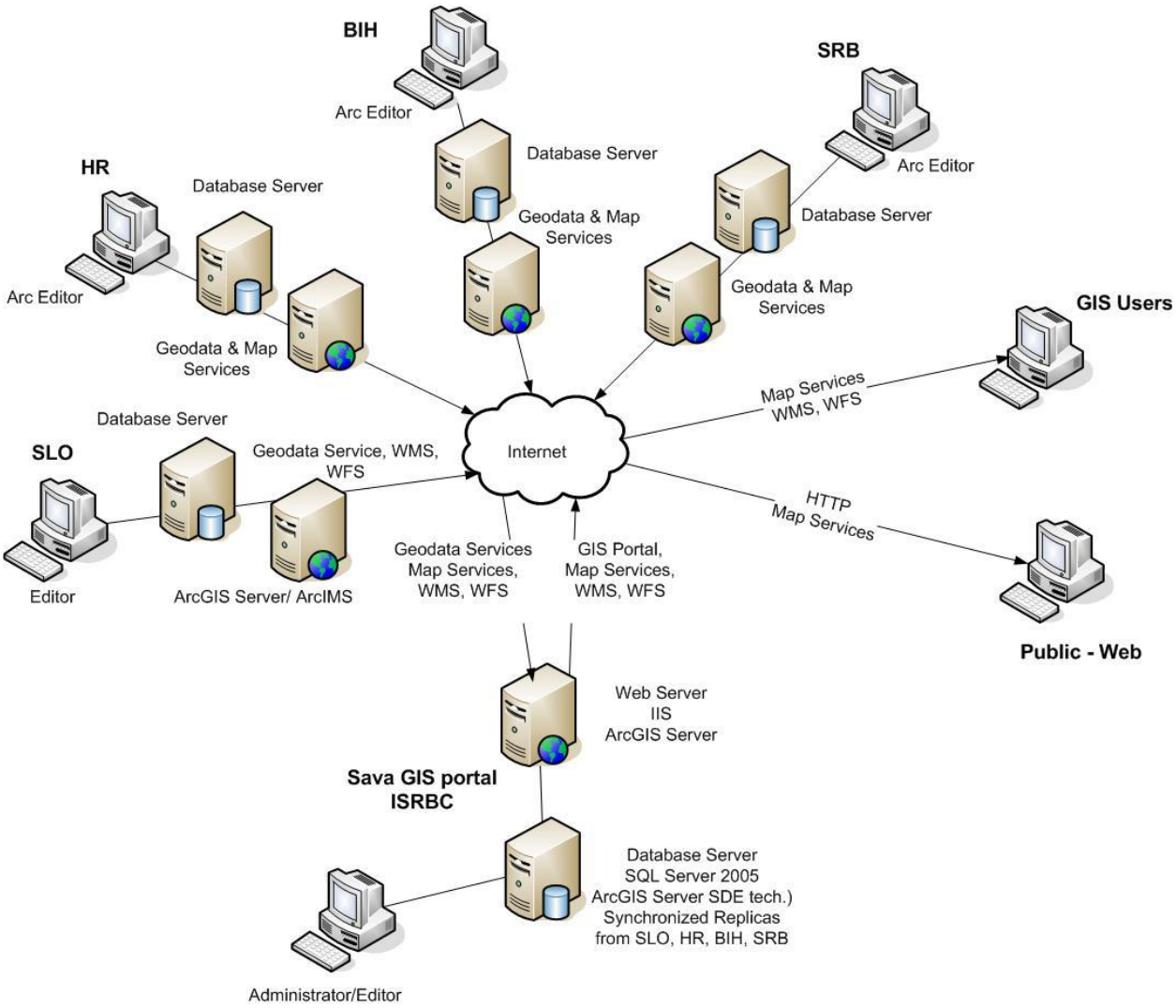



**Figure 3: Existing GISs and Network Architecture of the ISRBC Parties**

These main components of the Sava GIS architecture will be comprised of:

- **ISRBC Users** who will make use of the service offered by the Sava GIS.
- **Web GIS Applications** that will provide a graphic interface and varying degree of tightly coupled logic for ISRBC users to perform tasks (a crossover area of ISRBC solutions versus the SOA loosely coupled ideal).
- **Sava Geoportal with tools and services** that will perform a specific task such as publishing map service, metadata service, etc when invoked.
- **Service Support -**software and hardware logic that will provide a background to support functions for SOA.
- **Contributor - ISRBC Parties -** who will provide a specific service or functionality.

## *Sava GIS Component and Functionalities*

Based on the defined content and recommendations aforementioned, for Sava GIS following components need to be establish and action performed:

- Common Sava geodatabase model;
- Data Contributors specific applications for data harmonisation and integration;
- Data load into virtually enabled central database or enabled via services
- Sava GeoPortal services, tools and applications.

Sava GeoPortal will be a gateway to Sava GIS information and information services. It will enable to discover, view and access geospatial information and services made available by their sources. Likewise, ISRBC data contributors will enable their source of information and services to make geospatial information and services discoverable, viewable and accessible by ISRBC community. Sava GeoPortal will maintain a repository of metadata and services seeking to discover or to make available data to the ISRBC. Each metadata "record" in the repository will describe the nature and scope of a registered data "item" or service, and provides information that enables to locate and view each registered item or service within the Sava GeoPortal.

Sava Geoportal will enable following finctionalities:

- Discover geospatial information resources;
- View details about each discovered resource, including how to get it for own use;
- Immediately view Live Data and Map resources discovered;
- Create, upload and manage metadata that references geospatial data items and services organisation has produced;
- Manage and update user account information;
- Manage and save queries created for use during subsequent sessions.

## *Data flow*

To serve its purpose, Sava GIS needs spatial data accessible via services and complete metadata that describes those services. Data services and other GIS data items must be maintained as it described by the associated metadata.

The data contributors of the ISRBC Parties are encouraged to establish adequate information services for Sava GIS data provision. However, if contributor can not provide data via service, data will be posted and/or uploaded into central database hosted in the Secretariat of the ISRBC. Consolidated Sava GIS spatial data repository will be populated. This should be done by the trained individual(s).

ISRBC parties would use data from their Water information systems. Data would be refined and harmonised according to well defined rules and principles of creating geodatabases.

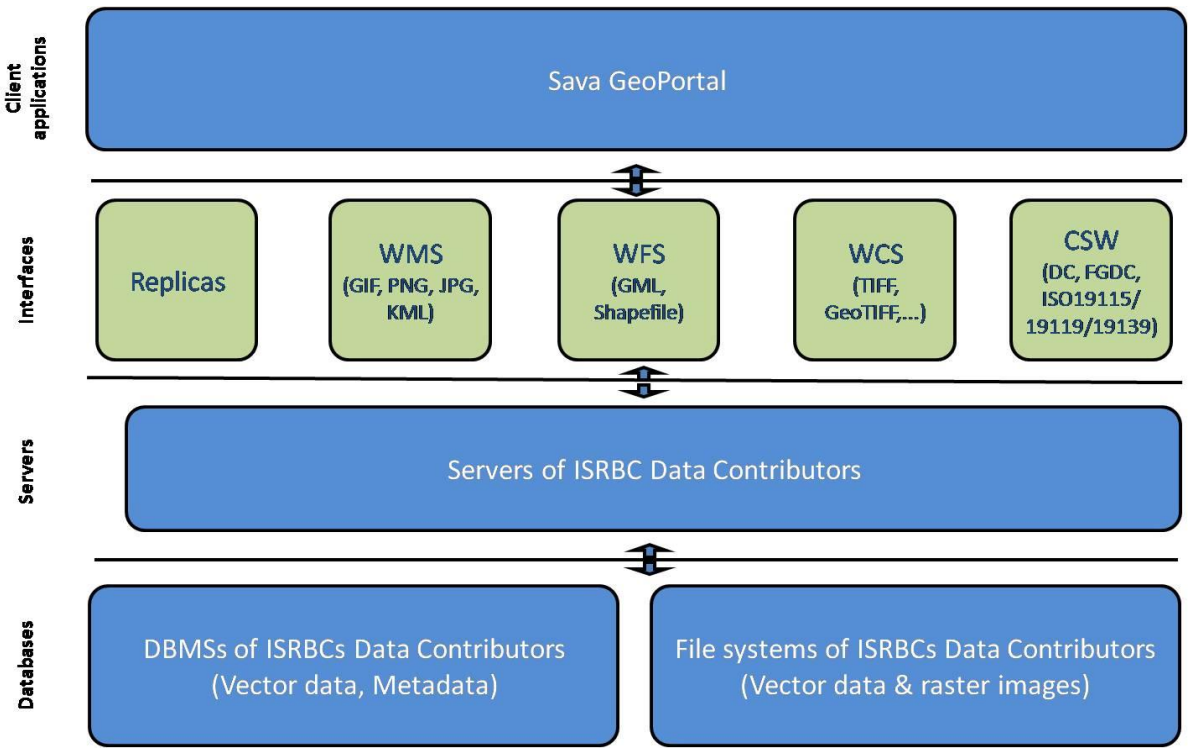



**Figure 4: Spatial Data Infrastructure of Sava GIS**

## SAVA CONTENT MANAGEMENT SYSTEM (CMS)

A **content management system** or broader term **enterprise content management** (**ECM**) system helps businesses to manage its information asset, including:

- Structured data captured in databases, and
- Unstructured data including all documents, spreadsheets, and other files.

