Software Requirement Specification

Waterway Monitoring System (WAMOS)

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Abbreviations

EPSG	European Petroleum Survey Group Geodesys
EVRF	European Vertical Reference Frame
EVRF2007	European Vertical Reference Frame 2007
DBMS	Database Management System
DRC	Data Requirement Catalogue
ERDMS	European Reference Data Management System
HNWL	Higher Navigable Water Level
HTTP	Hypertext Transport Protocol
HTTPS	Hypertext Transport Protocol Secure
IENC	Inland Electronic Navigational Charts
INEA	Innovation and Networks Executive Agency
ISRS	International Ship Reporting Standard
LB	Left Bank
LNWL	Lower Navigable Water Level
MW	Medium Water Level
NtS	Notices to Skippers
OGC	Open Geospatial Consortium
RB	Right Bank
RIS	River Information System
RIS COMEX	River Information Services Corridor Management Execution
RIS Index	River Information Services Index
SLD	Styled Layer Descriptor
SRS	Software Requirements Specification
SSL	Secure Sockets Layer
TLS	Transport Layer Security
TMS	Tile Map Service
UC	Use Case
US	User Story
UML	Unified Modeling Language
WFS	Web Feature Service
WMS	Web Map Service
WMTS	Web Map Tile Service
WRM	Water Related Message (of NtS)

1. Introduction

1.1. Purpose

The purpose of this document is to present a detailed description of the transnational waterway monitoring system - WAMOS. It explains the users, functions, features, constraints of the system, the interfaces to the national systems feeding the shared database and to external systems publishing data to web-portals and web-services like the FIS-portal or RIS COMEX.

1.2. Scope

The Transnational Waterway Monitoring System (WAMOS) is one output of the FAIRway Danube project which aims to increase safety, efficiency and environmental friendliness of inland navigation. The scope of FAIRway Danube (http://www.fairwaydanube.eu/) can be split up into the following steps[1]:

- Update national action plans regularly (twice a year, October and May)
- Concerted purchase of advanced equipment for hydrological services (gauging stations, surveying and marking vessels)
- Carry out pilot activities and evaluate results:
    - Collection of basic data for all critical locations of the Danube waterway
    - Analysis and evaluation of the data collected as basis for coherent monitoring of the navigation status
    - Harmonised water level forecasts
    - Optimized routing of the fairway based on current depth measurements
- Develop innovative approaches in the area of aerial monitoring, modern Aids to Navigation, and any other supporting tools for fairway rehabilitation

WAMOS is a web-based application for desktop PC which supports the waterway managers in aligning national fairway improvement strategies and shall ease the reporting of needs to national and international decision makers. As described in the feasibility study NEWADA duo[2] one of the most critical factors is providing sufficient fairway depths throughout the year together with accurate and reliable information on current waterway conditions for the users of the waterway. To meet this challenge in WAMOS all necessary data from the national systems will be merged into one transnational database to achieve the following goals:

- Provide information about the riverbed morphology and analyse the changes caused by sedimentation, dumping, erosion and dredging.
- Provide information about the fairway in terms of dimension and, availability in order to assess the effectiveness of measures by the waterway management authorities.
- Provide information on current, historical and projected water levels including their characteristics and hydrological conditions.
- Provide information about the rehabilitation and maintenance measures.
- Provide information about the fairway marking, especially along the shallow sections of the river Danube.
- Provide Information about the actuality and accuracy of the data in order to be able to assess the reliability of the statements derived from WAMOS.
- Provide information to external systems like RIS COMEX or FIS-Portal in form of data- and map services.

In addition, the non-goals of this document are as follows:

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[1] http://www.fairwaydanube.eu/fairway-in-a-nutshell/

[2] Network of Danube Waterway Administrations: Feasibility Study for a Waterway Management System for the Danube. December 2014.

- To cover the software requirements specification of the national systems.

In general WAMOS must be implemented to be able to process all the specifications of the Data Requirement Catalogue which also defines guidelines for waterway management authorities (see chapter 1.5).

1.3. Definitions, Acronyms and Abbreviations

This section contains definitions of acronyms and abbreviations used in this specification and which are necessary for understanding.

1.3.1. Definitions

Actor[3]

Actors are the users of the system being modelled. Each actor will have a well-defined role, and in the context of that role have useful interactions with the system. An actor role may be performed by a non-human system, such as another computer program.

Bathymetry

A study of underwater depth of water bodies, topography of a water body

Bottleneck

Sector of the waterway with restricted fairway parameters, due to morphological, hydrological or traffic density related reasons

Buoy

Floating device that aids the skippers by marking the fairway to allow ships to navigate safely

EVRS2007[4]

European Vertical Reference Frame 2007 is a vertical datum first defined in 2007 and is suitable for use in Europe - onshore - Andorra; Austria; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; Czech Republic; Denmark; Estonia; Finland; France - mainland; Germany; Gibraltar, Hungary; Italy - mainland and Sicily; Latvia; Liechtenstein; Lithuania; Luxembourg; Netherlands; Norway; Poland; Portugal; Romania; San Marino; Slovakia; Slovenia; Spain - mainland; Sweden; Switzerland; United Kingdom (UK) - Great Britain mainland; Vatican City State. European Vertical Reference Frame 2007 is a vertical datum for Geodesy. It was defined by information from European veritical data centre at Bundesamt für Kartographie und Geodäsie (BKG), Leipzig branch. http://crs.bkg.bund.de/evrs/ Realised by geopotential numbers and Normal heights of the United European Levelling Network. Replaces EVRF2000 (datum code 5129).

CEVNI

European Code for Inland Waterways, document of UNECE

Chainage

Distance along fairway axis from the mouth of the river in upstream direction.

Coordinate system

A reference system consisting of a set of points, lines, and/or surfaces, and a set of rules, used to define the position of points in space in either two or three dimensions

Critical sector

[3] https://en.wikipedia.org/wiki/Use_case

[4] http://georepository.com/datum_5215/European-Vertical-Reference-Frame-2007.html

Sector/section of the fairway where no sufficient depth/width/vertical clearance is guaranteed and available.

A national stretch of the river can include several critical sectors/sections, which may summarize a number of bottlenecks/critical locations (see below figure).

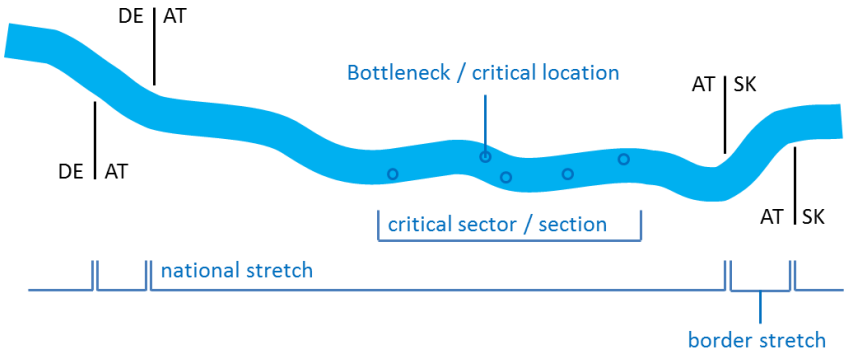

Figure 1: Stretches, Sections and Locations

Cross-section, profile

A plane, generally perpendicular to the centreline of the river or the fairway

Depth contours / Isobaths

A line on a map connecting points of equal depth below the hydrographic datum

EUSDR

Strategy of the EU for the Danube Region (Danube Strategy), Macro regional strategy of the EU gathering 9 EU member states and 5 non-member states

Fairway

Part of the waterway with specific depth, with and vertical clearance which enables continuous navigation

Ford

A shallow section sector in a river that stretches across the entire width of the river

Gauge zero

Elevation of the gauging station with respect to a defined vertical reference (mean sea level)

HNWL

The Highest Navigable Water Level (HNWL), which is the water level derived from the rating curve, defined for all navigable sections of the river, defined by the 1% duration of discharges over the 30 year period, on days without ice (defined by the Danube Commission)

Hydromorphology

Physical characteristics of the river, including the riverbed, banks, connections with the landscape, including longitudinal continuity and habitat continuity

Lateral Sedimentation

The natural process in which material (such as stones and sand) is carried to the lateral bottom of a body of water and forms a solid layer. This form of sedimentation can influence the fairway of the river Danube and leads to a bottleneck.

Level of Service (LOS)

The Level of Service describes a certain fairway depth and width,

- Level of Service 1: Deep fairway channel for a pushed convoy as foreseen by the respective waterway class downstream in one-way traffic (as defined in the Fairway Rehabilitation and Maintenance Master Plan[5])
- Level of Service 2: for a pushed convoy as foreseen by the respective waterway class downstream passing a single vessel upstream
- Level of Service 3: two passing pushed convoys as foreseen by the respective waterway class LOS

As an example for a class VIb waterway this would mean:

Table 1: Level of Service and Vessel Formation

LOS1		4-unit pushed convoy downstream in one-way traffic
LOS2		4-unit pushed convoy downstream and passing single vessel upstream
LOS3		Two 4-unit pushed convoys passing

LNWL

The Low Navigable Water Level (LNWL) is the water level corresponding to a discharge reached on 94% of days per year on average, over a period of 30 years, excluding periods with ice (defined by the Danube Commission).

Morphology

The shape of a body of flowing water that results from tectonics, rock, climate, vegetation and human influences.

NEWADA duo

The project NEWADA duo (Network of Danube Waterway Administrations) was part of the South-East Europe Transnational Cooperation Programme. It ended in 2015 and provided important groundwork for FAIRway Danube and the set-up of a Transnational Waterway Monitoring System.

Use Case[6]

In software and systems engineering, a use case is a list of actions or event steps, typically defining the interactions between a role (known in the Unified Modelling Language as an *actor*) and a system, to achieve a goal.

Water Gauge

Equipment for measuring the water level of over-ground water bodies

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[5] Fairway depth of 2.5 m at Low Navigable Water Level (ENR), i.e. on 94% (343 days) of the year, calculated on the basis of the discharge observed over a period of 30 years with the exception of ice periods. Fairway width (range of values accounts for different curve radii):
- 40 to 80 m in Austria
- 60 to 100 m in Slovakia and Slovakian-Hungarian border section
- 80 to 120 m in Hungary
- 80 m in Croatia, Serbia, Romania and Bulgaria (including border sections) – no range for curve radii as there is usually no passing of vessels/convoys in bends on these sections

[6] https://en.wikipedia.org/wiki/Use_case

Water Level

Water height at a certain point in the reference profile cross-section of a body of water

Waterway

Navigable body of water for which there are legal provisions for the safety and flow of commercial navigation

1.4. System Environment

The main components interacting with WAMOS are shown in Figure 2. There are five components which deliver and two which consume data. A list of the individual data streams can be found in Figure 3 and Figure 4.

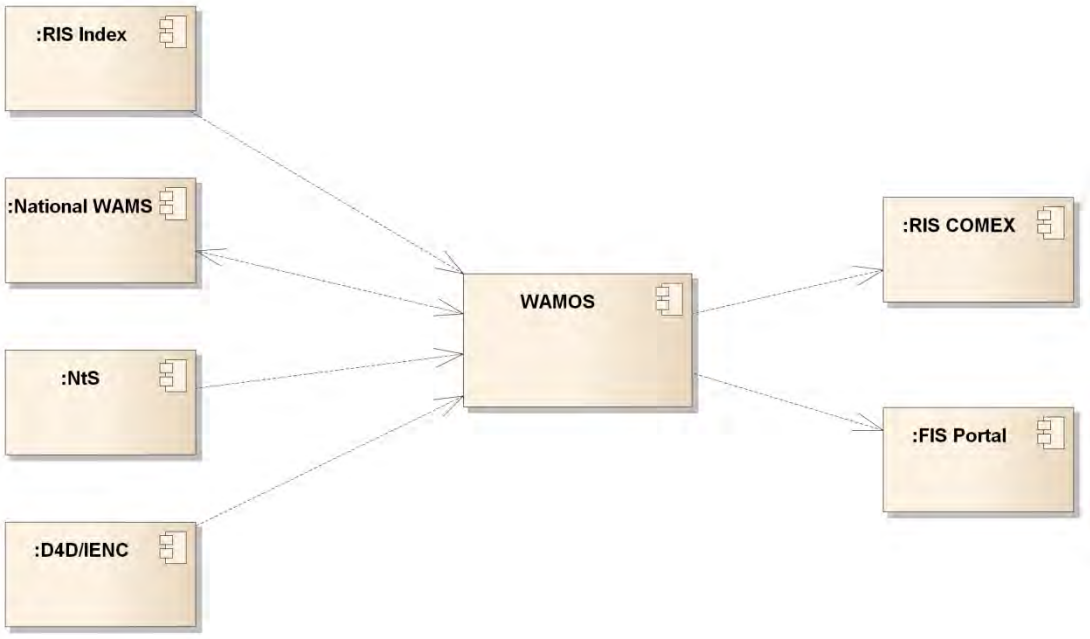

Figure 2: System Environment

RIS Index[7]

As stipulated in Article 4 and Annex 1 of the Directive 2005/44/EC on harmonised river information services (RIS), the RIS Index is a standardized structure for the description of geo-related RIS reference data maintained by national authorities on basis of definitions, which are set out by the Joint Task Force on the RIS Index. The RIS Index serves the purpose of addressing waterway objects unambiguously in RIS systems. All RIS Expert Groups agreed on the data format for reference data of objects; this is the so-called "RIS Index".

National WAMS

Each country has or develops a National Waterway Management System (WAMS) and other national information systems which shall exchange data with the transnational waterway monitoring system. National systems will be set up in Slovakia, Hungary, Croatia, Romania and Bulgaria. Within this document the interfaces to the national systems are defined. In the chapter 0

[7] http://www.ris.eu/library/expert_groups/ris_index/ris_index

Secondary Use Cases <SUC> the term of the national system is used for both, a waterway management system and a national data source which is upstream or downstream of the national WAMS, or in parallel.

Notices to Skipper (NtS)[8]

On basis of a requirement set out in Article 4 of the Directive 2005/44/EC, Notices to Skippers (NtS) are one of four River Information Services (RIS) key technologies designed to improve the safety and reliability of inland navigation by means of information technology. NtS provide information on long-term and short-term limitations along the fairway, weather information, current and future water levels at gauges, restrictions caused by ice or floods, regulations and other relevant data.

Inland ENCs (D4D/IENC)[9]

Inland ENCs are electronic navigational charts which can be displayed with the aid of special software (ENC/IENC Viewer). The basic contents of electronic inland navigational charts (Inland ENCs or short IENCs) are standardized as to content; structure and format. They include all chart information necessary for safe navigation and may contain supplementary information in addition, such as:

- Traffic control data such as fairway, buoys, zones where traffic is prohibited, lighting and traffic signs
- Structures and obstacles such as bridges, locks and weirs
- Shorelines and river engineering structures (groynes and training walls)
- Orientation guidance such as Waterway Axis, kilometre and hectometre markers

RIS COMEX (River Information Services Corridor Management Execution)[10]

The RIS COMEX Project is about to continue the pan-European expansion of River Information Services for inland navigation. The main focus of RIS COMEX is on the availability of reliable information on fairways, traffic and transport, harmonisation of data exchange, as well as existing transport information services, optimum use of the infrastructure, reduced administrative barriers and reporting burdens, optimum planning of transport routes and the support of the development of legal, financial and technical agreements in order to ensure the sustainable operation of the implemented Corridor Services even beyond the project end date (December 2020). Further information is available at http://www.riscomex.eu/.

FIS Portal

Developed within the NEWADA duo project, the Fairway Information Service (www.danubeportal.com) provides geographical, hydrological and administrative information regarding the waterway (fairway). National waterway administrations provide contents through this single-window information portal.

The D4D Portal (http://d4d-portal.info/) collects all Inland ENCs from the participating waterway authorities and shall be used as data source for Inland ENCs.

Danube STREAM

The objective of the project Danube STREAM (http://www.interreg-danube.eu/approved-projects/danube-stream, start date 01-01-2017, end date: 30-06-2019) is to establish and maintain an efficient and environmentally friendly transportation network (Danube and its navigable tributaries) by further developing effective waterway infrastructure management. In addition to consolidating common standards and tools, the project's results and outputs include user oriented information services (e.g. improved FIS Portal, NtS and IENCs).

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[8] http://www.doris.bmvit.gv.at/en/services/river-information-services/ris-standards/notices-nts/

[9] http://www.doris.bmvit.gv.at/en/services/river-information-services/ris-standards/inland-encs/

[10] http://www.ris.eu/projects/53/ris_comex_

1.5. References

This specification is based on the following documents:

Table 2: Referenced Documents

Version	Date	State	Document	Description	Reference
	20.10.1998		IEEE Software Engineering Standards Committee, IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications		
2.0 final	23.06.2015	Final	Annex\References\RIS Index\2015_06_23_RIS-Index_Encoding_Guide_v2p0.docx	RIS Index Encoding Guide	RIS Index Encoding Guide
1.1	11.05.2017	draft	WAMOS_DRC_1.1.docx	WAMOS Data Requirement Catalogue	Data Requirement Catalogue
4.0	Nov. 2016	Under Revision	Annex\References\NtS (all files)	NtS XSD 4.0.4.0 and WSLD 2.0.4.0	NtS
1.0 final		Final	Annex\References\RiverbedScans\IRIS_II_SuAc 1 1 - Deliverable 1_final document.pdf[11]	Surveying Workflow, Pre-Processing Steps	Riverbed Scan Process
Edition 2.3	13.01.2011		Annex\References\IENC\Standard\prodspec_ienc_2_3.pdf	Product Specification for Inland ENCs	IENC Product Specification
Edition 2.3.6	July 2014		Annex\References\IENC\Guides\inland_enc_encoding_guide_edition_2_3_6.pdf	Encoding Guide for Inland ENCs	IENC Encoding Guide
	Mai 2015		Annex\References\other_sources\2015_05_WAMS_Endbericht.pdf	Kurzbericht zum Forschungsprojekt (11/2012 – 04/2015) WAMS WASSERSTRASSEN MANAGEMENT SYSTEM	WAMS Final Report
2011-07-28	2011-07-28		Annex\References\RIS Index\2011-0415 PLATINA RISDataManagement Service API Interface Final 20110728....doc	RIS Data Management Service API Interface	Platina RIS-API
v1p0 (final)	2011-03-15	final	Annex\References\other_sources\accuracy_update_requirements_depth_data_v1p0_final.pdf	Recommended accuracy and update requirements for depth data	RIS eu

[11] This document is no longer up-to-date, but it is included to provide an overview of the processing and visualization of riverbed surveys.