Enterprise Content Management (ECM) is a technology and discipline of managing content assets across an enterprise. These content assets are the pieces of information, documents and records that are important for successful business management.

The assessment on ECM or CMS functionalities included two concurrent software products: Alfresco (Open Source) and MS Share Point 2010 (Commercial-Off-The Shelf).

Both Alfresco and SharePoint are considered as complex platforms, not simply products. This means their functional scope is intended to be expanded by the owner — either via custom development or via third party integration. No one considers either of these products black box tools which cannot be modified.

Summary of pricing for MS Share point Solution and Alfresco is shown in ***Annex 5***.

It has been shown that save up to 96% of the costs is possible by exploring and optimising alternative open source ECM solutions.

The most scalable collaboration sites and websites in the world now run on open source software. Alfresco Software, as an open source business model, may significantly reduce the expenses of the organization acquire while offering a robust, scalable, enterprise-class solution by:

- Lower Cost - A low cost, subscription model with minimal upfront investment that can be driven out of operating expense as opposed to capital expense;
- Greater Simplicity - Rapid deployment to deliver immediate business value; and
- Greater Customer Choice - Lower Total Cost of Ownership (TCO) by reusing existing hardware, software and skills- No lock-in to one ECM vendor or one stack which means when a vendor tries to dramatically increase maintenance fees, organizations have a choice to go elsewhere.

The description of functionalities and pricing policy was sufficient to make quality selection and prepare proposal for the Sava CMS.

## SELECTION OF THE BEST SOLUTION FOR SAVA GIS

Consultant made the assessments on web mapping and web-based service's capabilities of the Open Source and COTS software products and architectures which might be appropriate as for Sava GIS.

It is obvious that utilisation of Open Source products, as cheaper solution, is rather biased and not serving cautiously the needs of the Sava Commission.

**However, taking numerous advantages into account and fact that the most important web and map serviced-based European information systems are developed on ESRI's architecture, as well as having in mind that main data contributors in the ISRBC have been using ArcGIS Serves and ESTI software for some time, Consultant proposed utilisation of ESRI's software products to establish serviced-based Sava GIS architecture.**

In the terms of costs (see ***Annex 4***) and location of infrastructure, administration and maintenance of Sava GIS, four options were considered:

1. Infrastructure placed in the Secretariat of the ISRBC, administration and maintenance of Sava GIS is hand over by the Secretariat
2. Infrastructure placed in the Secretariat of the ISRBC, administration and maintenance of Sava GIS hand over by external service provider
3. Sava GIS infrastructure hosted internally (within ISRBC) by one of the ISRBC Partie's institution, administration and maintenance of Sava GIS hand over by the same institution
4. Infrastructure hired, administration and maintenance of Sava GIS provided by the external service provider.

Option 4 and Option 2 are expensive solutions therefore, the for making final choice on the best solution for Sava GIS architecture, Option 1 and Option 3 are further considered.

Option 1 is not only the cheapest solution but has following intangible advantages:

- Offer higher degree of control, since this duty is already enlisted in the description of the tasks of the Secretariat. For any other hosting institution, Sava GIS will require additional effort and reorganisational consideration, which are in the current economically constrained environment, very unpopular and not accepted well.
- Provide ability to oversee the entire process and technologies at basin level,
- Lower risk of loss the focus and direction, because external institutions has own duties and may postponed execution of agreed activities because of the higher priorities.
- Low risk to have difficulties in managing relationship with external partner (ISRBC Institution),
- Unified, consistent and continuous approach on the Sava GIS needs related to operating, maintenance, control and upgrade.
- Managerial simplicity, since there is no treat in dealing and managing external difficulties and opportunities,
- From the operational point of view it will be more efficient since Secretariat of the ISRBC in the organisational structure have defined position of Special Advisor for Information System. It can not be expected that the institution of the Party will employ person who carry out only duties and responsibilities related to the Sava GIS operation.
- Brings innovative capacities and add value to Secretariat and ISRBC as whole.

Having abovementioned in mind, **Consultant recommends Option1 - Infrastructure, administration and maintenance of the Sava GIS provided by Secretariat of the ISRBC, as the best and the most effective solution.**

## *Selection of Best Sava CMS Solution*

Taking into account benefits and particular constrains, as well reconsidering all issues related to the possible grow of Sava CMS and limited number of future CMS user, it is **proposed** to use **Alfresco Software as the optimal solution for the Sava Content Management System**.

## WHO WILL USE SAVA GIS AND WHY?

Extensive analysis was undertaken within Project through interviews and workshops identify who will use Sava GIS, and what these users' expectations are. An identified set of users are listed in ***Table 1*** along with typical tasks that these users will be able to perform with Sava GIS.

**Table 1: Sava GIS Users**

| User group | Typical requirements that could be met through Sava GIS |
|---|---|
| Sava Commission | ▪ Review, evaluation, approval, assessment of policies and strategies.<br>▪ Identify the essential elements of a particular issue.<br>▪ Provide evidence that justifies a specific position. |
| Stakeholders - Policy and strategy planers and managers | ▪ Setting benchmarks and reporting criteria, status reports<br>▪ Identify data gaps and areas of priority for funding assistance<br>▪ Determine validity of creating the program or project, or using the resource. |
| Experts in water management field (RBM, navigation, flood, protection of waters, etc.) | ▪ Determine characteristics of water in specific areas<br>▪ Determine water access rights<br>▪ Obtain data to inputs or conduct independent analysis<br>▪ Understand data availability, reliability, accuracy and currency.<br>▪ Identify and review ISRBC water information related activities |
| Researcher | ▪ Obtain predefined information to answer specific questions<br>▪ Find more information on timely 'issues of the day'<br>▪ Quote facts and figures, obtain maps and diagrams that will improve the quality of assignments, media stories etc<br>▪ Help in setting the scene and providing introductory / contextual / preliminary information |
| Public | ▪ Answer to specific questions as they arise<br>▪ Similar tasks to elementary researchers |

# SAVA GIS ACTION PLAN

## *Organisational Plan*

Fundamental to a successful Sava GIS and GeoPortal extension deployment is a clear understanding of hosting and management requirements at the outset of implementation efforts. Such requirements include underlying host system software and hardware infrastructure, technical personnel and organisational charter for supporting it, and the dedication of appropriate management resources to maintain Sava GeoPortal content both at the installation stage and during operations.

Sava GIS and Sava GeoPortal implementation will be accomplished atop a variety of essential building blocks that provide the underpinning for the successful installation, configuration, and operation of the software. Implementation can only succeed when these elements are in place:

- **Executive and organisational sponsorship** is required to initiate consideration of the Sava GIS and Sava Geoportal implementation.
- **People** must be in place and trained appropriately to manage and grow the Sava GIS.
- **Data** is required to support functions and must be prepared and available according to data specification and technical circumstance that feeds the Sava GIS seamlessly.
- **Underlying hardware/software/network** infrastructure must be in place and configured appropriately to support effective use of the portal.
- **Funds** must be in place or budgeted to support the ongoing operation of the portal.

These principal elements, along with a plan for the scheduling and critical path sequencing of their implementation, represent the scope of endeavour that ISRBC will necessarily undertake when implementing and operating Sava GIS.

### Executive Sponsorship

Operation of the Sava GIS will have a profound impact on the way geographic information will be produced, managed, used, and shared by the ISRBC Parties. Likewise, maintenance of the operational Sava GIS will have an impact on the structure and allocation of technical and personnel resources.

The process of successful establishing of the Sava GIS and active Parties' participations in the information sharing via Sava GeoPortal require consideration of the objectives, resource requirements, and benefits Sava GIS will provide to the ISRBC community.

### Required Roles

To ensure Sava GIS operation under ISRBC government, a several roles needs to be a clearly identified. Those roles include:

- Sava GIS Development and Implementation Coordination – *Ad-hoc* GIS Expert Group
- Sava GIS Administration – Secretariat of the ISRBC
- Sava GeoPortal Management – Secretariat of the ISRBC
- Further Data and Metadata Development – ISRBC Parties and Secretariat
- Application Development – Consultant
- End users – Sava Commission, Expert Groups, ISRBC stakeholders, international water management institutions and public.

The personnel issues are often overlooked when implementing a GIS. However, successful implementation of Sava GIS will rely on the ability of qualified personnel to fulfil these basic roles.

**Coordination on the Sava GIS** phased implementation will be carrying out by the *Ad-hoc* GIS Expert Group and according to its mandate specified in the ToR.

**Sava GIS Administration** will involve overall operation of desktop and server based GIS software, as well periodical Installation of software and updates, data base administration, website administration, and performing backups.

**Further data collection, processing, refinement and expansion** will be performed by the ISRBC Parties.

### Technology Transfer and Trainings

A formal training program will be needed. Such a program will consist of both installation-phase technology transfer and the ongoing training of general users

## *Technical Process Plan*

### Required Technology Environment

#### *Hardware*

The specification of hardware requirements for support of Sava GIS is tied to the existing architecture of the main ISRBC water management institution and hosting organisation i.e. Secretariat of the ISRBC for the core level of use.

In general, common practice for running all software's components is to use a minimum of two dedicated servers with Internet connectivity along with at least one desktop computer with Internet connectivity. In addition, provision of database servers within the Secretariat of the ISRBC is required to serve data that will be uploaded into central Sava GIS database when ISRBC Parties can not publish data via service.

#### *Software*

It is recommended that underlying software specified to support the Sava GIS and Geoportal will be built with ESRI's ArcGIS products, mainly ArcGIS server with Geoportal Extension Functionalities. Main water management institutions contemplating implementation of the Sava GIS already have needed infrastructure and licenses for much of the needed underlying software. Nevertheless, a periodical review of their existing software and architecture in the ISRBC water management institution's, together with a review of the specific software required to support information sharing via Sava GeoPortal, is recommended to determine overall level of efforts and expenses that will be required.

#### *Catalogues*

A key consideration is that Sava GeoPortal catalogues data and services with sufficient metadata information so that users can find what they need and gain access as appropriate. The Internet is a primary medium for the mechanism to allow users to access the catalogue of available data and products, with hardcopy media to also be available as appropriate. Users searching Sava GIS catalogues will find descriptions of the ISRBC members, Parties' institutions and the components they support, leading directly to whatever information is needed to access the specific data or service in a harmonised way, independent of the specific provider.

Sava GIS will promote the use of common mechanisms for the cataloguing of archives, including how to access them. All providers need to ensure that archived data and products provide a statement of the access conditions in terms of the mechanics and policies. There should also be a well-

documented statement of the ancillary data needed to understand and use basic data sets and products.

## *Implementation Plan*

The Sava GIS establishment will be divided into three phases:


- First implementation phase (2010-2012) work package (WP1) will be focused on the setup of the core Sava GIS functionalities: Sava GeoPortal, tools, services and products in line with the preparation of the Sava River Basin management Plan.
- Second implementation phase (2013-2015) work package (WP2) will be oriented to the development and implementation of the advanced tools, mapping and reporting services as well as basic application and/or decision support system.
- In third phase (2015-…) the common data model will be extended to accommodate additional themes and datasets and the most advanced service component such as dynamic reporting and mapping, on-line monitoring and observing, advance decision support systems, will be established.

### Work Plan

| Item | Phase 1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | | 2011 | | | | 2012 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| **WP1: Core Sava GIS and Sava GeoPortal Functionalities** | | | | | | | | | | |
| Upgrade of hardware and software in the Secretariat | | | | | | | | | | |
| Enhancement of network infrastructure | | | | | | | | | | |
| Refinement and harmonisation of datasets | | | | | | | | | | |
| Create Data Services:<br>- Create metadata<br>- Create central repository | | | | | | | | | | |
| Deploy Parties Infrastructure | | | | | | | | | | |
| Launch Sava GeoPortal prototype | | | | | | | | | | |
| Conduct user trainings | | | | | | | | | | |

| Item | Phase 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | | | | 2014 | | | | 2015 | |
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 |
| **WP2: Advanced Sava GIS and Sava GeoPortal Functionalities** | | | | | | | | | | |
| Content Management System (CMS) | | | | | | | | | | |
| Report Services | | | | | | | | | | |
| CMS Catalogue Services | | | | | | | | | | |
| Reporting services | | | | | | | | | | |
| Advance mapping services | | | | | | | | | | |
| Visusalisation services | | | | | | | | | | |
| Conduct user trainings | | | | | | | | | | |

## SUPPORTING PROCESSES

### *Investments*

The sustainable way to secure funding for Sava GIS is to ensure continuous support by the Sava Commission. Another way is to demonstrate that the development and implementation of the Sava GIS is addressing critical international initiatives efficiently.

Sava GIS will require financial resources to be securing not only for the maintenance of the system but as well for further developments and improvements. The financial support can be gained through a mix of grants, ISRBC, national funds, structural funds, EU and other international funds. With adequate coordination in planning, financial resources can be wisely spent in Sava GIS operational, maintenance and upgrade phases.

The creation and growth of the Sava GIS/GeoPortal contents and functionalities will require more than a one-time software purchase. The principal costs will be related to allocation of the organisational support structures, technologies, and staff time that are necessary to support a geospatial information portal over time.

Whilst Sava GIS will realise cost benefits for the ISRBC community by increasing the efficiency of the basin-wide information distribution and standardising the quality of geospatial information used, it will also involve ongoing line-item management costs.

Principal cost items will include the following:

- Establishment and maintenance of organisational arrangements and internal workflows that may be necessary to implement common spatial infrastructure in general and to host and support Sava GIS and GeoPortal operations in particular;
- Hardware and underlying software;
- Sava GIS/GeoPortal establishment i.e. implementation and maintenance;
- Work on data refinement and data quality /quantity increasing;
- Data adjustments and harmonisation processes;
- Upgrade of information and communication infrastructure to achieve Sava GIS functionalities, and to demonstrate powerful information sharing tools and services;
- Support user trainings;

- Support raising awareness on the used solutions, challenges, benefits, etc. (organisation of Sava GIS thematic workshops and conferences)
- Project administration and management.
- Staff time for Sava GIS and Sava GeoPortal installation including programming for the ISRBC specific customisations;
- Staff time to undertake Sava GIS and GeoPortal content management;
- Staff time to undertake Sava GIS and Sava GeoPortal operations management;
- Staff time to prepare and maintain participating data services and associated metadata;
- Technical training on Sava GIS and GeoPortal management and use.

Long-term costs will be associated with ongoing maintenance, operational expenses, system enhancements, and staff resources.

Operational expenses constitute the primary long-term costs and include various items associated with software maintenance, software upgrades, training requirements, technical support, map printing supplies, and miscellaneous costs related to attending user group meetings.

System enhancements will be identified after a period of time and also as users become familiar with the capabilities of Sava GIS and web services in general. Possible areas that might be identified include:

- Development of new features, service or tools;
- Development of new datasets;
- Enhancements to the application to support additional functionalities;
- Migration of system to new hardware or updated software platform.

It is difficult to estimate costs associated with future changes as specific requirements and priorities are subject to change over time.

## *Implementation Costs*

In the terms of location of infrastructure, administration and maintenance of Sava GIS and Sava Geoportal, several options are possible. Consultant recommends following four options:

5. Infrastructure placed in the Secretariat of the ISRBC, administration and maintenance of Sava GIS is hand over by the Secretariat
6. Infrastructure placed in the Secretariat of the ISRBC, administration and maintenance of Sava GIS hand over by external service provider
7. Sava GIS infrastructure hosted internally (within ISRBC) by one of the ISRBC Partie's institution, administration and maintenance of Sava GIS hand over by the same institution
8. ICT infrastructure foe Sava GIS hired, administration and maintenance provided by the external service provider.

The amounts needed for ensuring the infrastructure, system administration and maintenance are identical for four assessed COTS options.

Summary on pricing for the implementation and maintenance of Sava GIS is provided in ***Annex 4***.

### Software Maintenance and Upgrades

The software which will be selected for the Sava GeoPortal will be a subject to a yearly maintenance fee. Yearly maintenance entitles the licensee to technical support, software upgrades, and admission

to national user conferences. It is recommended that the ISRBC provide budget for the cost of yearly maintenance as part of its ongoing expenses related to the GIS.

### Data Maintenance

During data development and acquisition, attention should be given to establishing a data management plan, a structure for the master data repository and QA/QC procedures.

Sava GIS datasets will require ongoing maintenance and updates to reflect changes and refinements. The following items describe recommendations that are relevant to ensuring an effective data maintenance strategy for the ISRBC.

- Identify frequency of data updates necessary to ensure currency of data;
- Maintain accurate Sava GIS metadata.

## TORS FOR ESTABLISHMENT SAVA GIS

To deliver reliable, trustful and reliable information which will aid the Sava Commission and its stakeholders to maximise the benefits delivered through Sava RBM Plan, in phase 1 of the implementation following shall be elicit:

- ✓ Consolidated, refined and verified data to prepare maps for Sava RBA;
- ✓ A common geodatabase comprising of core datasets agreed within ongoing project "Preparation of Implementing Documents for Establish Sava GIS";
- ✓ Initial loading of consistent and coherent datasets provided by the SRBC Parties into Sava GIS geodatabase;
- ✓ Upgrade of the information and communication infrastructure to be able to utilize Sava GIS;
- ✓ Establish continuous data flow between ISRBC Parties and its data providers and Secretariat by setting-up core Sava GeoPortal functionalities and services.

### *Data refinement and consolidation*

A consistency[4] between data is a very complex subject to deal with. Even if data are harmonised according to very well defined rules, they rarely fit exactly for various reasons. Generally, consistency encompasses: i) harmonisation of data specifications, ii) conformance to this specification (including selection rules and application schema), iii) coherence between spatial objects of the same theme at different levels of detail and at least iv) coherence between different spatial objects within a same area and v) consistency along state boundaries.

In the heterogeneous Sava River basin environment, strict standardisation process is hardly feasible. The harmonisation of data specifications is the best way to promote consistency. The harmonisation in the field of spatial data quality is concerning the standard implementation of data quality measurements and the documentation about the spatial data set, which should include data sources, data input techniques, positional accuracy, attribute classification and definitions and quality control procedures used to validate the spatial data.