			(http://www.ris.eu/docs/File/428/accuracy_update_requirements_depth_data_v1p0_final.pdf)		
	2017-01-18		Annex\References\other_sources\comm_cef_leaflet_final.pdf also available under the following link: https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/beneficiaries-info-point/publicity-guidelines-logos		INEA publicity guidelines

1.6. Overview

This document is laid out in a modified IEEE830-1998 style. The biggest difference from the standard is the addition of the system interface descriptions in chapter 3.3.2. Because the main challenge of WAMOS is the interfaces definition to the national systems it was decided to describe these in detail.

Chapter two provides an overview of the system functionality and system interaction with other systems. It is intended to provide a "management summary". Also a brief overview of the use-cases and the client mock-ups is given in this chapter.

Chapter three describes the functional and non-functional requirements in detailed terms, and also deals with the user and data interfaces.

Chapter four is the annex with all further documents complementing this specification.

2. Overall Description

This chapter provides an overview of the system functionality and system interaction with other systems by means of a drafted business process, the product perspective and an overview of the needed use cases.

2.1. Business Process

One of the main activities of WAMOS is the collection and integration of data from different sources. As shown in Figure 3 there are the IENC Data files, the NtS Web Service, the RIS Index Encoding Guide and finally the national authorities, who provide data for their national stretch directly. This bundle of data contains all necessary information (e.g. actual water levels, fairway dimensions, riverbed surveys etc.) as basis for WAMOS' functionalities.

The data integration process shall be triggered in two different ways. One is to start it manually by an external message or input, the other is to call it periodically in a certain, configurable interval. Depending on the dependency of the data type, one of the two methods is called. After the data has been transmitted, it has to be checked, consolidated and stored in an internal database. The checks at this time of the import process are carried out automatically. The data is checked for structure, completeness and plausibility. Based on valid data the process activity is started, generating additional data. Manually imported data have to pass additional quality tests by the administrator in a staging area and can be manually checked. Then the release for the productive system is made. In contrast to this, automatically imported data are imported directly into the productive area of the database. Finally, depending on the data type to be updated, the data is transferred to the external systems e.g. the Danube FIS Portal and RIS COMEX. Afterwards the data integration process is finished and starts again from the beginning after a certain time, depending on the update interval of the data type. For example the update interval of riverbed surveys may be one month, whereas the water levels will be transferred at least once a day. The data transmission is done using well-defined interfaces.

The result of the data integration process is a database with valid, checked, homogeneous and harmonized data sets for visualization, analysis and export.

The main activities of the waterway users are displaying data in the map and generating reports and statistics based on WAMOS data. This includes among others the display of Riverbed Changes, Hydrological Conditions, Available Fairway Depths and Water Levels. WAMOS presents all actual joined data in a map and shows all detailed data in form of attributes, charts, statistics and reports.

Finally the updated map data shall be provided to the FIS-Portal or to the national authorities in form of OGC services. These external systems need the information for a seamless digitization of their data near the national borders. So it is guaranteed that both ends of a dataset fit together.

Also shown in Figure 3 are the different types of data sets transferred from each data source:

- (NWA)-Waterway Area
- (F)-Fairway dimensions
- (SD)-Sections and Stretches
- (RHM)-Distance Marks (Distance Marks along Waterway Axis and Distance Marks Ashore)
- (WA)-Waterway Axis
- (BN)-Bottleneck
- (G)-Waterway Gauge
- (GM)-Gauge Measurements
- (AF)-Available fairway depths
- (SR)-Sounding Results
- (FM)-Fairway Marks
- (RMM)-Rehabilitation and Maintenance Measures
- (WP)-Waterway Profile (including Water Level Reference Data)

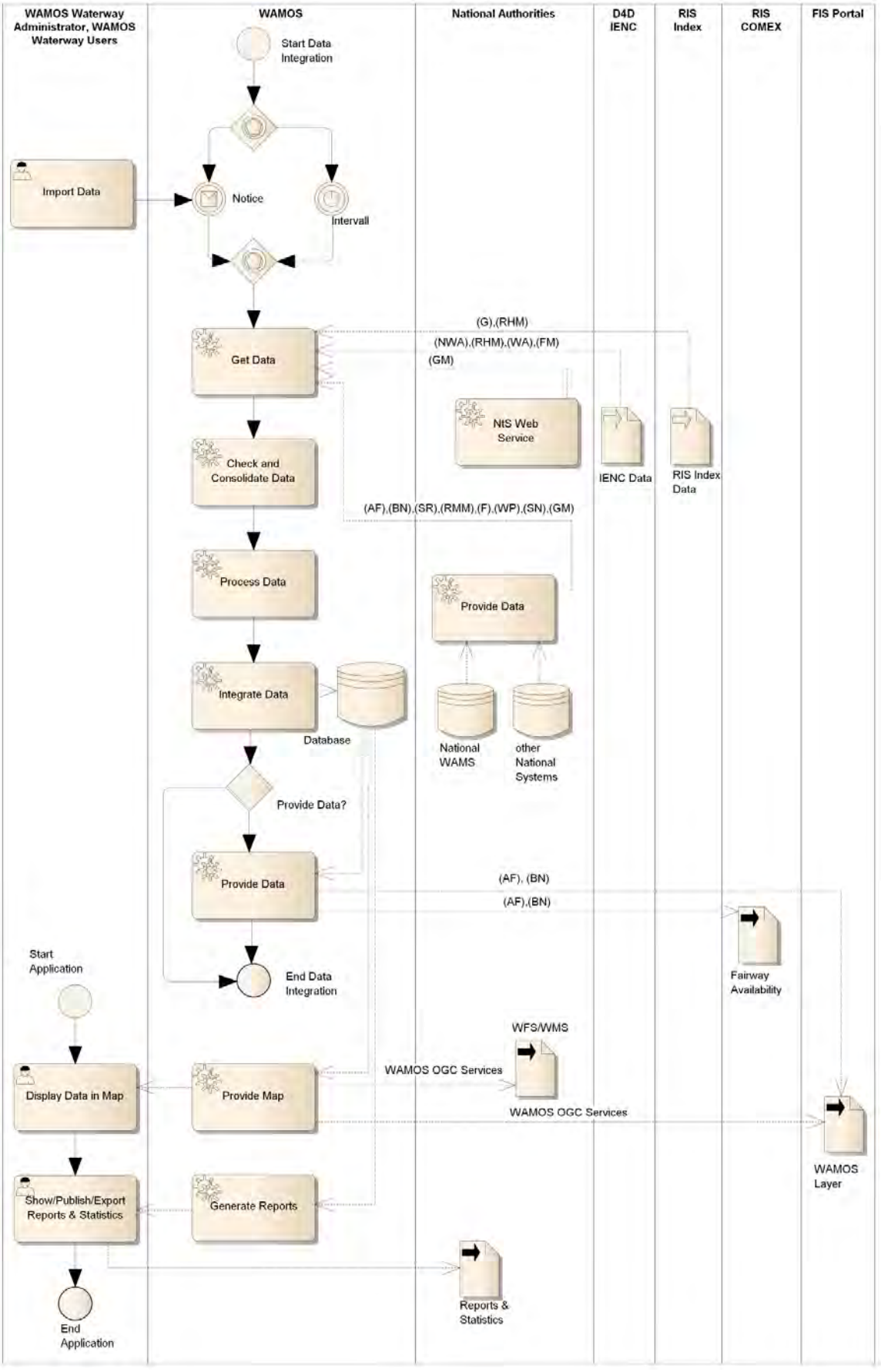


Figure 3: WAMOS Business Process

2.2. Product Perspective

Based on the main functionality of WAMOS identified for the Business Process, Figure 3 shows all system components which are decisive for WAMOS, both internal and external.

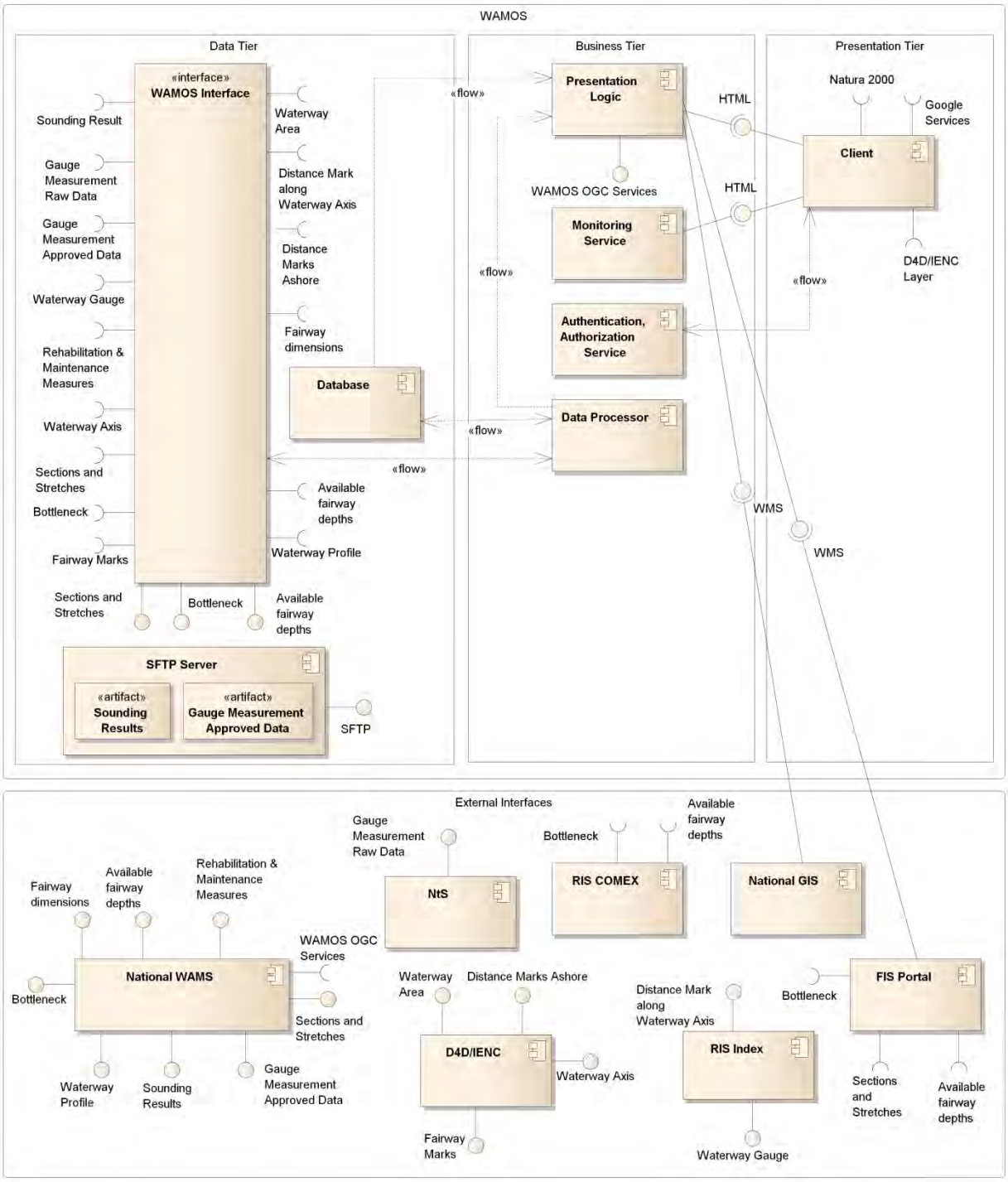


Figure 4: WAMOS System Context

Outside of the WAMOS System border resides the FIS Portal (http://www.danubeportal.com), the planned system(s) of RIS COMEX consuming the WAMOS data, the Notices to Skipper (NtS) Web Service, the National Data Providers, the D4D/IENC Data and RIS Index data.

The WAMOS System can be divided into three tiers: First the data tier holding the database and data related components, second the business tier holding all components related to the business and presentation logic and third the presentation tier that holds the client.

A very important and in the concept figure also large component in the data tier is the interface component holding the input interfaces. All of the imported input data will be checked, consolidated and additional data will be generated in the data process component (see also Chapter 2.4.4). Afterwards the data is integrated in the database.

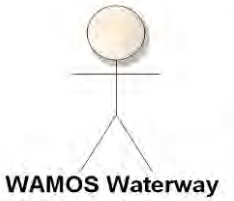
Furthermore the business tier includes the components for authentication, authorization, monitoring, presentation and export.

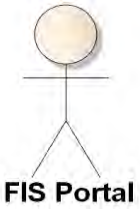
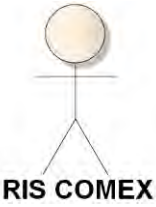
The presentation itself is done by the client implemented as a web application. The client uses external web services (e.g. aerial images from Google services), but also WAMOS map data. All functionalities are backed by the presentation logic hosted at the WAMOS server.

2.3. User Characteristics

There are five types of users interacting with modules of WAMOS (see Table 3: Actors). The first three are humans; the latter two are external systems. Users working with WAMOS shall be authenticated and authorized by the Authentication and Authorization Service, in order to constrain access to the information based on the role and privileges of the authenticated user:

Table 3: Actors

Actor	Description
	The WAMOS Waterway User is the primary target group of WAMOS. The system shall support this user in aligning national fairway improvement strategies and shall ease the reporting of needs to national and international decision makers. Each WAMOS Waterway User from each country has read access to all user functions, maps, data and documents (see Table 4: Use Case assignment to the actors). Because there is no separation according to customer-specific information needed, a multi-tenant capability is not needed. The only exception from this concept are the statistic templates or report templates. These are configured by the WAMOS System Administrator on user-level.
	The WAMOS Waterway Administrator is a kind of super-user which has the same permissions as the WAMOS Waterway User. In addition, the administrator can also import data [APUC5] and follow the import process in a statutory page [APUC7]. These activities are restricted to his area of activity (=country), which ensures that only one person is responsible for the data import. In order to prevent false data import, the data entries are filtered by geographic regions. For example, importing data and monitoring the import process is only allowed for the country referenced to the WAMOS Waterway Administrator. The responsibilities at the border sections must be allocated organizationally. For this reason, the spatial extent of the area of authority does not correspond exactly to the country's borders, it extends a certain distance into the respective neighboring country. Per default each country is setup with one WAMOS Waterway Administrator account.

	The WAMOS System Administrator is responsible for all administrative functional aspects of the system. The administrator creates users, assigns privileges to user roles, is - like the WAMOS Waterway Administrator - responsible for importing and publishing the data via the data interface and generates and publishes document templates. Typically, the WAMOS System Administrator coordinates the first and second level system support activities. This WAMOS System Administrator is authorized to create other Waterway Users or Waterway Administrators and to assign user rights (see chapter 3.1.1).
	The FIS portal is an existing web-portal to provide online transnational, fairway-related information from all Danube countries. WAMOS must publish relevant data to this portal.
	The RIS COMEX services provide relevant information for fairway users in order to increase efficiency of inland navigation. Therefore the services of RIS COMEX need up-to-date data from WAMOS.

2.4. Product Functions

The product functions of WAMOS can be divided into primary use cases, which are started directly from the user and secondary use cases which are called indirectly by a primary use case. In order to ensure a clearer overview, the primary use cases were categorized in three categories – administrative, general and special.

The initial assignment of the use cases to the user roles is shown in Table 4, the assignment shall be able to be changed by the WAMOS System administrator.

Table 4: Use Case assignment to the actors

UseCase	WAMOS System Administrator	WAMOS Waterway Administrator	WAMOS Waterway User	FIS-Portal	RIS COMEX
Administration Login [APUC1]	x	x			
Administration Logout [APUC2]	x	x			
Manage Users [APUC3]	x				
Manage Roles and Privileges [APUC4]	x				
Import Data [APUC5]	x	x			
Manage Templates for Printing, Statistics and Reports [APUC6]	x	x			
Display Interface and Process Status [APUC7]	x	x			

Display System Logs [APUC8]	x				
System Notification [APUC9]	x				
Manage System Configuration [APUC10]	x				
Login [GPUC1]		x	x	x	x
Logout [GPUC2]		x	x	x	
Reset Password [GPUC3]		x	x		
Choose Language [GPUC4]		x	x		
Overview of Base Data [GPUC5]		x	x		
Navigate in Map [GPUC6]		x	x		
Print Map Content [GPUC7]		x	x		
Identify Tool [GPUC8]		x	x		
Measure on Map [GPUC9]		x	x		
Search Features [GPUC10]		x	x		
Manipulate Map Content [GPUC11]		x	x		
Identify Map Content [GPUC12]		x	x		
Download User Manual [GPUC13]		x	x		
Display Riverbed Morphology [SPUC1]		x	x		
Display Riverbed Changes [SPUC2]		x	x		
Display Fairway Dimensions [SPUC3]		x	x		
Display Available Fairway Depths [SPUC4]		x	x		
Display Available Fairway Depths vs. LNWL [SPUC5]		x	x		
Timeline Availability/Measures [SPUC6]		x	x		
Display Water Level [SPUC7]		x	x		
Display Hydrological Conditions [SPUC8]		x	x		
Display Rehabilitation & Maintenance Measures [SPUC9]		x	x		
Evaluate Rehabilitation & Maintenance Measures [SPUC10]		x	x		
Display current and historic Fairway Marks [SPUC11]		x	x		
Availability/Accuracy of Data [SPUC12]		x	x		
Generate Reports & Statistics [SPUC13]		x	x		
Provide Data for RIS COMEX [SPUC14]					x
Provide Map Content for FIS Portal [SPUC15]				x	

2.4.1. Overview of Administrative Primary Use Cases

Administrative primary use cases are actions to setup the system from the initial installation and maintain the system user accounts and the privileges.

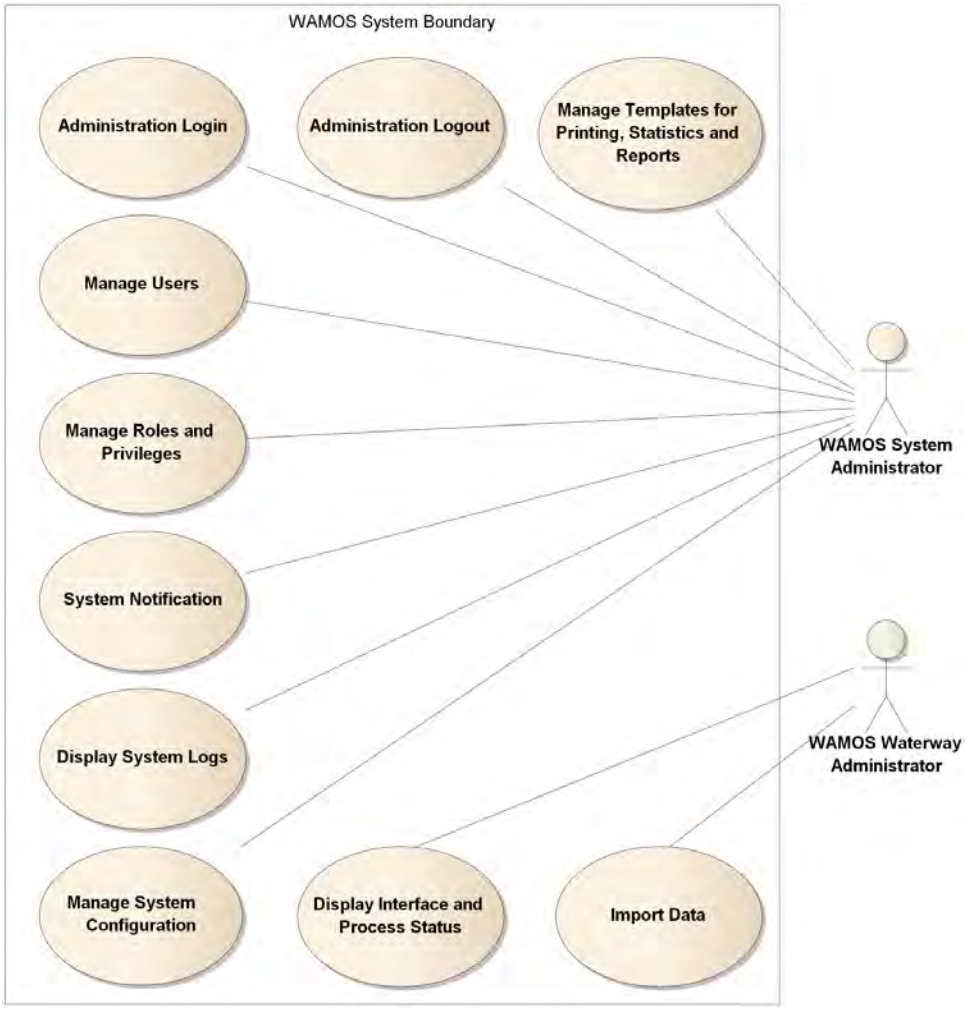


Figure 5: Administrative Primary Use Cases

- Administration Login [APUC1]
- Administration Logout [APUC2]
- Manage Users [APUC3]
- Manage Roles and Privileges [APUC4]
- Import Data [APUC5]
- Manage Templates for Printing, Statistics and Reports [APUC6]
- Display Interface and Process Status [APUC7]
- Display System Logs [APUC8]
- System Notification [APUC9]
- Manage System Configuration [APUC10]

2.4.2. Overview of General Primary Use Cases

The general primary use cases cover all actions which form a standard web-GIS application.

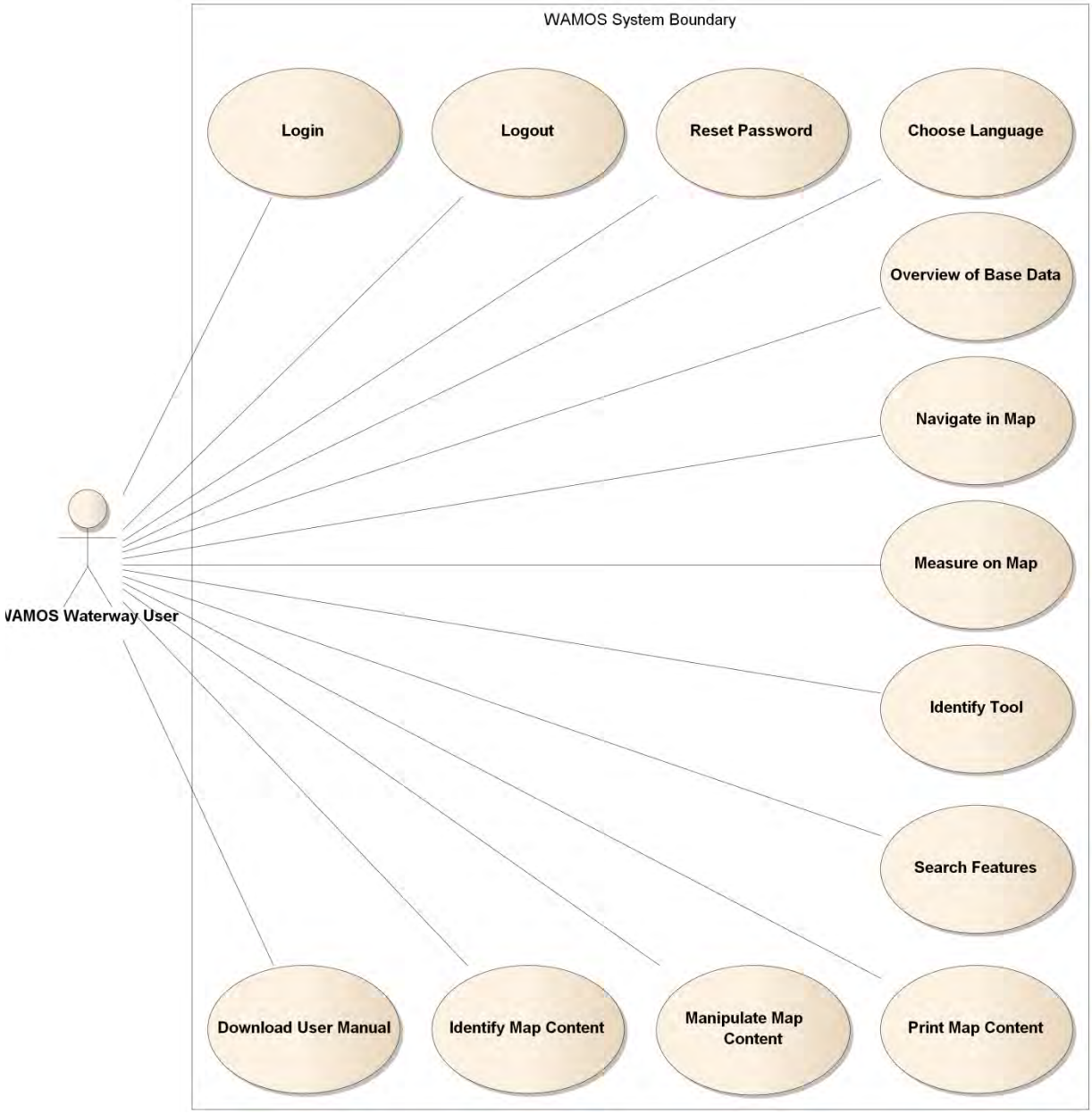


Figure 6: General Primary Use Cases

- Login [GPUC1]
- Logout [GPUC2]
- Reset Password [GPUC3]
- Choose Language [GPUC4]
- Overview of Base Data [GPUC5]
- Navigate in Map [GPUC6]
- Print Map Content [GPUC7]
- Identify Tool [GPUC8]
- Measure on Map [GPUC9]
- Search Features [GPUC10]
- Manipulate Map Content [GPUC11]
- Identify Map Content [GPUC12]
- Download User Manual[GPUC13]

2.4.3. Overview of Special Primary Use Cases

The special primary use cases cover all activities which are used to manage the waterway monitoring issues.

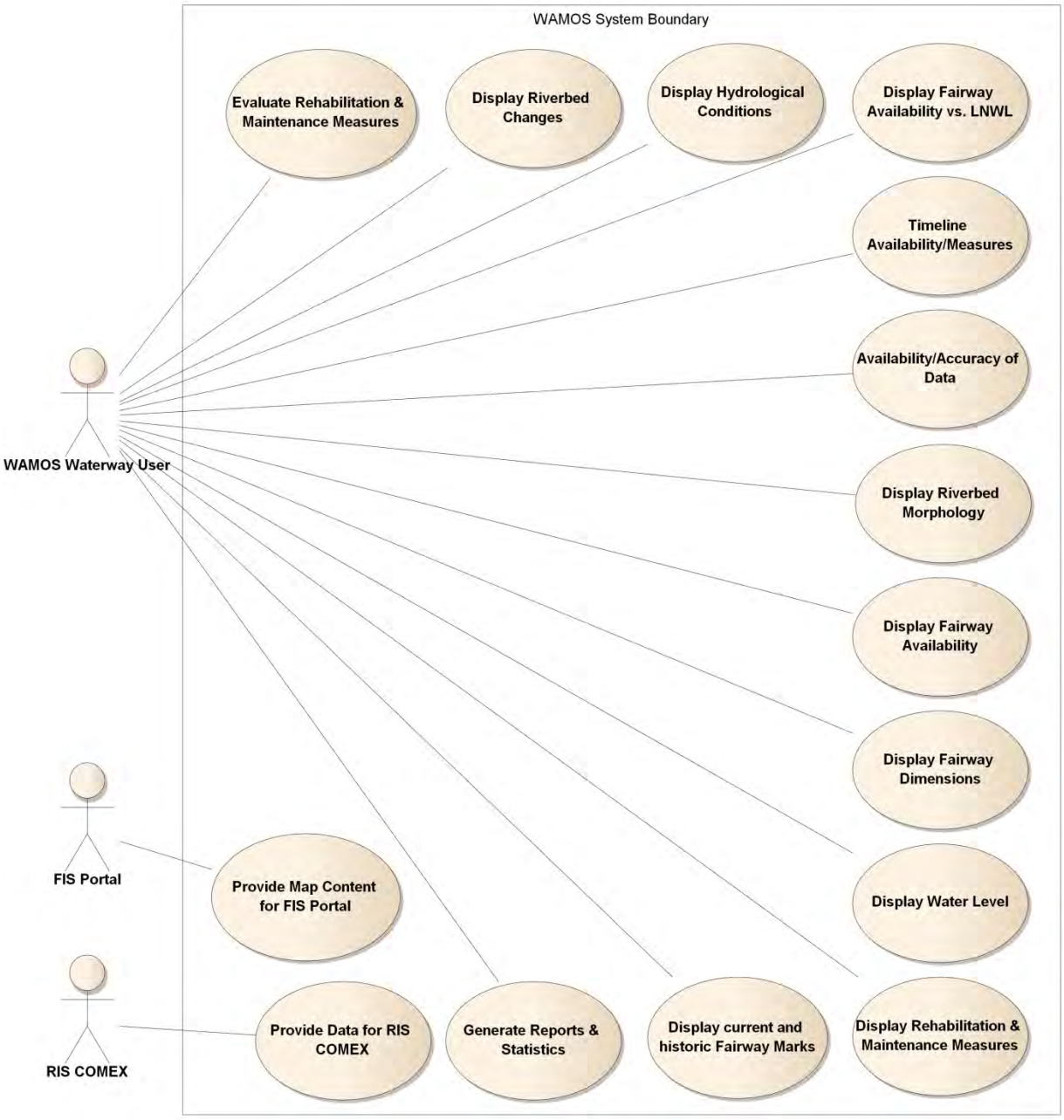


Figure 7: Special Primary Use Cases

- Display Riverbed Morphology [SPUC1]
- Display Riverbed Changes [SPUC2]
- Display Fairway Dimensions [SPUC3]
- Display Available Fairway Depths [SPUC4]
- Display Available Fairway Depths vs. LNWL [SPUC5]
- Timeline Availability/Measures [SPUC6]
- Display Water Level [SPUC7]
- Display Hydrological Conditions [SPUC8]
- Display Rehabilitation & Maintenance Measures [SPUC9]
- Evaluate Rehabilitation & Maintenance Measures [SPUC10]
- Display current and historic Fairway Marks [SPUC11]
- Availability/Accuracy of Data [SPUC12]

- Generate Reports & Statistics [SPUC13]
- Provide Data for RIS COMEX [SPUC14]
- Provide Map Content for FIS Portal [SPUC15]

2.4.4. Overview of Secondary Use Cases

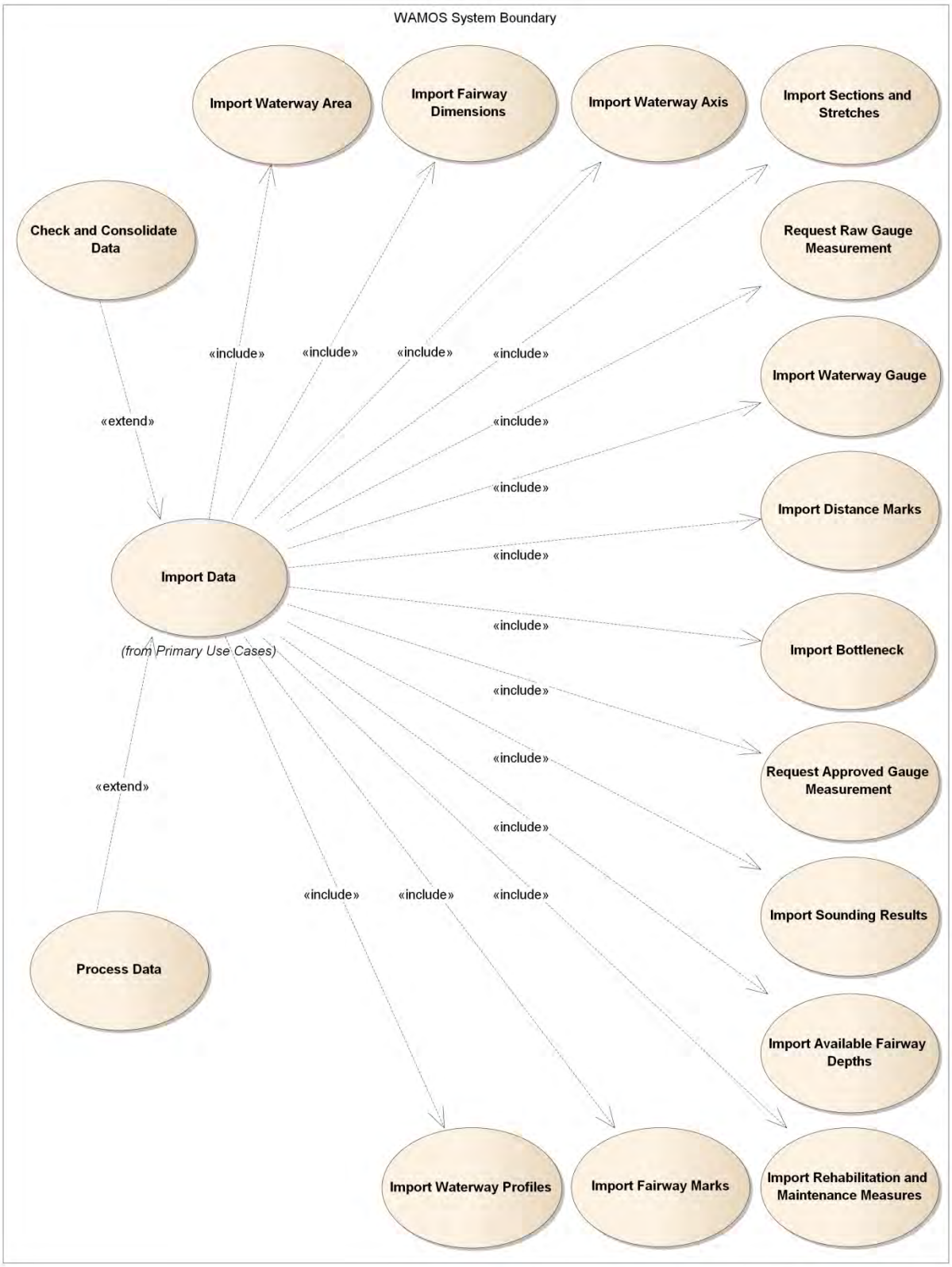


Figure 8: Secondary Use Cases

- Import Waterway Area[SUC1]
- Import Fairway Dimensions [SUC2]
- Import Waterway Axis [SUC3]
- Import Sections and Stretches [SUC4]
- Request Raw Gauge Measurement [SUC5]
- Import Waterway Gauge [SUC6]
- Import Distance Marks[SUC7]
- Import Bottleneck [SUC8]
- Request Approved Gauge Measurement [SUC9]
- Import Sounding Results [SUC10]
- Import Available Fairway Depths [SUC11]
- Import Rehabilitation and Maintenance Measures [SUC12]
- Import Fairway Marks [SUC13]
- Import Waterway Profiles [SUC14]
- Check and Consolidate Data [SUC15]
- Process Data [SUC16]

2.5. Assumptions and Dependencies

- The data connection between the external sources and the WAMOS interface must have sufficient data transfer speed so that the data packets can be transmitted in a time acceptable to the user. For the national WAMS as main data supplier, this means a speed of at least 5-10 Mbit/sec upload and 20-30 Mbit/sec download.
- Depending on the transmission interval, the external data interfaces are sufficiently available to ensure the predefined operating times of WAMOS (see chapter 3.2.9).
- The quality of the data transferred from the external sources corresponds to the established standard. All required checks and pre-processing steps as defined in the Data Requirement Catalogue are done before data transfer.
- The pre-processing of the single- and multi-beam riverbed surveys must be carried out as shown in *IRIS_II_SuAc 1 1 - Deliverable 1_final document.pdf*[12] by the national data provider, so that interpolated, checked and valid sounding data shall be passed to the interface.
- External interfaces rely mainly on available services. The internal services are divided into data upload via SFTP, data sets published by OGC web services and SOAP interfaces. SFTP and OGC conform data transfers shall be independent from the WAMS implementation and thus can be used by the waterway authorities with or without a running WAMS application. Considering the SOAP interfaces WAMOS shall provide a test client that shall support the development of the national WAMS interfaces but also shall be used to submit data if no WAMS is available.

[12] This document is no longer up-to-date, but it is included to provide an overview of the processing and visualization of riverbed surveys.

2.6. Apportioning of Requirements

An important functionality of the WAMOS system is the graphical display (and in some cases processing) of the collected/generated data. The present Software Requirements Specification was developed on basis of the existing requirements. It is however expected that the operational use of WAMOS leads to additional insights, which could modify the requirements slightly, especially as regards to the human machine interface. The WAMOS system shall therefore implemented in such a way, that the Graphical User Interface (including the display of graphs and tables) can be modified easily after the acceptance of the WAMOS system.

There are some requirements of the WAMOS System which cannot be implemented within the scope of the current implementation but may be realized in future versions.