### *Procurement of hardware, software and network enhancement*

Geoportal prototype setup, among the others, implies procurement and installation of the needed service infrastructure components (servers, software, network and other equipment) at the premises

[4] In classical GIS terminology "*consistency* refers to the lack of any *logical contradiction* within a model of reality". This must not be confused with *correctness*, which excludes any contradiction with reality. In itself, each individual level may be consistent, however, when integrating and comparing the different levels, inconsistencies may be detected if the representations contradict.

of the Sava Commission. The Secretariat will be services provider. Geoportal, as a standalone web and map based application, should allow publishing, managing discovering and viewing of metadata stored on metadata repository, as well catalogue service, metadata harvesting tools user managing tools, etc.

Data provider in Sava River Basin countries should maintain their data and metadata internally behind their firewalls, applying internal tools and business processes. To be able to contribute to the Sava GIS, the data provided have to adhere to agreed standards, data specifications and agreed application schemas, as well as other qualitative criteria. The data providers should make their data and metadata available through their own web service. Data should be generally held within the DMZ (Demilitarized Zone) of the data provider and may comprise of a copy of the production data that reside behind the agency firewall.

## *Sava Geoportal Prototype*

To be able to searches for data and services, users should discover relevant metadata in catalogues by using Sava GeoPortal and by defining the geographic area of interest, keywords and other specific search criteria. Afterwards, full descriptions of these data sets and services can be examined by the users. Through this process the user identifies all the data sets and related services that are relevant to the specific scenario. The Sava Geoportal prototype should include establishment of testing environment for the thematic datasets that can be reported throughout services as well for data/datasets that will be reported in traditional way by using the files.

# ANNEX 1 : MAPS FOR SAVA RIVER BASIN MANAGEMENT PLAN

| Reporting Topic |
|---|
| **A description of the Sava River Basin (WFD Article 3 and 5)** |
| 1. Sava River Basin and Competent authorities map |
| 2. Catchments and hydrografy map |
| 3. Map of the location and boundaries of surface and ground water bodies |
| 4. Map of the ecoregions and surface water body types within the Sava River Basin |
| 5. Summary map on of reference conditions for the surface water body types and typology |
| 6. Map of the heavily modified and artificial water bodies |
| **A significant pressure types and impact of human activities on water bodies** |
| 7. Map of point sources pollution for : |
| *Surface water* |
| *Groundwater* |
| 8. Map of diffuse sources of the pollution for: |
| *Surface water* |
| *Groundwater* |
| 9. **Map on water abstractions for:** |
| *Surface water* |
| *Groundwater* |
| 10. **Map of water flow regulations and morphological alterations (*surface water*)** |
| 11. **Map of artificial recharges (*groundwater)*** |
| 12. **Map of other pressures on groundwater** |
| 13. **Map of other pressure on surface waters** |
| **Identification and mapping of protected areas as required by Article 6 and Annex IV** |
| 14. Map of surface water bodies overlapping protected areas |
| 15. Map of groundwater bodies overlapping protected areas |
| **Results of water monitoring programmes established for the purposes of Article 8 and Annex V. Monitoring of status of surface waters (chemical and ecological), groundwater (chemical and quantitave) and protected areas:** |
| *Surface water* |
| 16. A map on surface water quality monitoring network showing operational, investigative, surveillance and reference monitoring sites |
| 17. A map on ecological status class of natural water bodies including data at a water body level, on which BQEs the assessment is based (default setting "unknown status" is applied if no class and BQE-specific data are provided)[5]; |
| 18. A map on ecological potential class for HMWB - MS should specify BQE concerned (default setting "unknown potential" is applied if no class and BQE-specific data are provided); |
| 19. A map on achievement/ exceednce of EQS for **heavy metals**[6] out of list of Priority Substances; |
| 20. A map on achievement/exceedance of EQS for **pesticides**[7] out of list of Priority Substances; |

[5] The WFD requires to determine the ecological status/potential class of every water body, but not to monitor all quality elements of all water bodies. Furthermore, some MS may not have appropriate monitoring for all BQE in place. The map should enable to create a disaggregated picture where only selected information is shown. It may be necessary to describe more detailed data and reporting needs to fulfil this aim.

[6] Cadmium, lead, mercury, nickel.

[7] Alachlor, atrazine, chlorpyriphos, chlorvenfinphos, diuron, endosulfan, isoproturon, HCH, pentachlorobenzene, simazine, trifluralin.

| Reporting Topic |
|---|
| 21. A map on achievement/exceedance of EQS for **industrial pollutants**[8] out of list of Priority Substances; |
| 22. A map on chievement/exceedance of EQS for **other pollutants**[9] out of list of Priority Substances; |
| 23. A map on achievement/exceedance of EQS for other (national) pollutants. |
| 24. A map on application of exemption for WB (by quality element and the target class)[10], which illustrates the envisaged/agreed objective for 2015. |
| *Groundwater* |
| 25. A map on achievement/exceedance of good quantitative status; |
| 26. A map on achievement/exceedance of "good chemical status" for **nitrates** (value in Annex 1 of GWD, status assessment procedure in Article 4 of GWD) |
| 27. A map on achievement/exceedance of "good chemical status" for **pesticides** (combined total and individual value in Annex 1 of GWD, status assessment procedure in Article 4 of GWD); |
| 28. Achievement/exceedance of "good chemical status" based on national thresholds for **other pollutants** (selected from a minimum number of substances as listed in Annex II of GWD, status assessment procedure in Article 4 of GWD); |
| 29. A map with identified groundwater bodies for which a significant and sustained upward trend has been identified (noting the relevant pollutant(s) causing the trend). |
| 30. A map on groundwater that are used at rates which are greater than the rate at which it is replaced by natural processes, its level within an aquifer drops |
| 31. A map on application of exemption for GWB (or groups of GWB) (by quality element and the target class)[11], which illustrates the envisaged/agreed objective for 2015. |
| *Protected areas* |
| 32. A map on status of surface water bodies in protected areas |
| 33. A map on status of groundwater bodies in protected areas |

[8] Anthracene, Benzene, $C_{10-13}$-chloroalkanes, Naphthalene, Nonylphenol, octylphenol, chlorinated organics (incl. SCCP, TRI, PER, DCM, Chloroform, 1,2-Dichloroethane...), PentaBDE, DEHP.

[9] DDT, HCB, HCBd, TBT, PAHs (including Fluoranthene), PCP, TCB, drins.

[10] Default status "good status" unless water body is already at "high status" according to 2009 monitoring data and classification.

[11] Default status "good status".

# ANNEX 2: LIST OF THEMATIC DATASETS FOR SAVA GIS

| Datasets title[12] | GIS presentation type | Availability status[13] |
|---|---|---|
| SRB _SavaRiverBasin | Polygon | |
| SRB_CompetentAuthority | Point | |
| SRB_SubBasin | Polygon | |
| SRB_Rivers | Line | |
| SRB_Lakes | Polygon | |
| SRB_RWB[14] | Line, point (centroid) | |
| SRB_LWB[15] | Polygon, point (centroid) | |
| SRB_GW[16] | Polygon, point (centroid) | |
| SRB_GWB[17] | Polygon, point (centroid) | |
| SRB_RiverBasinShare | Polygon, table | |
| SRB_PADrinkingWater[18] | Point | |
| SRB_PAAquaticSpecies | Point | |
| SRB_PANutrientSesitive | Point | |
| SRB_PAHabitat | Point | |
| SRB_PARecreationalBathing | Point | |
| SRB_LateralConectivity | Polygon, point (centroid) | |
| SRB_SWMonitoringNet | Point | |
| SRB_SWMonitoringQuantity<br>*Subset of SRB_SWMonitoringNet* | Point | |
| SRB_SWOperationalMonitoring<br>*Subset of SRB_SWMonitoringNet* | Point | |
| SRB_SWSurveillanceMonitoring<br>*Subset of SRB_SWMonitoringNet* | Point | |
| SRB_SWInvestigativeMonitoring<br>*Subset of SRB_SWMonitoringNet* | Point | |
| SRB_ReferentialMonitoringSites<br>*Subset of SRB_SWMonitoringNet* | Point | |
| SRB_SWDrinkingAbstractionSites<br>*Subset of SRB_SWMonitoringNet* | Point | |
| SRB_SWBClassStatus[19]<br>*Subset of SRB_RWB and Subset of SRB_LWB* | Line, polygon, point (centroid) | |

[12] Datasets: A **core datasets** are displayed in white. **RBM datasets** are displayed in blue. A **derived-RBM specific datasets** are displayed in light yellow. **Navigation Safety Management datasets** are displayed in gray. **Flood Management Datasets** are displayed in light brown. **Sediment Management datasets** are displayed in violet. A **supporting dataset** are displayed in light green.