2.6.1. Display of Vessel Tracks

Travel routes of vessels are tracked by means of on-board Inland AIS transponders. They provide among other data, information on the position and the type of the vessel. The amount of data requires the use of aggregation and data protection regulations require their anonymization.

2.6.2. Register Feedback & Complaints

Based on the results of regular user surveys, using standardized feedback forms, complaints may be shared with the other involved waterway authorities. Adding a location to the complaint makes it more specific and may be addressed by the competent organisation.

2.6.3. Display Suitability of Fairway Position

Comparing the historic tracks certain types of vessels used at defined water levels within the fairway gives an indication on the suitability of its position. Significant deviations shall be highlighted in order to trigger measures by the waterway administration.

2.6.4. Automatic Calculation of Fairway Availability

In the current document, the Fairway Availability for each Bottleneck is either manually set, or semi-automatically calculated. The fully automated calculation of the Fairway Availability is currently not part of the functionality of WAMOS, but could be implemented at a later date.

2.6.5. System Extensions

The scope of implementation required in this document shall be extensible in future versions of the system. In this way additional riparian countries (DE, RS, UA, MD) and rivers (e.g. Sava, Tisza, Váh) are to be included in the system without software adaptation.

3. Specific Requirements

3.1. Functional Requirements

3.1.1. Administrative Primary Use Cases <APUC>

ID	**APUC1**
Title:	Administration Login

Description: The WAMOS System Administrator or the WAMOS Waterway Administrator wants to login to the WAMOS System. Therefore the administrator opens the WAMOS client in a browser window and in sense of a role-based access control it has to be entered login and password. After the authentication the WAMOS client starts and shows the administration main page. The login page as well as the administration main page show all required programme and project logos (see INEA publicity guidelines[13,14]).

Dependencies: One default WAMOS System Administrator account is created during the system installation.

ID	**APUC2**
Title:	Administration Logout

Description: The WAMOS System Administrator or the WAMOS Waterway Administrator wants to logout from the WAMOS System. Therefore the administrator chooses the logout function in the client and will be redirected to the login screen.

Dependencies: [APUC1]

ID	**APUC3**
Title:	Manage Users

Description: The WAMOS System Administrator wants to manage the WAMOS Waterway Users and the WAMOS Waterway Administrator of each country. Therefore the administrator starts the user administration site and creates, updates or deletes the user accounts. Users will be authenticated and authorized as defined by the system administrator. For each user the administrator must set a country, a default language and a default extent the map zooms to when entering the client.

Additionally for each WAMOS Waterway Administrator the WAMOS System Administrator must set a border polygon e.g. a buffer polygon of the country area which is used as a spatial restriction for the data import.

At the first login, the user is automatically prompted to change his/her password. The password must meet certain complexity requirements:

- minimum password length of 8 characters
- contains at least one non-alphanumeric character (e.g. !, $, #, %)
- contains at least one digit (0 to 9)
- password must be different from the 10 previous passwords

After a configurable number of days the password expires and a new one must be entered.

[13] https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/beneficiaries-info-point/publicity-guidelines-logos

[14] http://ec.europa.eu/inea/sites/inea/files/comm_cef_leaflet_final.pdf

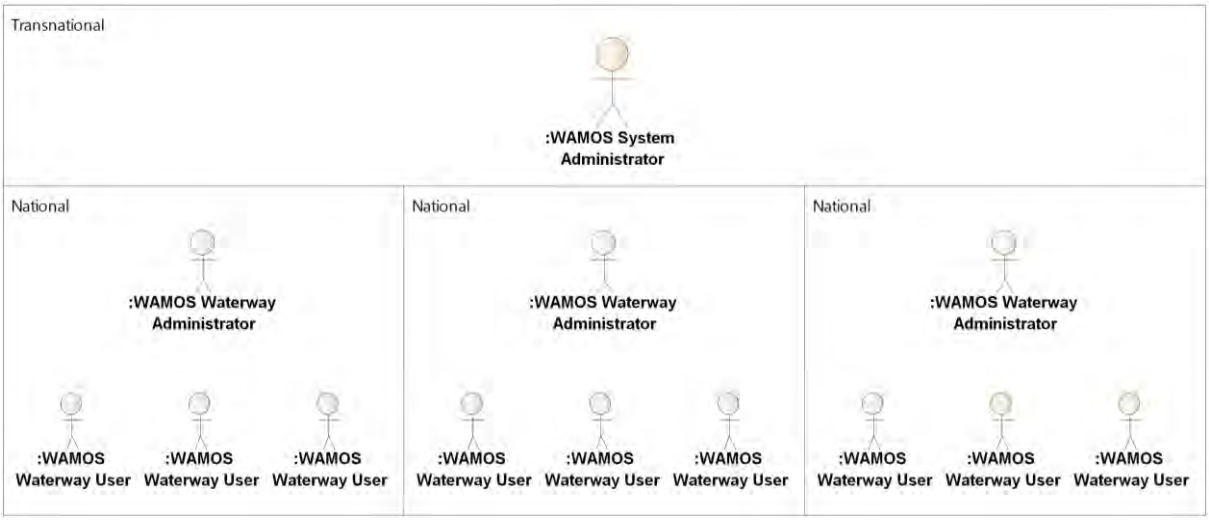


Figure 9: Organization of Users

Dependencies: [APUC1]

ID	**APUC4**
Title:	Manage Roles and Privileges

Description: The WAMOS System Administrator wants to manage the roles and the privileges. Therefore the administrator starts the administration site and assigns a role to an existing user. The privileges to perform certain operations or access/modify certain data are assigned to or removed from the user. It is currently planned that there will be three roles in the system (see [APUC3] and chapter 2.3).

Dependencies: [APUC1], [APUC3]

ID	**APUC5**
Title:	Import Data

Description: The WAMOS Waterway Administrator wants to import data for his country manually. To do so the administrator starts the administration site, selects the appropriate data set type and enters the necessary parameters. After starting the import process, the administrator can track the status according to use case APUC7. After the data has been successfully imported, the WAMOS Waterway Administrator has the possibility to check the correctness. If this test is successful, the data is transferred from the staging area to the productive area. In the event of an unsuccessful test, the WAMOS Waterway Administrator can discard the imported data and restart the import with corrected data.

Dependencies: [APUC1]

ID	**APUC6**
Title:	Manage Templates for Printing, Statistics and Reports

Description: The WAMOS System Administrator or the WAMOS Waterway Administrator wants to manage the templates for printing, statistics and reports. Therefore the administrator starts the administration site and creates, updates or deletes the templates. Each template is stored in the system with name and timestamp and may be released on user level. As a result, it is possible that, for example, the users per country have a special template that differs in terms of language and layout.

Dependencies: [APUC1]

ID	**APUC7**
Title:	Display Interface and Process Status

Description: The WAMOS System Administrator or the WAMOS Waterway Administrator wants to see all currently running data import processes and all past ones. Therefore a list is displayed which shows all

processes including statistics of the import process like type of import, duration, number of features, user started the import etc. and their status: done, working, warning or failure. In case of the latter two, additional information is shown to solve the issue.

Dependencies: [APUC1], [APUC5]

ID	**APUC8**
Title:	Display System Logs

Description: All tasks and actions of the WAMOS System are logged in the WAMOS Database. The WAMOS System administrator wants to see all log files divided into the following categories.

- Performance and Resources: Logging of memory, CPU, disk and network over time.
- Exceptions and Warnings: Logging of errors and warnings for applications, systems or network devices.
- User Actions: Logging user access and actions within the system of WAMOS.
- Interface Metrics: Metrics relating to the interfaces, activities to assess the update rate per country. Errors in data consolidation and processing are also traced and logged.

See also Chapter 3.2.18 Monitoring.

Dependencies: [APUC1]

ID	**APUC9**
Title:	System Notification

Description: In case of a warning or error the system shall notify the WAMOS System Administrator of these exceptions. This must be done by an automatic email notification so that the administrator can make timely steps to eliminate the error cause (see chapter 3.2.18).

Additionally any status change (e.g. start, pending, working, error, finished etc.) during the import process (SUC1-SUC14) shall be notified to the WAMOS Waterway Administrators by email notification. The circle of the receivers shall be configurable.

Dependencies: [APUC1]

ID	**APUC10**
Title:	Manage System Configuration

Description: The WAMOS System Administrator wants to centrally define the system configuration. Therefore the administrator enters the administration site and is able to configure the following settings:

- Configure the log level and the log period
- Addresses of the background map services
- Endpoints for the export interfaces
- Addresses of the national data providers
- URL Addresses of the IENC servers (D4D-Portal)
- SFTP sources
- URL of Address of the hydrographic service
- Configure the class break boundaries for the traffic light visualization of the availability/accuracy of data
- Configure the timespan between requesting data of gauge levels, IENCs, NtSs, etc.
- Configure language configuration files (see chapter 3.2.16)
- Configure several sets of class breaks for the processing of the riverbed surveys (depth contours)
- Configure the data source for generating the Bottlenecks, Sections and Stretches and Rehabilitation and Maintenance Measures geometry per country.
- Configure the notification receivers

Dependencies: [APUC1]

3.1.2. General Primary Use Cases<GPUC>

ID	GPUC1
Title:	Login

Description: The WAMOS Waterway User wants to login to the WAMOS System. Therefore the user opens the WAMOS application in a browser window and in sense of a role-based access control the user has to enter login and password in a login page. After the authentication the WAMOS client starts, shows the base information and sets the language and the spatial extent stored with the user account. The login page as well as the WAMOS client pages show all required programme and project logos (see INEA publicity guidelines).

In the event that the WAMOS Waterway User logs into the WAMOS System for the first time, a new password must be assigned according to certain security criteria (see [APUC3]). In addition, the WAMOS Waterway User has the option to change his password at any time.

Dependencies: [APUC3], [APUC4]

ID	GPUC2
Title:	Logout

Description: The WAMOS Waterway User wants to logout from the WAMOS application. Therefore the user chooses the logout function in the client and will be redirected to the login screen.

Dependencies: [GPUC1]

ID	GPUC3
Title:	Reset Password

Description: The WAMOS Waterway User or the WAMOS Waterway Administrator wants to reset his/her password. In the event that the registered user has forgotten the password, it can be reseted by the system. The user must enter his/her email address to which a link is sent where he/she can enter the new password.

Dependencies: [APUC3], [APUC4]

ID	GPUC4
Title:	Choose Language

Description: The WAMOS Waterway User wants to set a language for the WAMOS client. In a drop down field, the user has several languages to choose from (EN, DE, SK, HU, HR, RS, BiH, BG, RO, UA). The support of multilingualism must be implemented in such a way that a new list of translations may be imported into the system at any time - starting from an English basic version – making new languages available to the WAMOS Waterway User. The default language which is used when entering the client is stored with the user account and can be changed by the WAMOS System Administrator. The language selected by the WAMOS Waterway User is retained for the active session and is active again at the next login. The WAMOS System Administrator is in charge of translating the language configuration files into other languages.

Dependencies: [GPUC1]

ID	GPUC5
Title:	Overview of Basic Data

Description: The WAMOS Waterway User gets an overview of the situation and therefore the base data layers are shown. Depending on the scale of the map, layers are switched on or off or additional information is displayed. A common harmonized visualisation is needed. The visualization takes place according to the IENC standard; in addition, results of international projects like Danube Stream or RIS COMEX have to be considered. The base map contains the following information:

Overview:

- Background map (roadmap, satellite, hybrid, terrain)
- Overview of IENC sheets covering the Danube area

Detailed information depending on scale

- Fairway Dimensions
- Waterway Area
- Bottlenecks
- Waterway Axis
    - Distance Marks
- Natura 2000 Areas
- Fairway Availability – highlighting the currently worst bottlenecks
- Fairway Marks

Each layer of the WAMOS map has a defined, configurable scale range within which the objects are visible. The reason for this setting is to reduce the amount of clutter displayed to the map.

Dependencies: [GPUC1], [SUC1], [SUC2], [SUC3], [SUC6], [SUC7], [SUC8], [SUC13], [SUC15], [SUC16]

ID	**GPUC6**
Title:	Navigate in Map

Description: The WAMOS Waterway User wants to navigate through the map using general map controls. Navigation shall include the functionality to

- seamlessly zoom in and out by using the scroll wheel of the mouse
- zoom by rectangular extent
- pan
- zoom back to previous map extents (last 20 previous extents) and zoom forward to next map extents
- zoom to a user defined scale
- zoom to a specific geographic location via coordinate input by the user
- zoom to features as search result

Dependencies: [GPUC1], [GPUC5]

ID	**GPUC7**
Title:	Print Map Content

Description: The WAMOS Waterway User wants to print the current map composition. Therefore the user zooms to the certain extent, enters a print scale and starts the print function. It is possible to preview the print before being printed. A download dialog appears with a pdf-file containing the map content according to the default template, defining:

- data/time of printing
- user
- header/footer (with a reference to WAMOS, FAIRway Danube and the EU co-financing)
- scale bar
- north arrow
- legend
- disclaimer
- map contents

The map content can be rendered in landscape or portrait format - both A4 and A3 - and the pdf can be sent to the printer. In case the scale does not fit to the print area of the map the current map extent is adjusted automatically.

The template content will be defined by the WAMOS System Administrator in [APUC6].

Dependencies: GPUC1], [GPUC5], [GPUC6], [APUC6

ID	GPUC8
Title:	Identify Tool

Description: The WAMOS Waterway User wants to identify the features shown in the map. Therefore the user clicks in the map and all attributes of the features in this location are displayed in a pop-up window. This functionality is not limited to the layers provided by WAMOS but is also applicable to external layers if supported.

Dependencies: GPUC1], [GPUC5], [GPUC6

ID	GPUC9
Title:	Measure in Map

Description: The WAMOS Waterway User wants to measure in the map. The user chooses a measurement geometry type -line or polygon- and a corresponding unit. The user draws the geometry in the map and reads the length or area in a measurement window. The drawing is continuously updated during the measurement process.

Dependencies: GPUC1], [GPUC5], [GPUC6

ID	GPUC10
Title:	Search Features

Description: The WAMOS Waterway User wants to navigate to a certain river kilometre, bottleneck, gauge, section, stretch, build-up area or infrastructure of the river Danube, a tributary or a canal. Therefore the user can enter a text string, which can be either a single term or a phrase, in a search field. The system searches the different layers and fields in the database and displays a result list ordered by the match score. Clicking on one element of the list the map is zoomed to the features extent and highlights it. The WAMOS Waterway User has also the ability to choose whether the zoom level should change or not. In case of a fixed zoom level the system will pan to the found location.

Dependencies: GPUC1], [GPUC5], [GPUC6], [SUC4], [SUC7

ID	GPUC11
Title:	Map Content

Description: The currently displayed layers are tailored to the tasks at hand. Depending on the selected function WAMOS will display the needed layers. Nevertheless the WAMOS Waterway User can manipulate the content of the map by switching the layers on or off in the table of content (TOC).

Dependencies: GPUC1], [GPUC5], [GPUC6

ID	GPUC12
Title:	Identify Map Content

Description: The WAMOS Waterway User wants to identify the map content at any time of usage through a legend control. The legend control has to be displayed all the time and shall be adjusted automatically when the map content changes. For example when the WAMOS Waterway User displays the gauges in the map, then the legend has to show all types of gauges. Same shall be true for marks, water levels, riverbed dimensions, riverbed morphology etc.

Dependencies: GPUC1], [GPUC5], [GPUC6

ID	GPUC13
Title:	Download User Manual

Description: The WAMOS Waterway User wants to download the User Manual (see chapter 3.2.14).

Dependencies: GPUC1

3.1.3. Special Primary Use Cases<SPUC>

Although the special use cases listed here are described separately, it must be possible to display the different representations in map and diagrams at the same time and thus to be able to compare information e.g. to see SPUC6 and SPUC7 next to each other for a bottleneck, the related reference gauge and the same period of time.

ID	**SPUC1**
Title:	Display Riverbed Morphology

Description: The WAMOS Waterway User wants to display the Riverbed Morphology of a certain Bottleneck of the river Danube using one uniform horizontal reference system. The WAMOS client shows a list with all bottlenecks, sorted by river-kilometre with the latest survey for this bottleneck. This list can be sorted by all available fields and it is also possible to change the content,

- to show all surveys sorted by date
- to search one bottleneck with all surveys

After selecting the survey, it is displayed with a uniform colour scheme in the map. The class breaks differ from section to section, since the depth targets of each section differs. The class break intervals as recommended by Inland ECDIS Expert Group are determined as follows:

Table 5: Depth data intervals for ISO baths as recommended by Inland ECDIS Expert Group [15]

Depth (in m)	Minimal ISO spacing (in cm)
0m to 1m	no isobaths
1m to (RWDR – 1m) 50	50
(RWDR – 1m) to RWDR +/- 20 cm +/- 50 cm 20	20
RWDR +/- 15 cm +/- 40 cm 10	10
RWDR to (RWDR + 1m) +/- 20 cm +/- 50 cm 20	20
(RWDR + 1m) to (RWDR + 2m) +/- 50 cm +/- 100 cm 50	50
(RWDR + 2m) to (RWDR + 3m) +/- 50 cm +/- 100 cm 100	100
> (RWDR + 3m) +/- 50 cm +/- 100 cm 500	500

The Depth (in m) refers to the Relevant Water Depth Range (RWDR) which might be different from waterway section to waterway section and from region to region.

Assuming a RWDR of 2.5, the following classification would result:

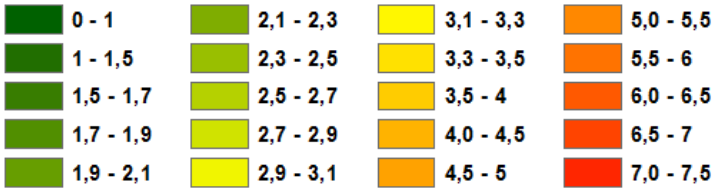


Figure 10: Depth data intervals for ISO baths with an RWDR of 2.5

The class breaks shall be defined by the WAMOS System Administrator (see APUC10).

The isobaths are also displayed.

[15] http://www.ris.eu/docs/File/428/accuracy_update_requirements_depth_data_v1p0_final.pdf

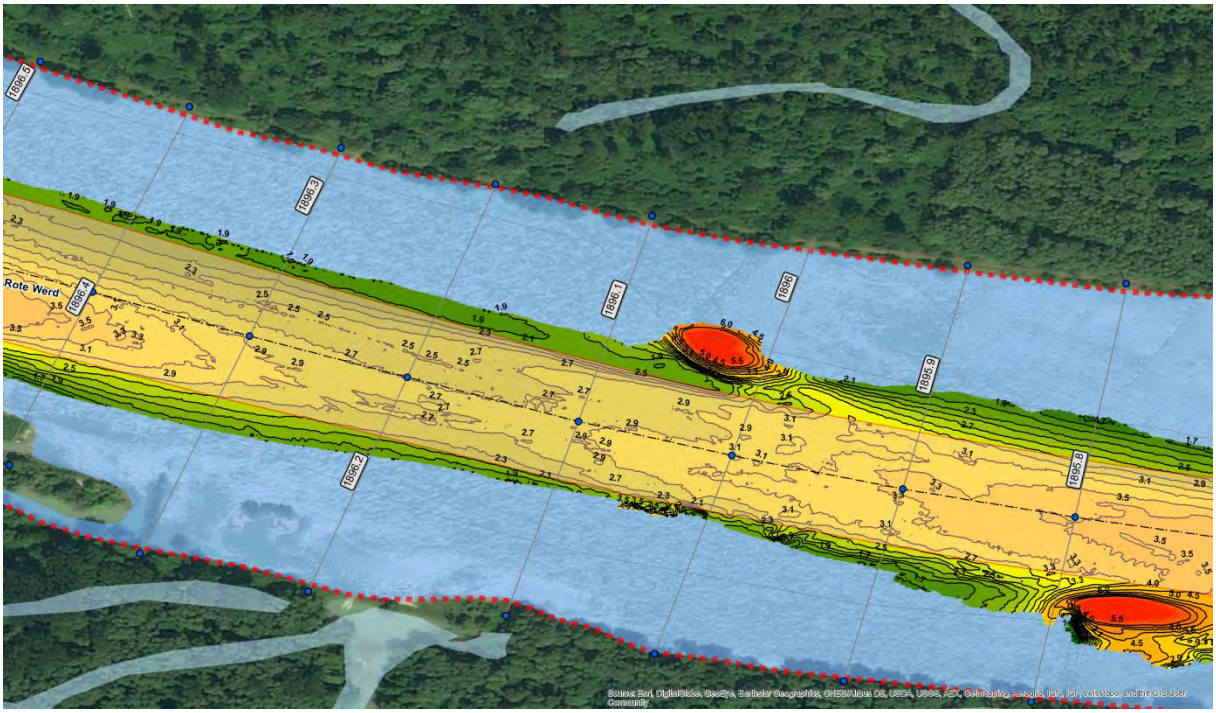


Figure 11: Visualization of a Riverbed Survey

All riverbed surveys from all countries are displayed in the map; one uniform horizontal reference system is used.

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC8], [SUC10], [SUC15], [SUC16]

ID	**SPUC2**
Title:	Display Riverbed Changes

Description: The WAMOS Waterway User wants to analyse the Riverbed Changes by intersecting two bathymetric surveys from different points in time. The result is a visualization with a uniform colour scheme showing the sedimentation and erosion processes.

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC8], [SUC10], [SUC15], [SUC16]

ID	**SPUC3**
Title:	Display Fairway Dimensions

Description: The WAMOS Waterway User wants to display the Fairway Dimensions in the map. This information will be presented in two different ways. First the extent of Level of Service (LOS) 1, 2 and 3 will be shown from a birds eye view, secondly the WAMOS Waterway User can display the vertical cross profiles for an arbitrary location of the Danube. In this profile the fairway dimension for all available Levels of Services and the riverbed morphology is shown.

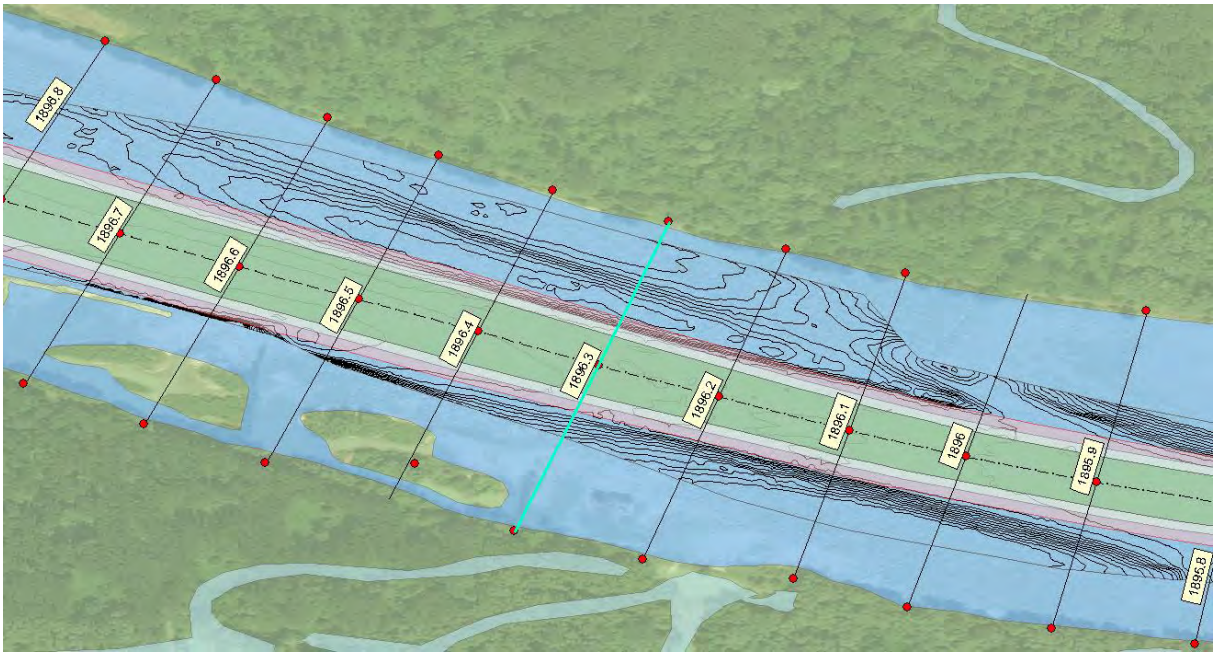


Figure 12: Visualization of the Fairway Dimension

To display the cross profile, either the depth reference as defined in the Bottleneck is used as default water level, but the WAMOS Waterway User also can change the reference to the current water level of this location.

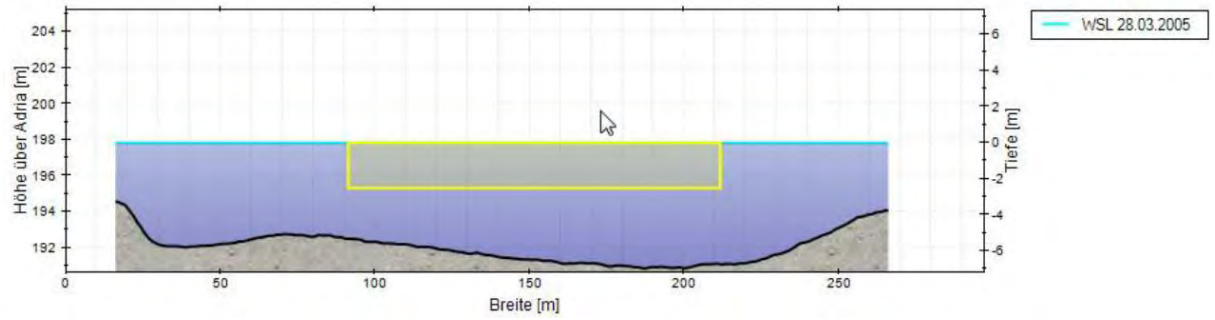


Figure 13: Visualization of the Fairway Profile [WAMS Final Report]

Additionally it shall be possilbe to compare the different Profiles of different points in time in one figure.

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC2], [SUC3], [SUC8], [SUC10], [SUC15], [SUC16]

ID	**SPUC4**
Title:	Display Available Fairway Depths

Description: The WAMOS Waterway User wants to display the number of days per month, quarter or year with a fairway depth below a selectable value e.g. within selectable depth ranges (e.g. <23 dm, >23.1dm and <25 dm, >25dm 22 dm…) over a selectable fairway width of LOS 1 to 3. This information must be available for all Bottlenecks, Sections or Stretches. Therefore the WAMOS Waterway User defines the limit depth and the width, clicks on a certain Bottleneck, Section or Stretch and a chart with the appropriate information pops up. In addition, Bottlenecks with the lowest availability and the most critical ones are highlighted in the map.

For statistical analysis the dynamic nature of sections has to be considered. Stretches stay more or less the same and are reliable statistical units whereas sections might change over time and do not exist in all countries.

Also the assessment can be made for defined sections and stretches. The number of days with an available depth exceeding the requirements defined in the level of service (e.g. 25dm) needs to be compared to the number of days with a water level exceeding the LNWL.

At bottlenecks where the limiting factor is the fairway width the same shall be available for selectable width ranges referring to a selectable depth of LOS 1 to 3.

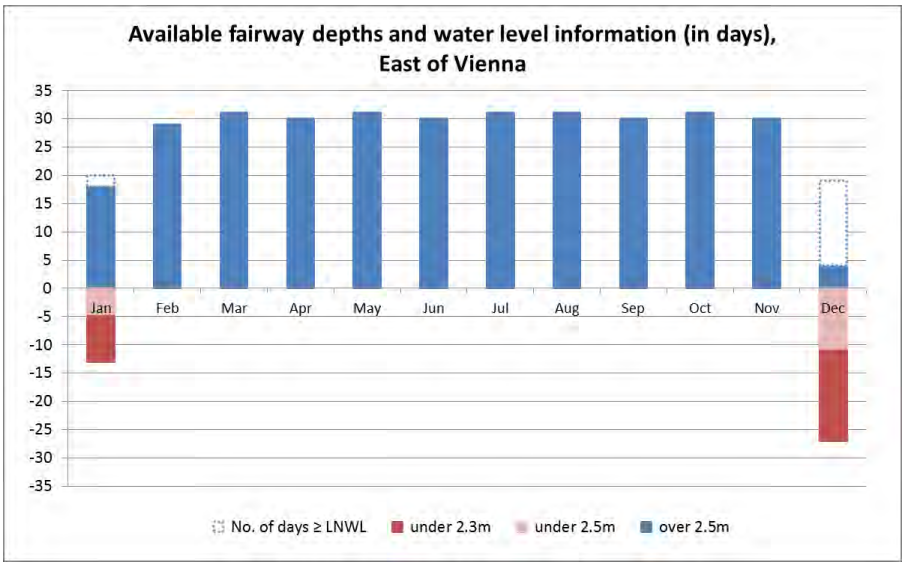


Figure 14: Bar chart showing Available Fairway Depths vs. LNWL

Additionally there has to be shown an information text below the chart, indicating the number of surveys on which the chart is based, the surveying type and coverage (e.g. 1 Multi-Beam/whole river, 5 Single beam/longitudinal profiles).

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC2], [SUC3], [SUC5], [SUC8], [SUC10], [SUC11], [SUC15], [SUC16]

ID	**SPUC5**
Title:	Display Available Fairway Depths vs. LNWL

Description: The WAMOS Waterway User wants to evaluate the effectiveness of interventions by the waterway managers, by displaying the number of days on which the LNWL was reached or exceeded and the actual fairway depth was at a defined depth graduation e.g. 24 dm. Therefore the user selects a Bottleneck and the depth graduation and as a result the two values are compared in a pie chart. The data is displayed for each year and month. In addition, Bottlenecks with the lowest availability are highlighted in the map and the respective pie charts are shown.

Given figure below illustrates how such statistic may be presented. The situation as regards water levels (outer circle) i.e. the given hydrological framework conditions cannot be influenced by the waterway managers, whereas the Available Fairway Depths (inner circle) is one core task of waterway administrations.

Figure 15: Pie chart showing Available Fairway Depths vs. LNWL

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC2], [SUC3], [SUC5], [SUC8], [SUC10], [SUC11], [SUC15], [SUC16]

ID	SPUC6
Title:	Timeline Availability/Measures

Description: The WAMOS Waterway User wants to display for each bottleneck a timeline which indicates the periods in which the fairway was available (colour gradations according to different service levels). The date and type (surveying, dredging) of rehabilitation and maintenance measures at the same bottleneck shall be shown on a separate, parallel bar.

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC2], [SUC3], [SUC5], [SUC8], [SUC10], [SUC11], [SUC15], [SUC16]

ID	SPUC7
Title:	Display Water Level

Description: The WAMOS Waterway User wants to see the current and historical water level of a gauge. The values were checked with regard to plausibility (see SUC15). To get this information all gauges are displayed in the map showing the latest measured value directly in the map. When clicking in the map on a gauge a chart with the current and historical values is displayed. The time period of the displayed data is adjustable e.g. last days, weeks, month, year or a freely selectable period.

Figure 16: Example of a water level visualisation of a gauge

In addition, for the relevant gauges, reference water levels (LNWL, HNWL and MW) are also displayed in the chart. Furthermore for some gauges a 3 to 5 days-ahead forecast plus a confidence interval is also part of the chart.

Additional the "accuracy of water level forecast vs. reality" - indicator described by the Nash–Sutcliffe model efficiency coefficient for different forecast windows (24h, 48h, 72h) can be displayed in the diagramm see (see also SPUC12)

To identify the different types of gauges clear symbols classify them into the following classes.

- range of the actual water level
  - Brown: Low Water (<LNWL)
  - Blue: Mean Water (LNWL – HNWL)
  - Red: High Water (>HNWL)
  - White: no data available
- gauge with water level characteristics
- gauge with water level forecast
- reference gauge

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC5], [SUC6], [SUC9], [SUC15], [SUC16]

ID	SPUC8
Title:	Display Hydrological Conditions

Description: The WAMOS Waterway User wants to compare daily mean water levels at decisive gauges for different years. Therefore the user has to select a gauge in the map or via a list. The hydrological data is displayed in a chart, also showing long term minima and maxima. In addition, for the relevant gauge reference water levels (LNWL, HNWL and MW) are displayed in the chart.

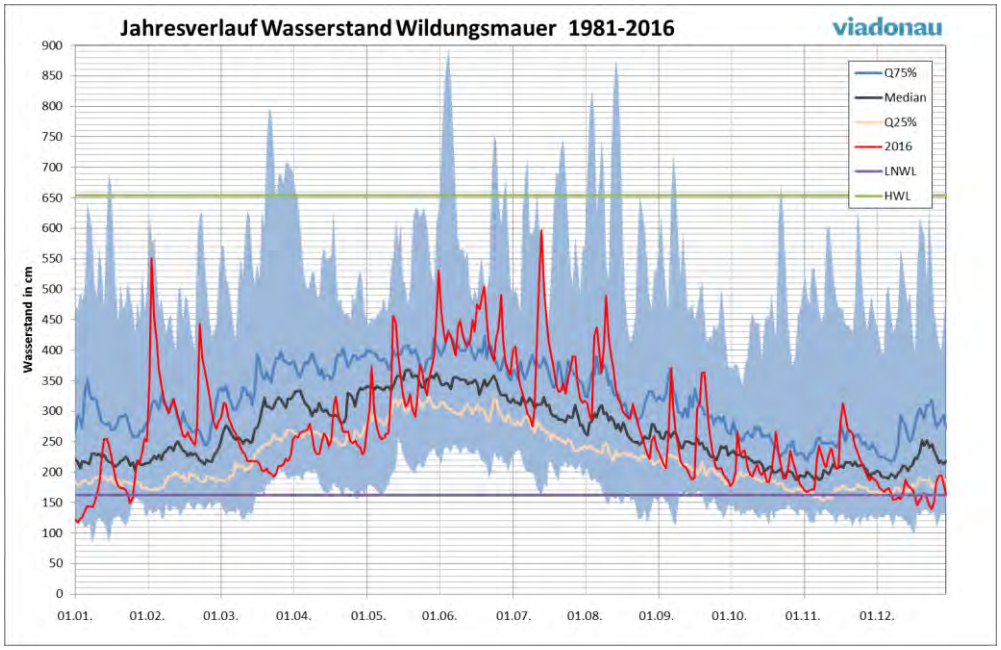


Figure 17: Example of a hydrological condition visualisation of a gauge

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC5], [SUC6], [SUC9], [SUC15], [SUC16]

ID	SPUC9
Title:	Display Rehabilitation & Maintenance Measures

Description: The WAMOS Waterway User wants to see all rehabilitation and maintenance activities classified by the type (dredging, relocation of the fairway, surveying) in the map. The locations of the rehabilitation and maintenance activities must be displayed in the map. Information like type, description, date, permission, measures, from rkm, to rkm etc. shall be shown for all rehabilitation and maintenance activities when clicking on a Bottleneck. The rehabilitation and maintenance measures are presented in a list, sorted according to the "river hectometre from" attribute. The List can be filtered for surveying, dredging and fairway marking. When a specific measure is selected the details are shown.

The content of the Rehabilitation & Maintenance Measures List and the Rehabilitation & Maintenance Measures Layer in the map are synchronized, so that all selections in the list are displayed in the map and vice versa.

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC8], [SUC12], [SUC15], [SUC16]

ID	SPUC10
Title:	Evaluate Rehabilitation & Maintenance Measures

Description: The WAMOS Waterway User wants to get an overview on the performed Rehabilitation and Maintenance Measures at a section or stretch. Overview charts show the river kilometres of a section or stretch and indicate the position of bottlenecks. Layers for the different measure types can be combined in one chart. The presentation differentiates between different survey types (inspection tours, multi beam, single beam or ADCP) and includes fairway relocation activities as well as the amount of dredged material.