[13] Availability status: gree – available in all Countries; orange – under prepration and/or; available in some countries; red – not available or not under prepration in any country

[14] RWB abbreviations refers to River Water Body

[15] LWB abbreviation refers to Lake River Body

[16] GW abbreviation refers to Groundwater

[17] GWB abbreviation refers to Groundwater Body

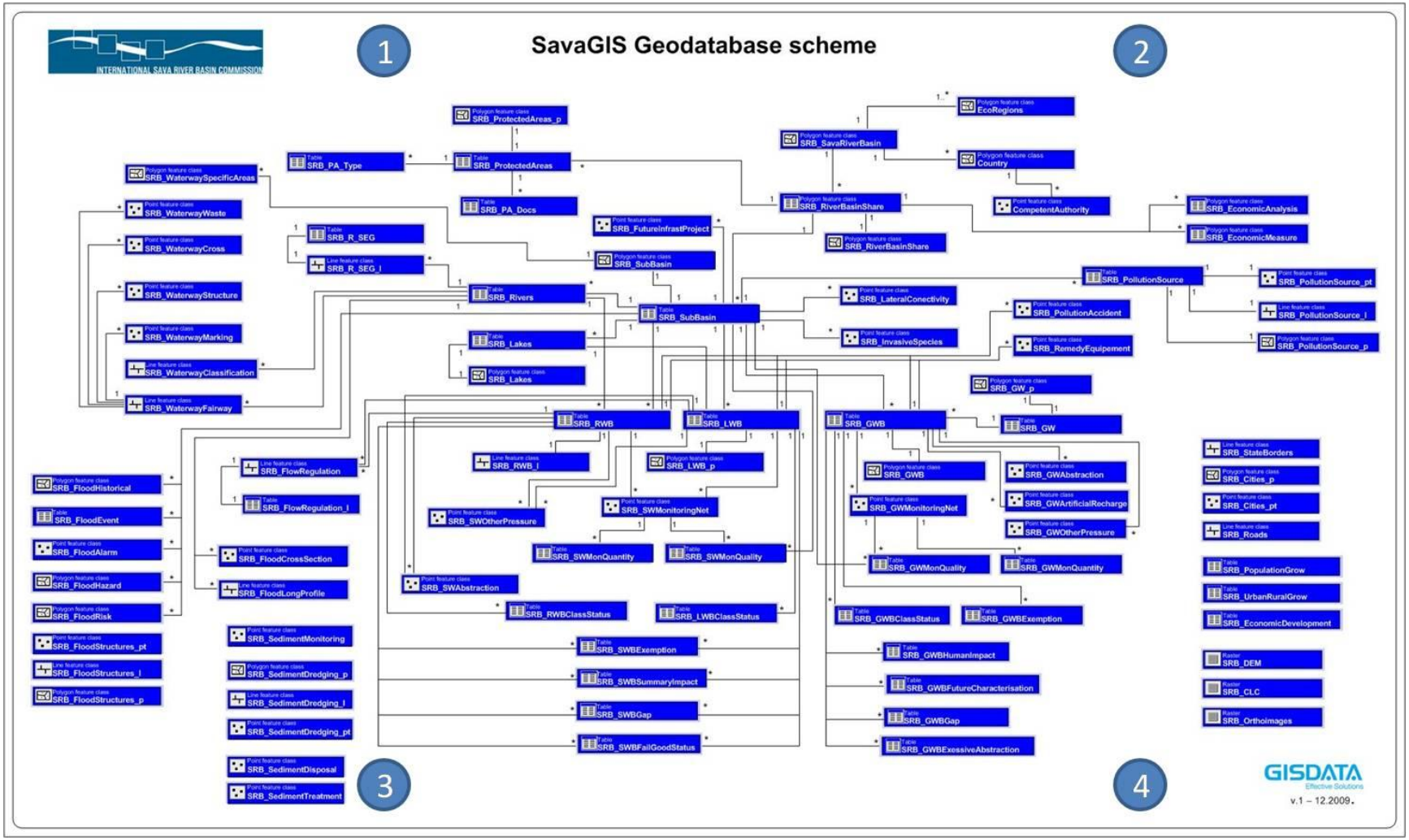
[18] PA abbreviation refer to Protected Areas

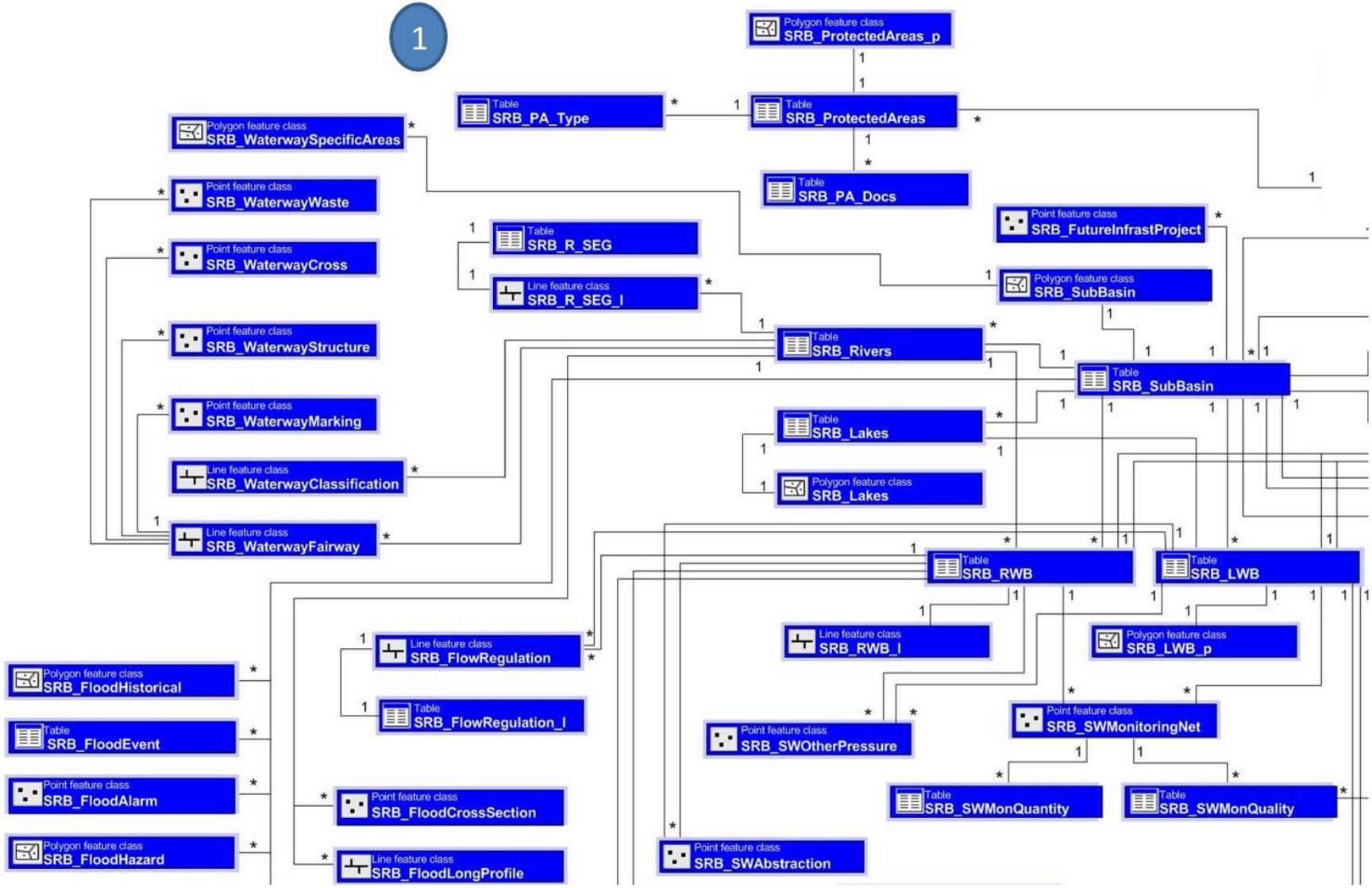
[19] SWB abbreviation refers to Surface Water Bodies