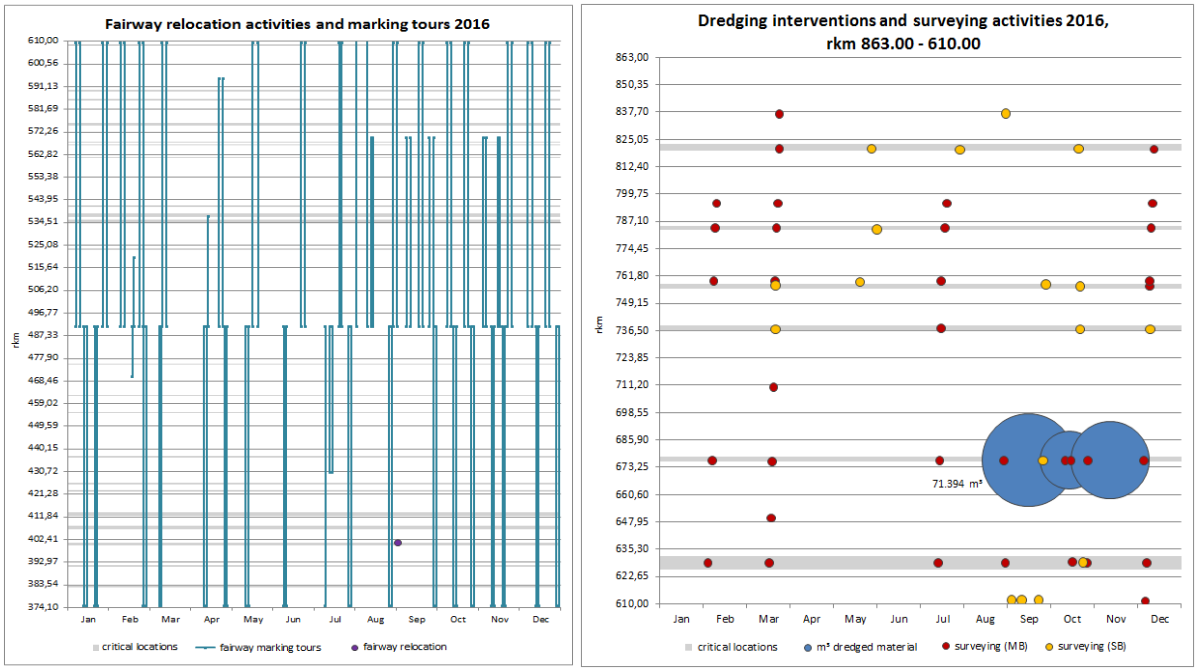


Figure 18: Example of an evaluation visualisation of Rehabilitation and Maintenance Measures

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC8], [SUC12], [SUC15], [SUC16], [SUC9]

ID	**SPUC11**
Title:	Display current and historic Fairway Marks

Description: The WAMOS Waterway User wants to display all fairway marks of the current map extent. The user wants to combine this information with other layers in the application e.g. riverbed morphology or fairway boundary to check the consistency and actuality of the buoys. Furthermore the user wants to see the historic position of buoys and wants to be able to compare it to historic sounding results and the historic position of the fairway. The historical settings shall be adjusted via a time slider.

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC2], [SUC13]

ID	**SPUC12**
Title:	Availability/Accuracy of Data

Description: The WAMOS Waterway User wants to verify the reliability of the available data in the WAMOS application. For each Bottleneck or Gauge and in aggregated form also for sections and stretches the WAMOS Waterway User wants to see on first sight the data quality and availability.

- Topicality of the riverbed surveys. This is defined by the indicated frequency of riverbed surveys (revisiting time) per Bottleneck compared to the last date of survey:
    - Green: OK- within the measurement frequency
    - Yellow: New survey needed- starts 1 day after expected new riverbed data set
    - Red: Starts if 50% of the survey frequency per Bottleneck has passed without new dataset.

  When a new data set arrives the period starts again.

- Depending on the attributes of the "surveying" Rehabilitation and Maintenance Measures a reliability indicator will be calculated.
    - Green: very accurate surveying data available (e.g. Multibeam with RTK)
    - Yellow: reliable surveying data available (e.g. Singlebeam with modelled reference water level)
    - Red: all other measurements (e.g. Singlebeam with defined reference water level at reference gauge)

- The availability of current and continuous water level measurements:
    - Green: OK- one continuous measurements available for the last 14 days.
    - Yellow: Restricted availability- some values are missing due to gauge error or quality check.
    - Red: Caution- in the last 24 hours no value available calculation not possible.
- Accuracy of water level forecast. This indicator defines the range of the confidence interval:
    - Green: OK - the next 4 day forecast is within the tolerated deviation of 15 cm.
    - Yellow: Critical- uncertainty greater than 15cm within the next 3 days.
    - Red: no prediction possible or great uncertainty within the next 1 days.
- Accuracy of water level forecast vs. reality. This indicator defines the reliability of the forecast by comparing the predicted values (24h, 48h, 72h) with the real water levels:
    - Green: OK –difference between prediction and real water level between 0 and 10cm.
    - Yellow: Critical-difference between10 and 20cm.
    - Red: no prediction available or differences greater than (20cm)

The state of these three information sections must be displayed using traffic lights in the map.

Dependencies: [GPUC1], [GPUC5], [GPUC6], [SUC1], [SUC2], [SUC5], [SUC6], [SUC10], [SUC11], [SUC12], [SUC15], [SUC16]

ID	**SPUC13**
Title:	Reports & Statistics

Description: The WAMOS Waterway User wants to export any pre-defined (see chapter 3.1.1) content and statistics like reports e.g. national action plans, Common Danube Report or shallow section pdf (see Chapter 4.1 Annex I – Documents) from the WAMOS application in different formats.

- The statistics shall be exported in CSV, XLSX, DOCX, PDF
- The reports shall be exported in DOCX, PDF

Dependencies: [APUC6], [GPUC1], [GPUC5], [GPUC6], [SUC15], [SUC16]

ID	**SPUC14**
Title:	Provide Data for RIS COMEX

Description: The external system RIS COMEX wants to use relevant data from the WAMOS System. The focus is to provide new information which is not already provided by existing services and relevant for the route planning and live information on the river. Possible data layers shall be:

- available Fairway Depths per Bottlenecks
- use common naming and definition of Bottlenecks
- Depth contours
- Shallow section pdf

Dependencies: [SUC15], [SUC16]

ID	**SPUC15**
Title:	Provide Data for FIS Portal

Description: FIS Portal wants to use OGC Map Services from the WAMOS System for publishing on the already existing Web-Portals or for the use by national authorities. Possible layers for the FIS-Portal are:

- Waterway Area
- Fairway Dimensions
- Waterway Axis
    - Distance Marks

- Bottlenecks
- Waterway gauges and measurements
- Fairway availability
- Fairway Marks

Therefore the Presentation Logic shall have the availability to provide a OGC compliant WMS in version 1.3.0 (ISO 19128) and a OGC compliant WFS in version 2.0 (ISO 19142). The WMS/WFS of the Presentation Logic shall have the availability to provide maps at least in the following Spatial Reference Systems:

Horizontal Reference (Coordiante System)		
Value	**Clarification**	**EPSG Code**
WGS84	WGS_1984	4326
WMC	WGS84 Web Mercator (Auxiliary Sphere)	3857

Dependencies: [SUC15], [SUC16]

3.1.4. Secondary Use Cases <SUC>

ID	SUC1
Title:	Import Waterway Area

Description: The extent of the river Danube shall be displayed as background information in the map. Therefore the named Water Area of the D4D/IENC must be imported into the WAMOS Database. This dataset is used for Visualisation [GPUC5], for creating the Bottlenecks geometry [SUC16] the Sections and Stretches geometry [SUC4] and the Rehabilitation and Maintenance Measures geometry [SUC12].

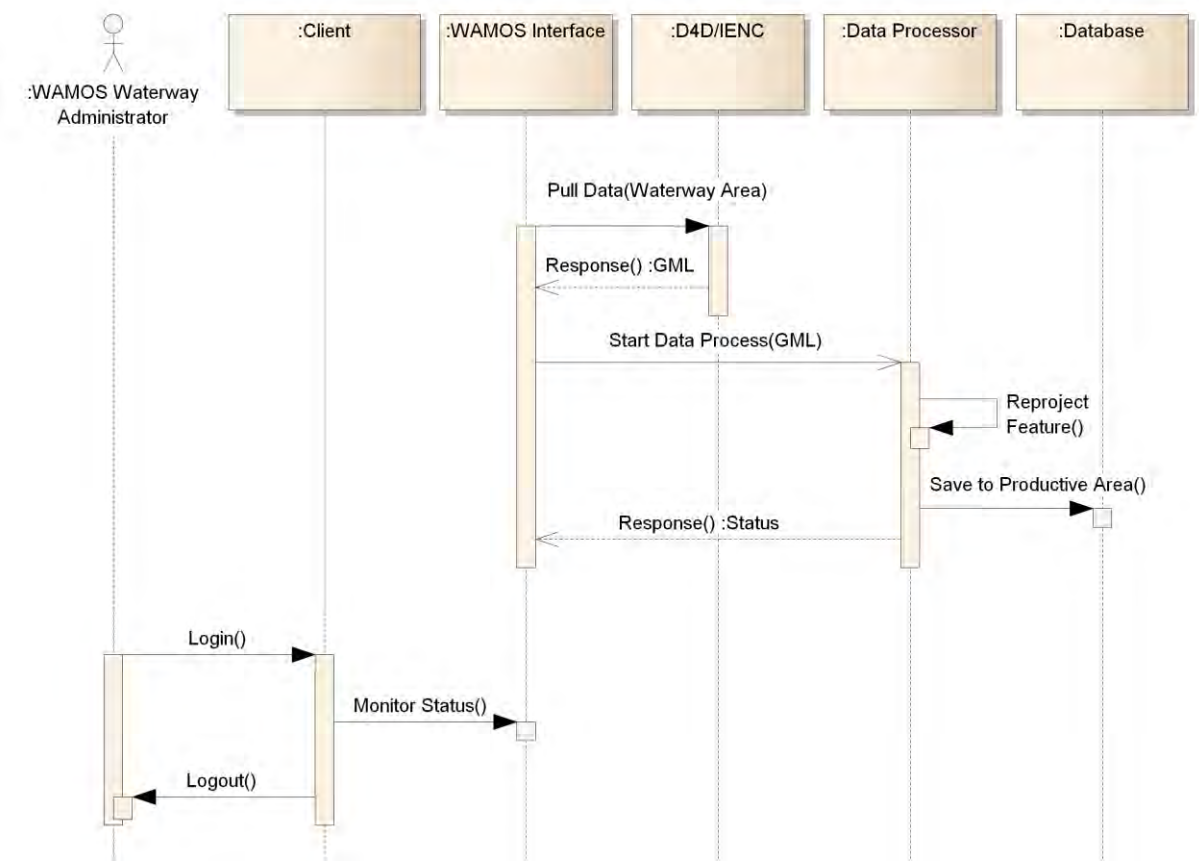


Figure 19: Sequence Diagram of the Waterway Area Import Process

The Waterway Area is imported periodically and runs completely automatically. No further action by the WAMOS Waterway Administrator is necessary.

Dependencies: [SUC15], [SUC16]

ID	SUC2
Title:	Import Fairway Dimensions

Description: The Fairway Geometry shall be displayed as background information. Furthermore the geometry is used when displaying the Fairway Dimension [SPUC3]. It is imported from National Data Providers (WAMS).

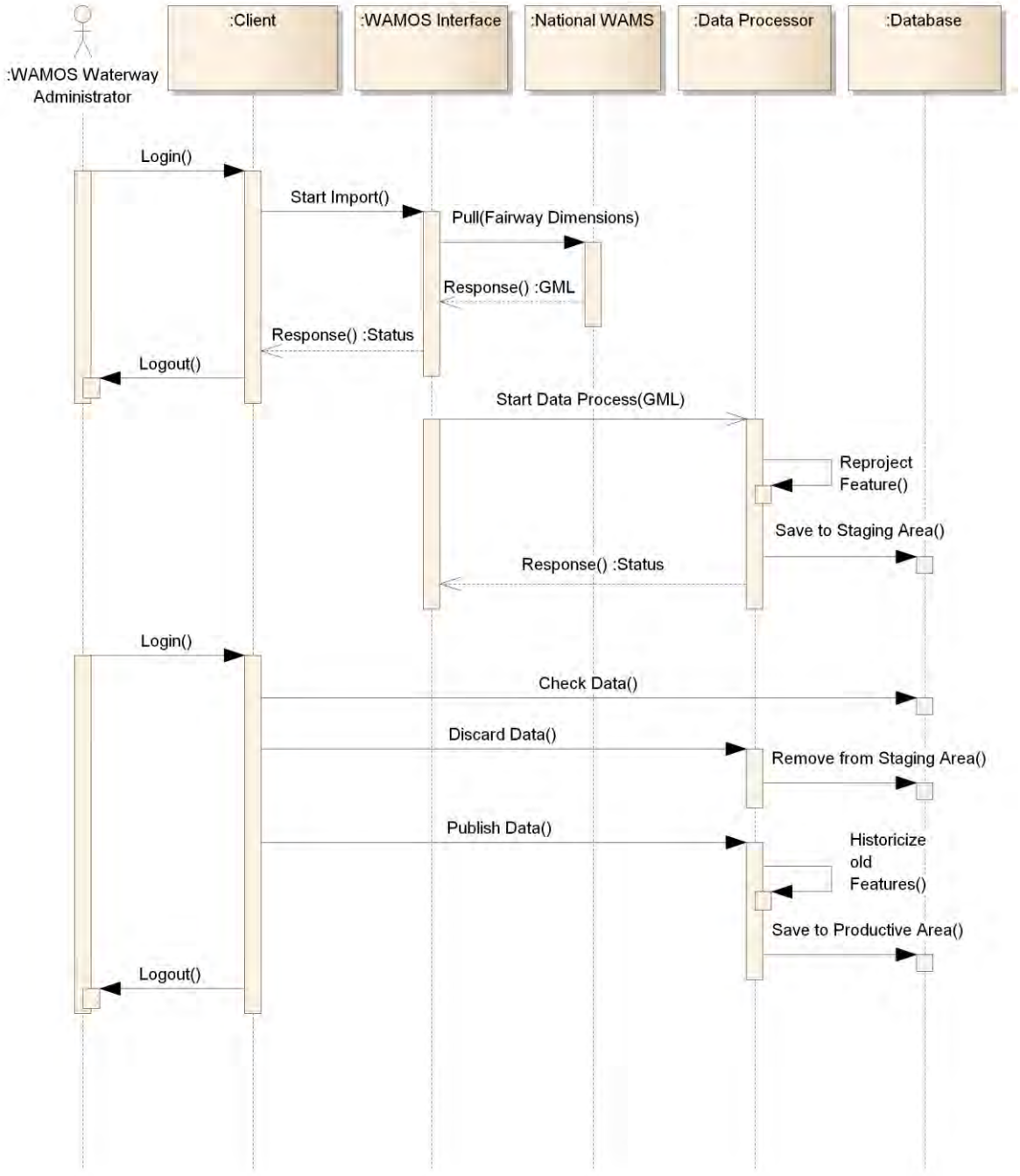


Figure 20: Sequence Diagram of the Fairway Dimensions Import Process

If the projection of the Fairway Dimensions does not match the WAMOS projection, the Reproject Feature function transforms the geometry into the correct projection. Then the data set is written into the staging area (see chapter 3.2.4 Staging) and the attributes and geometry can be checked by the WAMOS Waterway Administrator (Function Check Data). Depending on the result of this validation, the WAMOS Waterway Administrator either discards the data completely and restarts the import process (Discard Data) or releases the data for the users. With a function in the administration area, the data is automatically copied to the productive area of the database (Publish Data).

ID	SUC3
Title:	Import Waterway Axis

Description: The Waterway Axis is also imported from D4D/IENC and is used for Visualisation [GPUC5], to navigate through the map [GPUC10] and for intersecting the bottlenecks [SUC16].

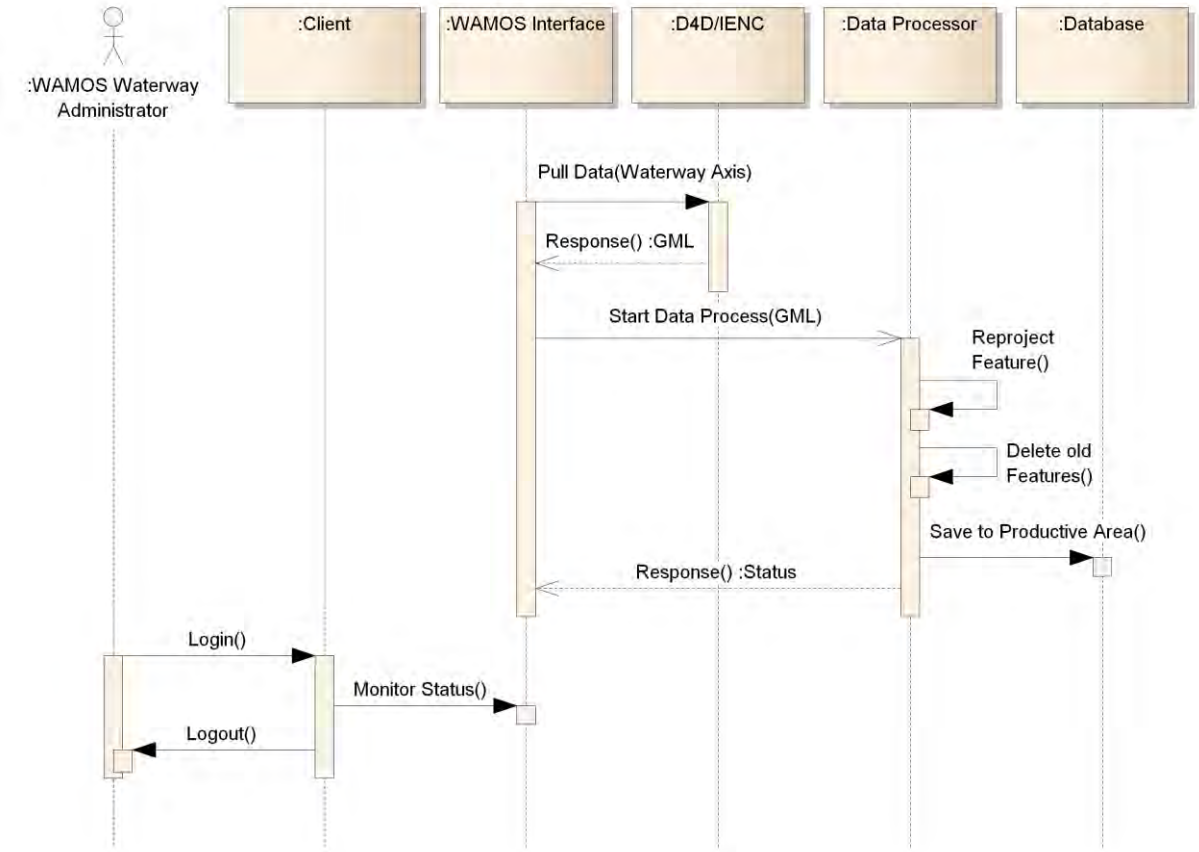


Figure 21: Sequence Diagram of the Waterway Axis Import Process

Like the Waterway Area the Waterway Axis is also imported automatically, called in configurable, periodic intervals to pull the data from the D4D/IENC Server.

ID	SUC4
Title:	Import Sections and Stretches

Description: The Sections and Stretches are also imported from the national WAMS. They are used to search and navigate through the map [GPUC10], to display Available Fairway Depths [SPUC4] and to display Available Fairway Depths vs. LNWL [SPUC5].

Since no geometry is transferred during the import of the Sections and Stretches, a spatial representation has to be derived from the start river hectometer to the end river hectometer (ISRS location) by cutting out the geometry from the Waterway Area or Fairway LOS3 (see [SUC16]).

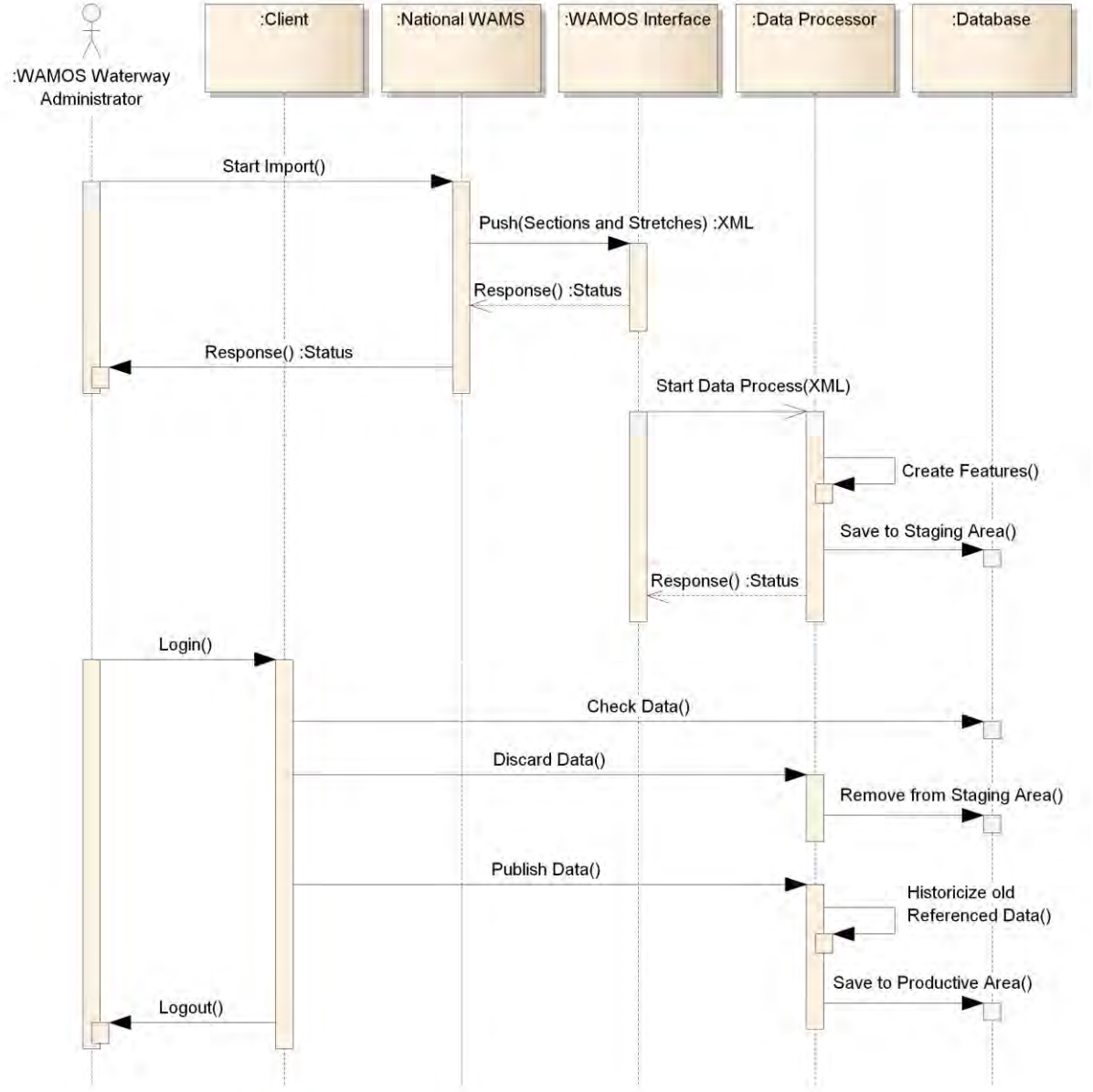


Figure 22: Sequence Diagram of the Sections and Stretches Import Process

The Sections and Stretches Import process is semi-automatic, with manual data control by the WAMOS Waterway Administrator (see chapter 3.2.4 Staging).

ID	SUC5
Title:	Request Gauge Measurement Raw Data

Description: The Gauge Measurement is requested from the NtS web service. The measurements are used to process further attributes like Fairway Availability [SUC16] and for Visualisation in the map [SPUC7], [SPUC8].

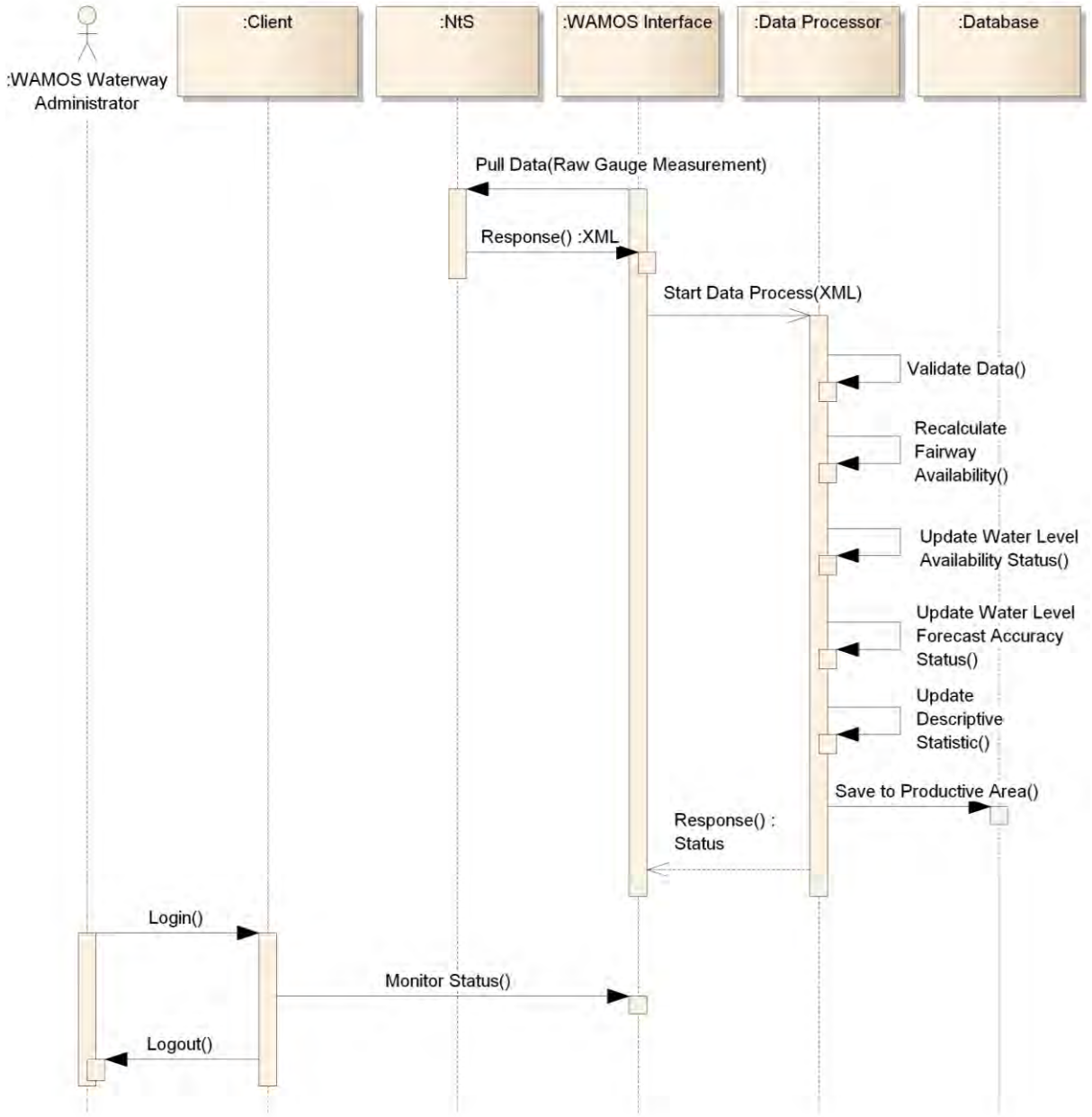


Figure 23: Sequence Diagram of the Raw Gauge Measurement Import Process

The Raw Data import of Gauge Measurements is a fully automatic process. The data request intervals shall be configurable. WAMOS actively has to request the measurement data.

ID	SUC6
Title:	Import Waterway Gauge

Description: The Waterway Gauges are imported automatically from the RIS Index and include also the LNWL and HNWL for each gauge. The data is used for Visualisation [GPUC5] and Analysis [SUC16].

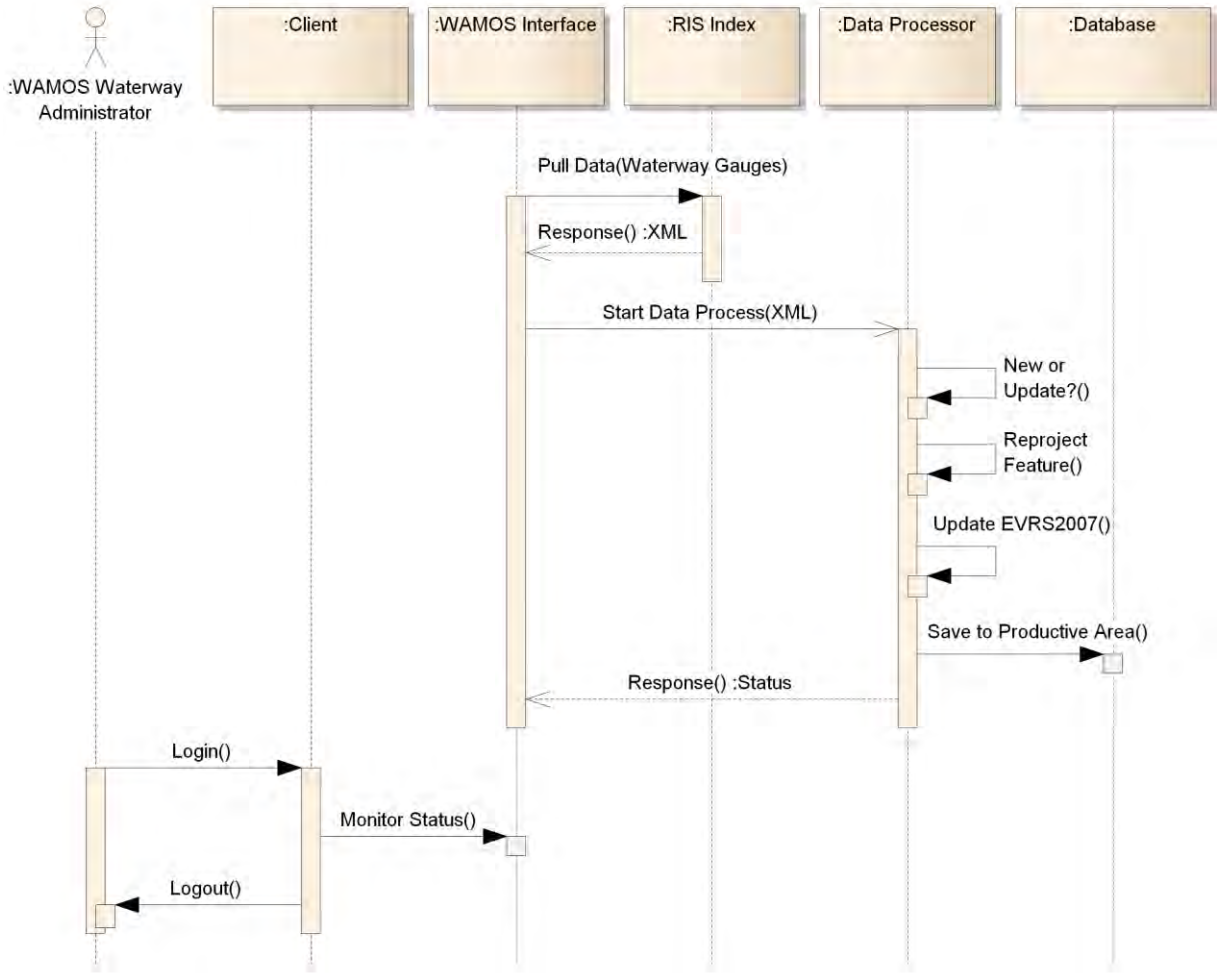


Figure 24: Sequence Diagram of the Waterway Gauges Import Process

ID	SUC7
Title:	Import Distance Marks

Description: The virtual Distance Marks along the Waterway Axis are imported automatically from then RIS Index, and are used to navigate through the map [GPUC10].

Physically stored distance marks are imported automatically from the D4D/IENC data sources. The Distance Marks along Waterway Axis are used for creating the Bottlenecks geometry [SUC16].

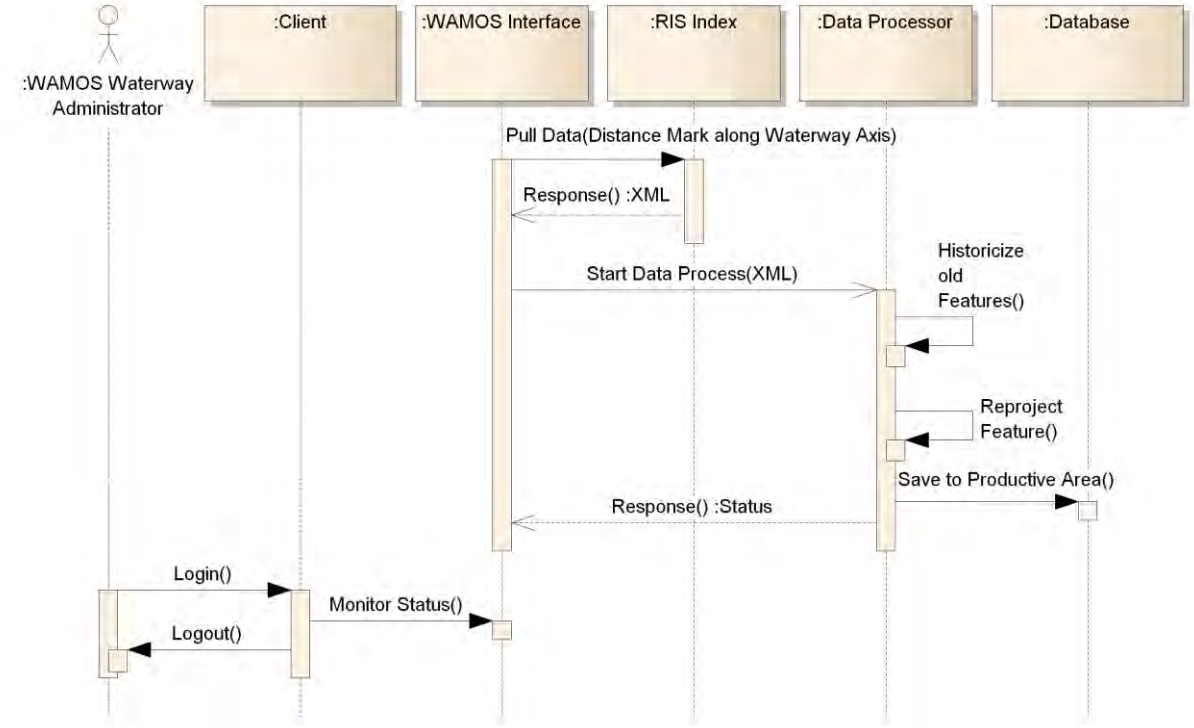


Figure 25: Sequence Diagram of the Distance Marks along Waterway Axis Import Process

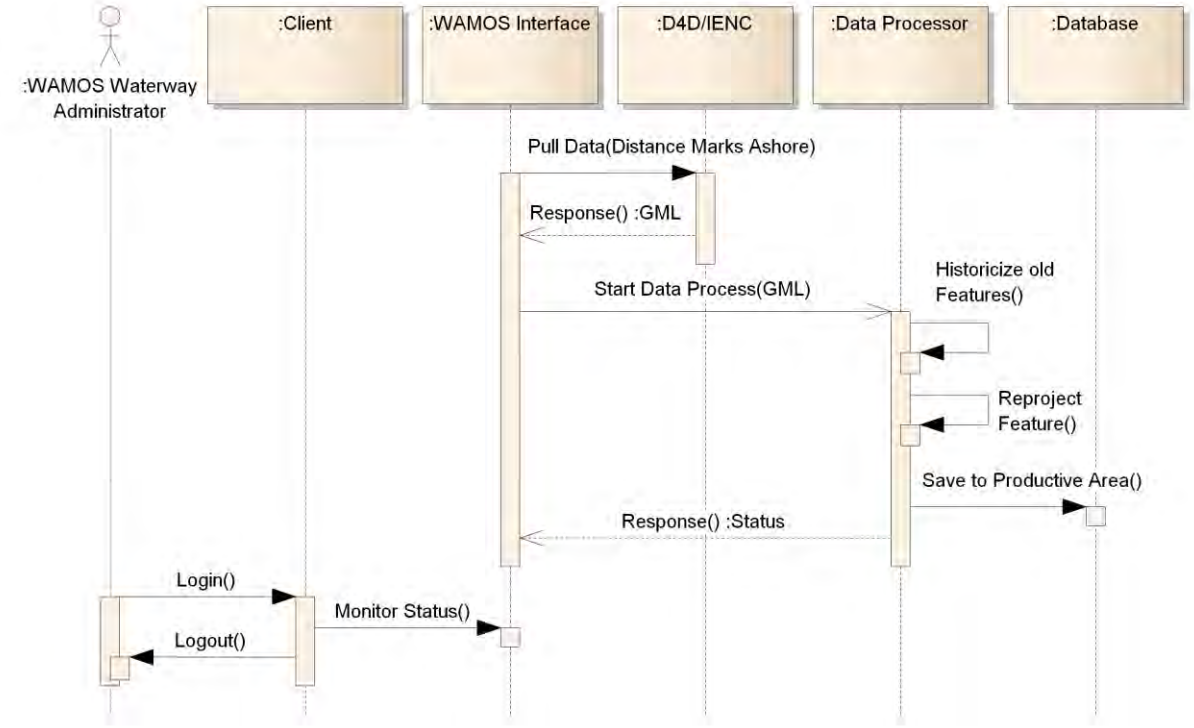


Figure 26: Sequence Diagram of the Distance Marks Ashore Import Process

ID	SUC8
Title:	Import Bottleneck

Description: The Bottlenecks are imported from the National Providers using the SOAP interface files. Bottlenecks don't have a geometry therefore the start river hectometre and the end river hectometer (ISRS location) are used to cut out the geometry from the Waterway Area or Fairway dimensions LOS3 (see [SUC16]). Which base geometry is used can be configured by the Waterway Administrator. The geometries thus generated must be checked manually by the WAMOS Waterway Administrator before they are set productively.