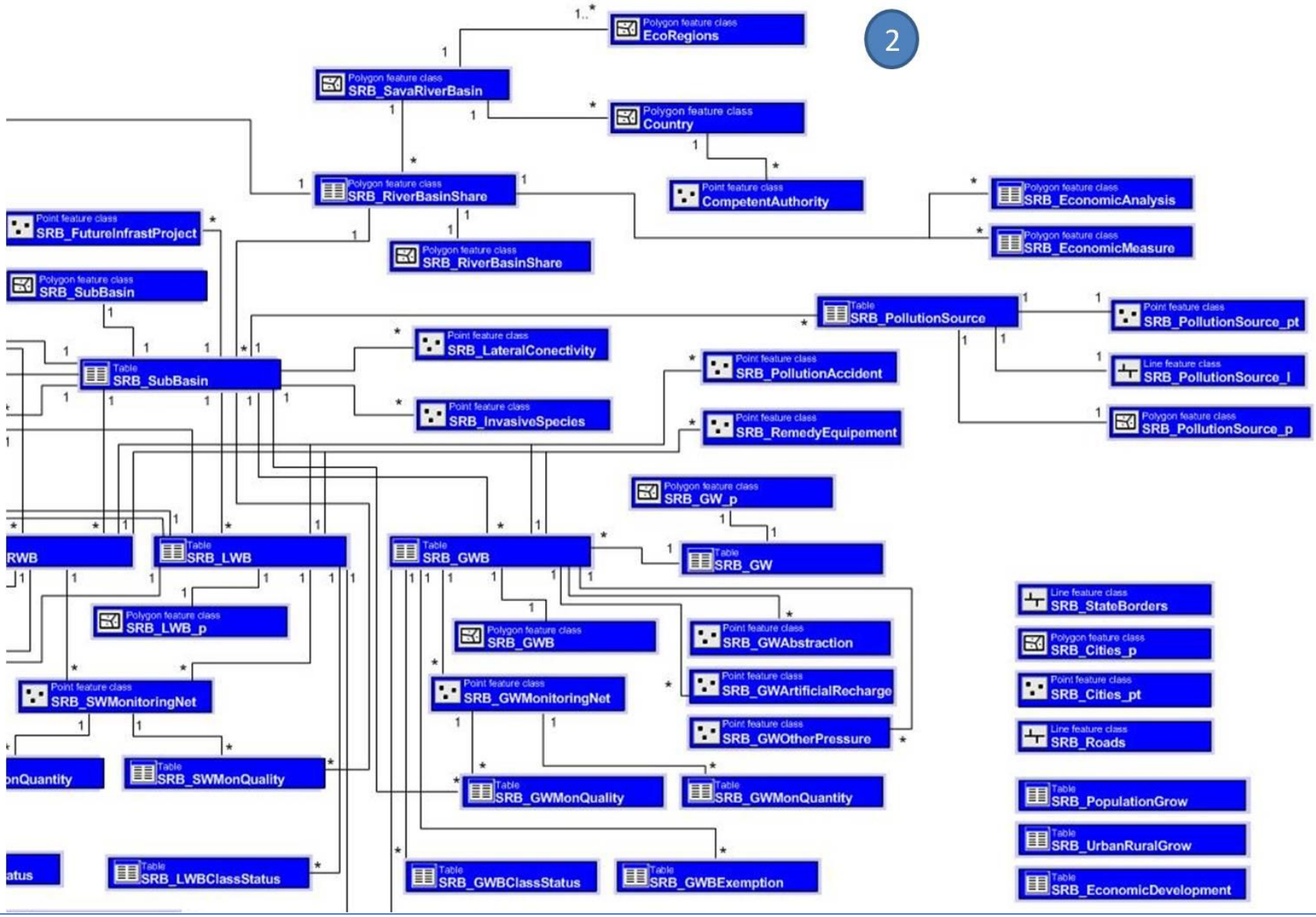
| Datasets title[12] | GIS presentation type | Availability status[13] |
|---|---|---|
| SRB_SWBExemption<br>*Subsets of SRB_RWB and SRB_LWB* | Line, polygon, point (centroid) | |
| SRB_GWMonitoringNet | Point | |
| SRB_GWMonitoringQuantity | Point, table | |
| SRB_GWOperatonalMonitoring | Point | |
| SRB_GWSurveillanceMonitoring | Point | |
| SRB_GWBClassStatus<br>*Subset of SRB_GWB* | Polygon, point (centroid) | |
| SRB_GWBExemption<br>*Subset of SRB_GWB* | Polygon, point (centroid) | |
| SRB_EcoRegions | Polygon | |
| SRB_SWPointSourcePollution | Point | |
| SRB_SWDiffuseSourcePolution | Polygon | |
| SRB_SWAbstraction | Polygon, point (centroid) | |
| SRB_SWFlowRegulation | Line | |
| SRB_SWOtherPressure | Polygon, line, point (centroid) | |
| SRB_SWBSummaryImpact<br>*Subset of SRB_RWB and SubsetSRB_LWB* | Polygon, line, point (centroid) | |
| SRB_SWBGap<br>*Subset of SRB_RWB and SRB_LWB* | Polygon, line, point (centroid) | |
| SRB_GWBFailGoodStatus<br>*Subset of SRB_GWB* | Polygon, point (centroid) | |
| SRB_GWPointSourcePolution | Point | |
| SRB_GWDiffuseSourcePollution | Polygon | |
| SRB_GWAbstraction | Polygon, point (centroid) | |
| SRB_GWArtificialRecharge | Point | |
| SRB_GWOtherPressure | Point | |
| SRB_GWBHumanImpact<br>*Subset of SRB_GWB* | Polygon | |
| SRB_GWFutureCharacterisation<br>*Subset of SRB_GWB* | Polygon | |
| SRB_GWGap<br>*Subset of SRB_GW* | Polygon | |
| SRB_GWExcessiveAbstraction<br>*Subset of SRB_GW* | Polygon | |
| SRB_InvansiveSpecies | Point | |
| SRB_FutureInfrastProject | Polygon, line, point | |
| SRB_EconomicAnalysis | Table | |
| SRB_EconomicMeasure | Table | |
| SRB_PollutionAccidentEvent | Polygon, line, point | |
| SRB_RemedyEquipement | Point | |
| SRB_Fairway | Line | |
| SRB_WaterwayClassification | Line | |
| SRB_WaterwayMarking | Point | |
| SRB_WaterwayTrainingWorks | Line | |
| SRB_WaterwayRestrictedAreas | Polygon, line, point | |

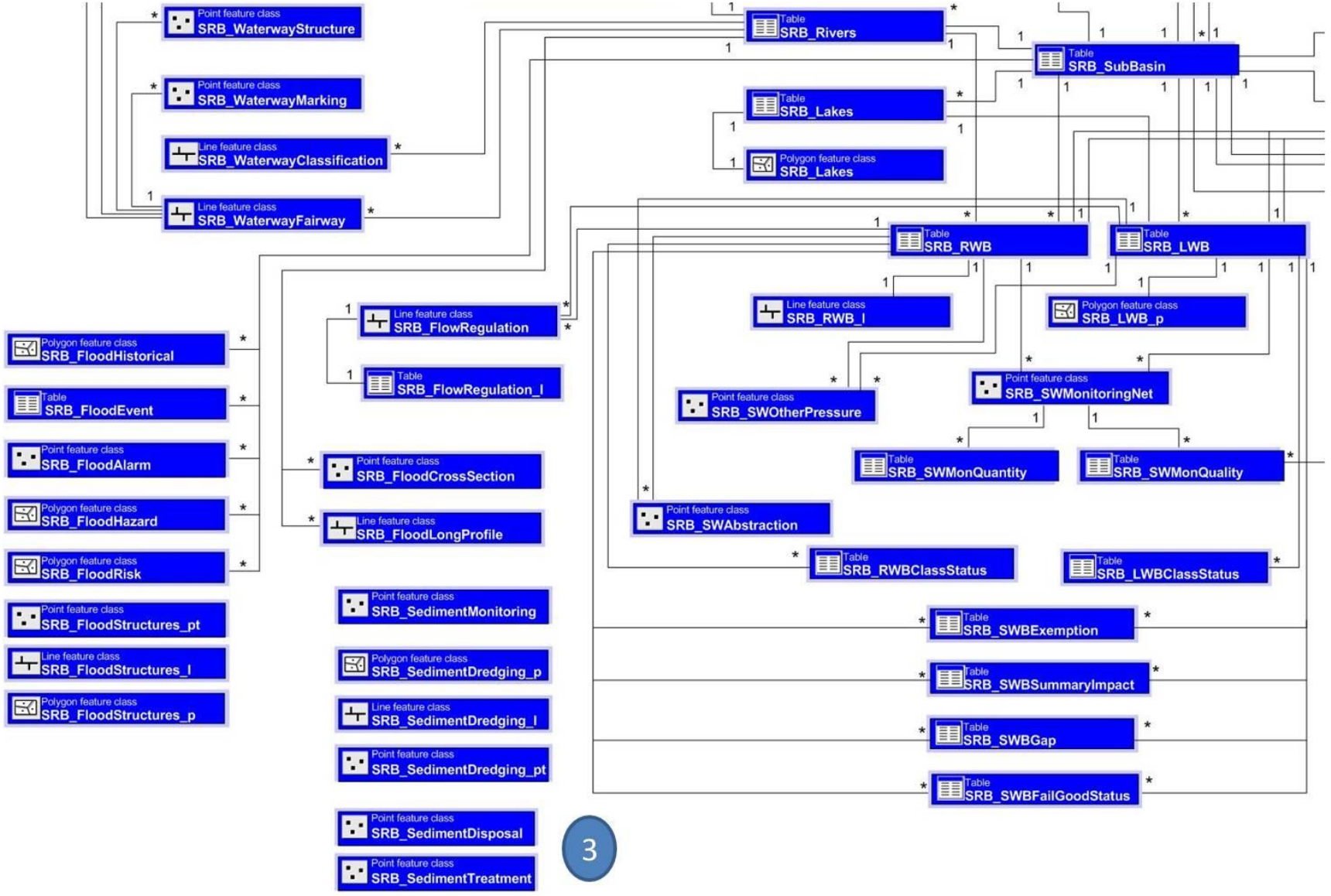
| Datasets title[12] | GIS presentation type | Availability status[13] |
|---|---|---|
| SRB_WaterwayDesignatedAreas | Polygon | |
| SRB_WaterwayOtherStructure<br>*Dataset derived from SWRegulation, SRB_SWAbstraction, SW_DiffuseSourcePollution, SWOtherPressure* | Polygon, line, point | |
| SRB_WaterwayInstitutions | Point | |
| SRB_WaterwayAreasofInterest | Polygon | |
| SRB_WaterwayCrossSection | Point | |
| SRB_WaterwayWaste | Point | |
| SRB_FloodCrossSection | Point, line | |
| SRB_FloodLongProfile | Line | |
| SRB_FloodStructures | Polygon, line, point | |
| SRB_HistoricalFlood | Polygon | |
| SRB_FloodHazard | Polygon | |
| SRB_FloodRisk | Polygon | |
| SRB_SedimentMonitoring | Point | |
| SRB_SedimentDredging | Polygon, line, point | |
| SRB_SedimentDisposal | Point | |
| SRB_SedimentTreatment | Point | |
| SRB_StateBorders | Line | |
| SRB_Cities | Polygon, point | |
| SRB_Roads | Line | |
| SRB_DEM | Raster | |
| SRB_CLC | Raster | |
| SRB_OrthoImages | Raster | |
| SRB_Population | Table | |
| SRB_EconomicDevelopment | Table | |

# ANNEX 3: SAVAGIS GEODATABASE SCHEMA




1
Polygon feature class
SRB_ProtectedAreas_p
Table
SRB_PA_Type
Table
SRB_ProtectedAreas
Polygon feature class
SRB_WaterwaySpecificAreas
Table
SRB_PA_Docs
Point feature class
SRB_WaterwayWaste
Point feature class
SRB_FutureInfrastProject
Table
SRB_R_SEG
Point feature class
SRB_WaterwayCross
Line feature class
SRB_R_SEG_I
Polygon feature class
SRB_SubBasin
Point feature class
SRB_WaterwayStructure
Table
SRB_Rivers
Table
SRB_SubBasin
Point feature class
SRB_WaterwayMarking
Table
SRB_Lakes
Line feature class
SRB_WaterwayClassification
Polygon feature class
SRB_Lakes
Line feature class
SRB_WaterwayFairway
Table
SRB_RWB
Table
SRB_LWB
Line feature class
SRB_FlowRegulation
Line feature class
SRB_RWB_I
Polygon feature class
SRB_LWB_p
Polygon feature class
SRB_FloodHistorical
Table
SRB_FlowRegulation_I
Table
SRB_FloodEvent
Point feature class
SRB_SWOtherPressure
Point feature class
SRB_SWMonitoringNet
Point feature class
SRB_FloodAlarm
Point feature class
SRB_FloodCrossSection
Table
SRB_SWMonQuantity
Table
SRB_SWMonQuality
Polygon feature class
SRB_FloodHazard
Line feature class
SRB_FloodLongProfile
Point feature class
SRB_SWAbstraction


2
Polygon feature class
EcoRegions
Polygon feature class
SRB_SavaRiverBasin
Polygon feature class
Country
Polygon feature class
SRB_RiverBasinShare
Point feature class
CompetentAuthority
Polygon feature class
SRB_EconomicAnalysis
Polygon feature class
SRB_EconomicMeasure
Point feature class
SRB_FutureInfrastProject
Polygon feature class
SRB_RiverBasinShare
Polygon feature class
SRB_SubBasin
Table
SRB_PollutionSource
Point feature class
SRB_PollutionSource_pt
Line feature class
SRB_PollutionSource_l
Polygon feature class
SRB_PollutionSource_p
Point feature class
SRB_LateralConectivity
Table
SRB_SubBasin
Point feature class
SRB_PollutionAccident
Point feature class
SRB_InvasiveSpecies
Point feature class
SRB_RemedyEquipement
Polygon feature class
SRB_GW_p
Table
SRB_LWB
Table
SRB_GWB
Table
SRB_GW
Polygon feature class
SRB_LWB_p
Polygon feature class
SRB_GWB
Point feature class
SRB_GWAbstraction
Point feature class
SRB_SWMonitoringNet
Point feature class
SRB_GWMonitoringNet
Point feature class
SRB_GWArtificialRecharge
Point feature class
SRB_GWOtherPressure
Table
SRB_SWMonQuality
Table
SRB_GWMonQuality
Table
SRB_GWMonQuantity
Table
SRB_LWBClassStatus
Table
SRB_GWBClassStatus
Table
SRB_GWBExemption
Line feature class
SRB_StateBorders
Polygon feature class
SRB_Cities_p
Point feature class
SRB_Cities_pt
Line feature class
SRB_Roads
Table
SRB_PopulationGrow
Table
SRB_UrbanRuralGrow
Table
SRB_EconomicDevelopment


Point feature class
SRB_WaterwayStructure
Point feature class
SRB_WaterwayMarking
Line feature class
SRB_WaterwayClassification
Line feature class
SRB_WaterwayFairway
Table
SRB_Rivers
Table
SRB_SubBasin
Table
SRB_Lakes
Polygon feature class
SRB_Lakes
Table
SRB_RWB
Table
SRB_LWB
Line feature class
SRB_RWB_l
Polygon feature class
SRB_LWB_p
Line feature class
SRB_FlowRegulation
Table
SRB_FlowRegulation_l
Point feature class
SRB_SWOtherPressure
Point feature class
SRB_SWMonitoringNet
Table
SRB_SWMonQuantity
Table
SRB_SWMonQuality
Polygon feature class
SRB_FloodHistorical
Table
SRB_FloodEvent
Point feature class
SRB_FloodAlarm
Polygon feature class
SRB_FloodHazard
Polygon feature class
SRB_FloodRisk
Point feature class
SRB_FloodStructures_pt
Line feature class
SRB_FloodStructures_l
Polygon feature class
SRB_FloodStructures_p
Point feature class
SRB_FloodCrossSection
Line feature class
SRB_FloodLongProfile
Point feature class
SRB_SWAbstraction
Table
SRB_RWBClassStatus
Table
SRB_LWBClassStatus
Point feature class
SRB_SedimentMonitoring
Polygon feature class
SRB_SedimentDredging_p
Line feature class
SRB_SedimentDredging_l
Point feature class
SRB_SedimentDredging_pt
Point feature class
SRB_SedimentDisposal
Point feature class
SRB_SedimentTreatment
Table
SRB_SWBExemption
Table
SRB_SWBSummaryImpact
Table
SRB_SWBGap
Table
SRB_SWBFailGoodStatus
3

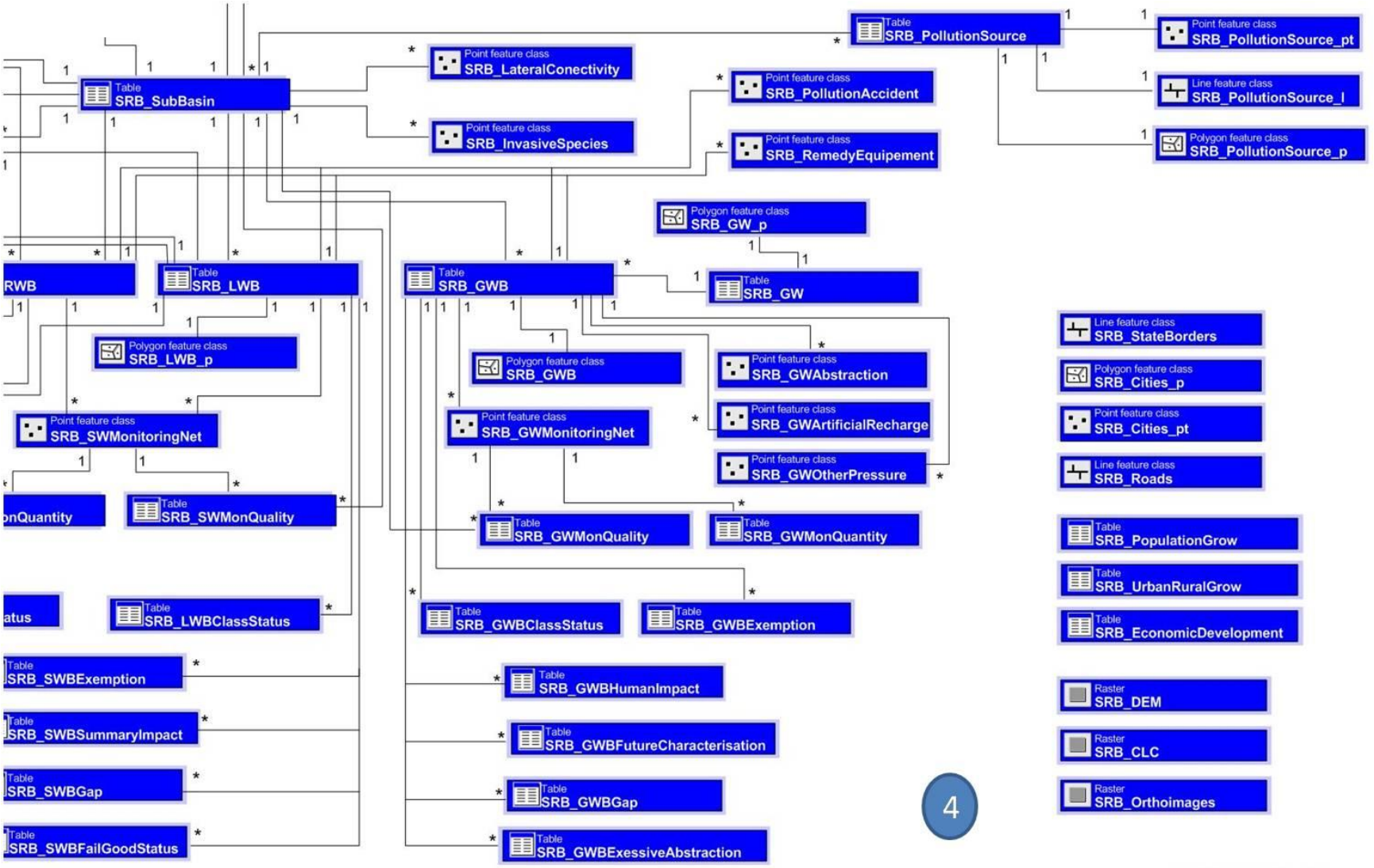


Table
SRB_PollutionSource
Point feature class
SRB_PollutionSource_pt
Line feature class
SRB_PollutionSource_l
Polygon feature class
SRB_PollutionSource_p
Table
SRB_SubBasin
Point feature class
SRB_LateralConectivity
Point feature class
SRB_InvasiveSpecies
Point feature class
SRB_PollutionAccident
Point feature class
SRB_RemedyEquipement
Polygon feature class
SRB_GW_p
Table
SRB_GW
Table
SRB_LWB
Polygon feature class
SRB_LWB_p
Table
SRB_GWB
Polygon feature class
SRB_GWB
Point feature class
SRB_GWAbstraction
Point feature class
SRB_GWArtificialRecharge
Point feature class
SRB_GWOtherPressure
Point feature class
SRB_SWMonitoringNet
Point feature class
SRB_GWMonitoringNet
Table
SRB_SWMonQuality
Table
SRB_GWMonQuality
Table
SRB_GWMonQuantity
Table
SRB_LWBClassStatus
Table
SRB_GWBClassStatus
Table
SRB_GWBExemption
Table
SRB_SWBExemption
Table
SRB_GWBHumanImpact
Table
SRB_SWBSummaryImpact
Table
SRB_GWBFutureCharacterisation
Table
SRB_SWBGap
Table
SRB_GWBGap
Table
SRB_SWBFailGoodStatus
Table
SRB_GWBExessiveAbstraction
4
Line feature class
SRB_StateBorders
Polygon feature class
SRB_Cities_p
Point feature class
SRB_Cities_pt
Line feature class
SRB_Roads
Table
SRB_PopulationGrow
Table
SRB_UrbanRuralGrow
Table
SRB_EconomicDevelopment
Raster
SRB_DEM
Raster
SRB_CLC
Raster
SRB_Orthoimages

# ANNEX 4: SUMMARY OF PRICING FOR SAVA GIS

**Table 2: Summary on pricing for the Sava GIS implementation**

| | Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|---|
| | HW, SW, Administration and Maintenance in Secretariat of the ISRBC | HW&SW in the secretariat of ISRBC + Administration & Maintenance outsourced | Hosting in one ISRBC Institution | Outsourced all |
| 1.1 Hardware Server x 2 | 8.000,00 | 8.000,00 | 8.000,00 | 2.700,00 |
| 1.2 HW Firewall and backup | 3.000,00 | 3.000,00 | 3.000,00 | 1.000,00 |
| 1.3 Operating system license | 1.000,00 | 1.000,00 | 1.000,00 | 350,00 |
| 1.4 RDBMS license | 5.000,00 | 5.000,00 | 5.000,00 | 1.700,00 |
| 1.5 Web GIS Server SW | 67.000,00 | 67.000,00 | 67.000,00 | 22.500,00 |
| 1.6 Desktop GIS SW | 10.000,00 | 10.000,00 | 10.000,00 | 3.500,00 |
| **1 Total HW&SW (€)** | **94.050,00** | **94.050,00** | **94.050,00** | **31.750,00** |
| 2.1 Geodatabase modelling, physical data model of SavaGIS | 25.000,00 | 25.000,00 | 25.000,00 | 25.000,00 |
| 2.2 Harmonisation application development (tools for 5 WIS) | 80.000,00 | 80.000,00 | 80.000,00 | 80.000,00 |
| 2.3 Web application - Geoportal and Map application | 50.000,00 | 50.000,00 | 50.000,00 | 50.000,00 |
| **2 Total Geodatabase and applications development (€)** | **155.000,00** | **155.000,00** | **155.000,00** | **155.000,00** |
| **Total Sava GIS implementation** | **249.050,00** | **249.050,00** | **249.050,00** | **186.750,00** |

**Table 3 - Summary on pricing for the Sava GIS yearly maintenance**

| | Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|---|
| | **HW, SW, Administration and Maintenance in Secretariat of the ISRBC** | **HW&SW in the secretariat of ISRBC + Administration & Maintenance outsourced** | **Hosting in one ISRBC Institution** | **Outsourced all** |
| 3.1 GIS Server and Database local administration - Yearly | 7.000,00 | 25.000,00 | 10.000,00 | 15.000,00 |
| 3.2 Yearly Administration OS - (on-line support on daily basis) | 15.000,00 | 30.000,00 | 25.000,00 | 30.000,00 |
| 3.3 Yearly maintenance for applications – outsourced (bug fix, technical support) | 20.000,00 | 20.000,00 | 20.000,00 | 20.000,00 |
| 3.4 Training and workshops | 4.000,00 | 4.000,00 | 4.000,00 | 4.000,00 |
| 3.5 GIS Server GIS extension, GIS Desktop - maintenance fees Yearly ** | 21.000,00 | 21.000,00 | 21.000,00 | 21.000,00 |
| 3.6 Outsourced HW&SW Yearly | - | - | - | 32.000,00* |
| **Total administration, competences development and maintenance Yearly (€)** | **70.000,00** | **100.000,00** | **80.000,00** | **90,000,00 + 32.000,00*** |

* For second and third year (with minimum 3 Year Contract)

** Not for the first year (first year is included in the purchase of software)

# ANNEX 5: SUMMARY OF PRICING FOR SAVA CMS

## MS SharePoint Solution

| Item | Price [€] |
|---|---|
| **1. Hardware + OS + DBMS** | |
| 1.1 Hardware | 3.000,00 |
| 1.2. Operating system license | 1.000,00 |
| **Total Hardware + OS+ DBMS (1)** | **9.000,00** |
| **2. KOFAX (scanner + software)** | |
| 2.1. Scanner hardware | 2.000,00 |
| 2.2. KOFAX Ascent Capture 7.5 (Stand Alone 5K month) | 1.000,00 |
| Total KOFAX (2) | 3.000,00 |
| **Total 1 + 2** | **12.000,00** |
| **1. Windows Small Business Server Premium 2008 for 15 users (MS SQL Server + MS Windows Server 2008, MS Exchange Server, MS SharePoint Service 3.0)** | **2.639,00** |
| **4. Establishment (15 users)** | |
| 4.1 Development, configuration and testing | 15.000,00 |
| 4.3. Training for 15 users | 5.000,00 |
| **Total Implementation (4)** | **20.000,00** |
| **Total (1+2+3+4)** | **34.639,00** |
| **5. Yearly maintenance (bug fix, technical support)** | **10.000,00** |
| **6. Out-sourced Administration (Business hours phone support, 1 hour response, Web support, unlimited incidents)** | **5.000,00** |
| **Total Maintenance (5+6)** | **15.000,00** |
| **TOTAL INVESTMENT IN FIRST YEAR + MAINTENACE IN SECOND YEAR** | **49.639,00** |

## Alfresco Solution

| | Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|---|
| | MS SQL Server + MS Windows Server 2008 + basic CMS features [€] | MS SQL Server + MS Windows Server 2008 + advanced CMS features [€] | MySQL + Linux + basic CMS features [€] | MySQL + Linux + advanced CMS features [€] |
| **1. Hardware + OS + DBMS** | | | | |
| 1.1 Hardware | 3.000,00 | 3.000,00 | 3.000,00 | 3.000,00 |
| 1.2. Operating system license | 1.000,00 | 1.000,00 | 0,00 | 0,00 |
| 1.3. DBMS license | 5.000,00 | 5.000,00 | 0,00 | 0,00 |
| **Total Hardware + OS+ DBMS (1)** | **9.000,00** | **9.000,00** | **3.000,00** | **3.000,00** |
| **2. KOFAX (scanner + software)** | | | | |
| 2.1. Scanner hardware + KOFAX Ascent Capture 7.5 (Stand Alone 5K month) [€] | 3.000,00 | 3.000,00 | 3.000,00 | 3.000,00 |
| Total KOFAX (2) | 3.000,00 | 3.000,00 | 3.000,00 | 3.000,00 |
| **Total 1 + 2** | **12.000,00** | **12.000,00** | **6.000,00** | **6.000,00** |
| **2. Alfresco CMS Software** | **0** | **0** | **0** | **0** |
| **4. Establishment (15 users)** | | | | |
| 4.1 Development, configuration and testing | 12.000,00 | 18.000,00 | 12.000,00 | 18.000,00 |
| 4.3. Training for 15 users (4 days) | 2.000,00 | 2.000,00 | 2.000,00 | 2.000,00 |
| **Total Implementation (4)** | **14.000,00** | **20.000,00** | **14.000,00** | **20.000,00** |
| **Total (1+2+3+4)** | **26.000,00** | **32.000,00** | **20.000,00** | **26.000,00** |
| **5. Yearly maintenance (bug fix, technical support via email-a)** | **3.000,00** | **3.000,00** | **3.000,00** | **3.000,00** |
| **6. Administration - outsourced (on-line support on daily basis via Skype)** | **6.000,00** | **6.000,00** | **6.000,00** | **6.000,00** |
| **TOTAL INVESTMENT IN FIRST YEAR + MAINTENACE IN SECOND YEAR** | **35.000,00** | **41.000,00** | **29.000,00** | **35.000,00** |