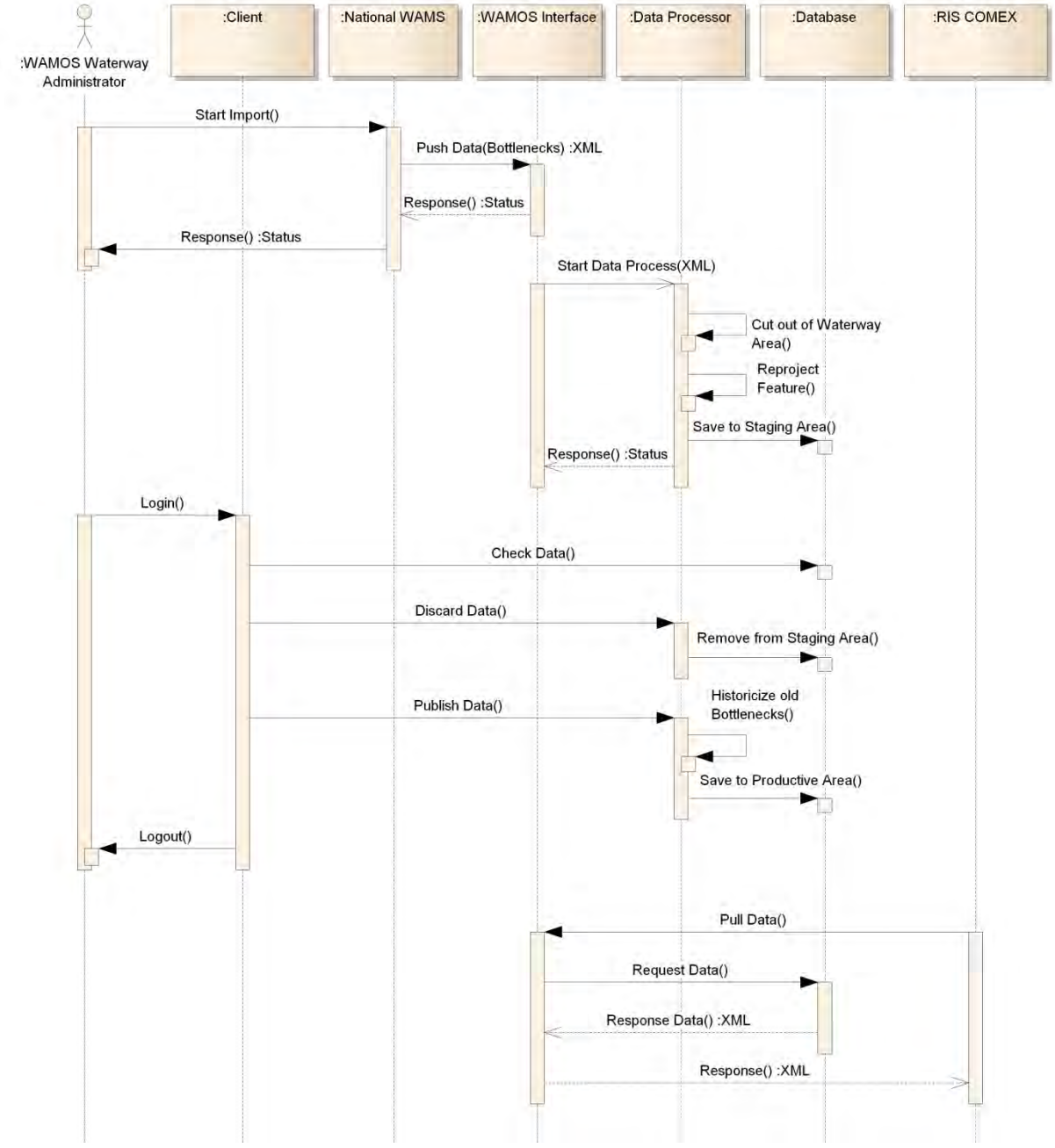


Figure 27: Sequence Diagram of the Bottlenecks Import Process

ID	SUC9
Title:	Request Approved Gauge Measurement

Description: The Approved Gauge Measurement is uploaded from the National Providers and will be transferred as csv file.

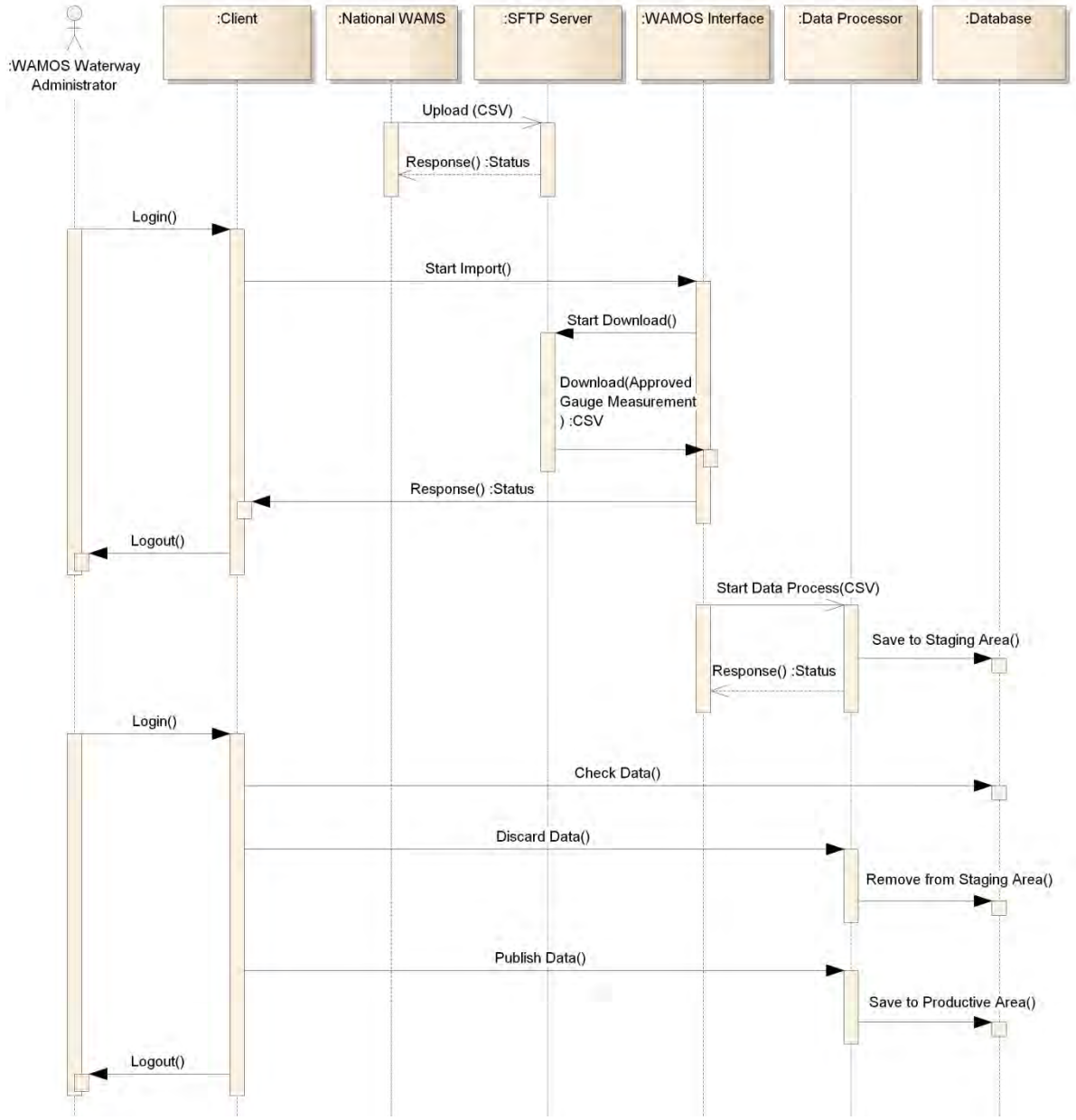


Figure 28: Sequence Diagram of the Approved Gauge Measurement Import Process

ID	SUC10
Title:	Import Sounding Results

Description: The Sounding Results are imported from the National Providers as x-y-z datasets. The format of the dataset is the same regardless whether they originate from a single-beam or multi-beam survey. The datasets are stored in the WAMOS Database and used for further processing [SUC16].

Each data set consists of the Sounding Results Data with the necessary metadata stored in the filename. It includes the surveyed area, the vertical and horizontal reference system and other information which helps to check and interpret the results (see chapter 2.2.3. Sounding results (SR) Catalogue of Required Data).

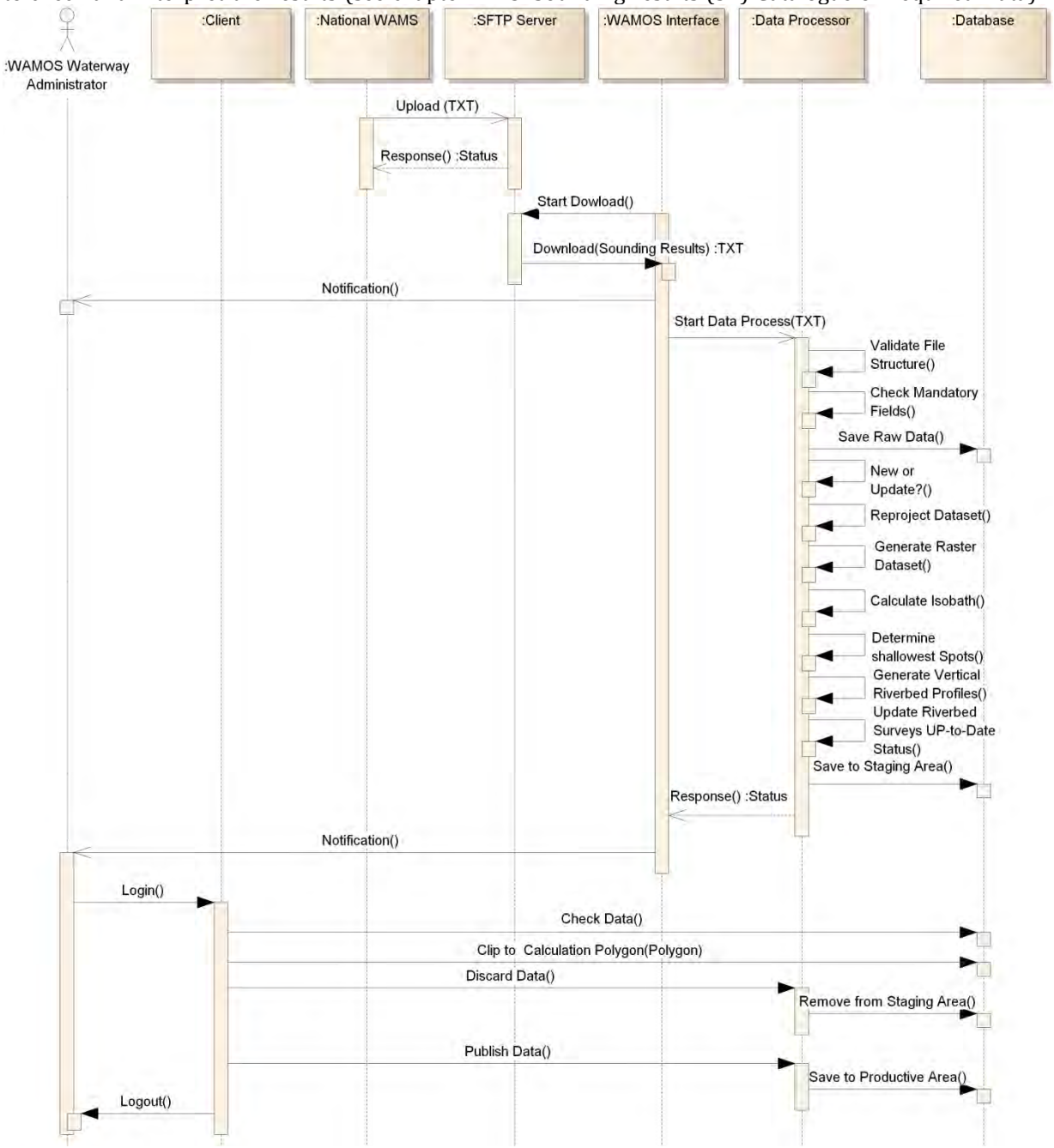


Figure 29: Sequence Diagram of the Sounding Results Import Process

The import process will per default determine automatically the boundaries of the sounding result data set. In some cases, this method might be not sufficient and may lead to imprecise results. Therefore Irrelevant areas (e.g. of bridge piers in the middle of the fairway) can be excluded by providing a more precise clip polygon. When a clip polygon is provided only the included area will be taken into account for the calculation of the raster and isobathic lines dataset.

The import process starts automatically after a certain waiting period when a new file has been uploaded to the SFTP server. This makes sure that there is enough time to provide the optional clip polygon as well. Furthermore, it must be ensured that, in the case of several uploads, the import processes are processed sequentially (queuing). Any status change during the import process should be notified to the WAMOS Waterway Administrator by email notification.

ID	SUC11
Title:	Import Available Fairway Depths

Description: In case of a non semi-automatic calculation of the Fairway Availability the values have to be imported manually from the national authorities.

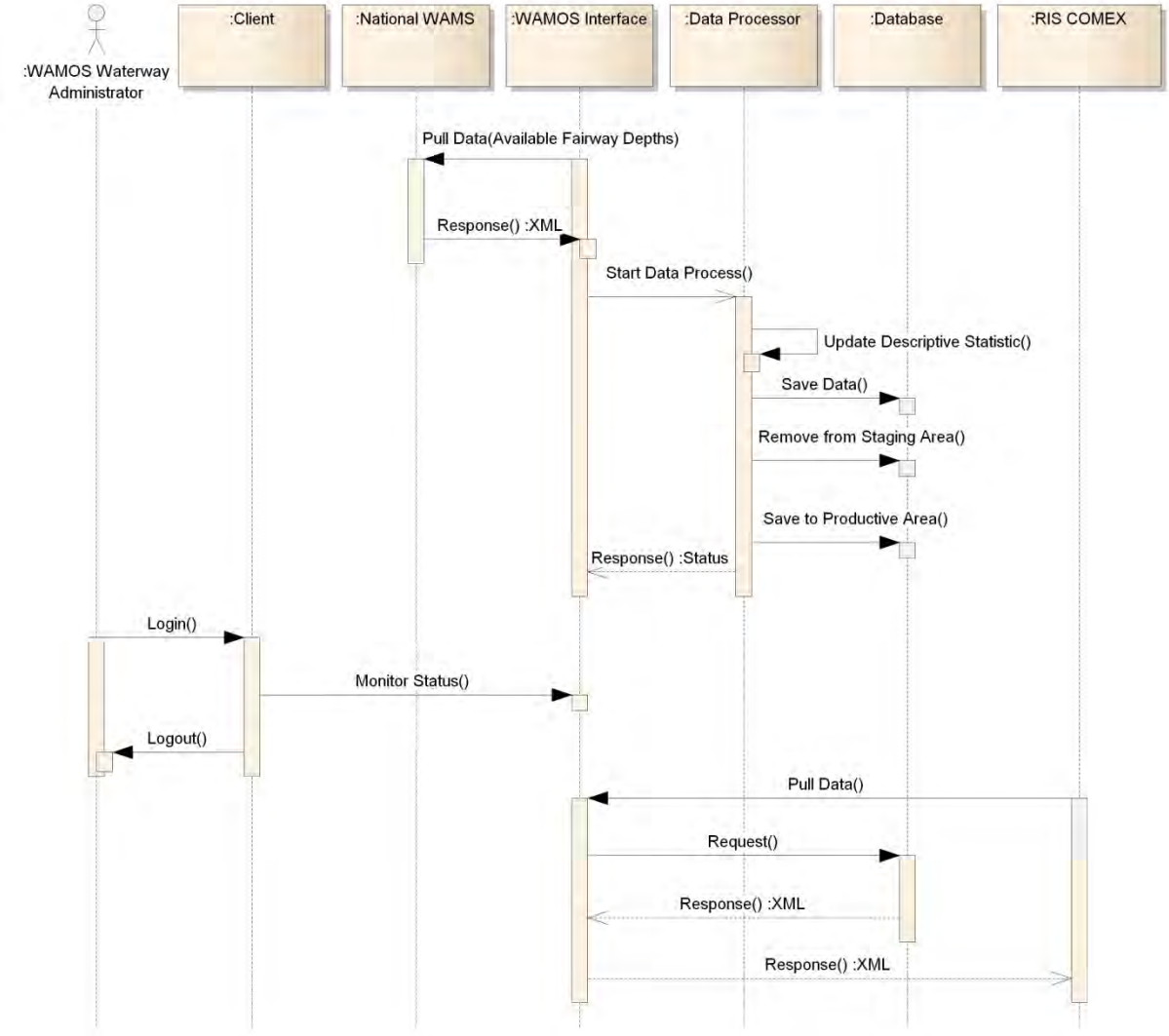


Figure 30: Sequence Diagram of the Available Fairway Depth Import Process

The Fairway Availability import of Gauge Measurements is a fully automatic process. The data request intervals shall be configurable. WAMOS actively has to request the Fairway Availability data.

ID	SUC12
Title:	Import Rehabilitation and Maintenance Measures

Description: The Rehabilitation and Maintenance Measures are imported from the National Providers and used for Display [SPUC9] and Evaluation [SPUC10] of Rehabilitation & Maintenance Measures. There can be two types of data collection. In case the National WAMS is not yet available via CSV download and if the national WAMS is available via SOAP request as XML response.

Since no geometry is transferred during the import of the Rehabilitation and Maintenance Measures, a spatial representation has to be derived from the start river hectometre to the end river hectometre (ISRS location) by cutting out the geometry from the Waterway Area or Fairway LOS3 (see [SUC16]).

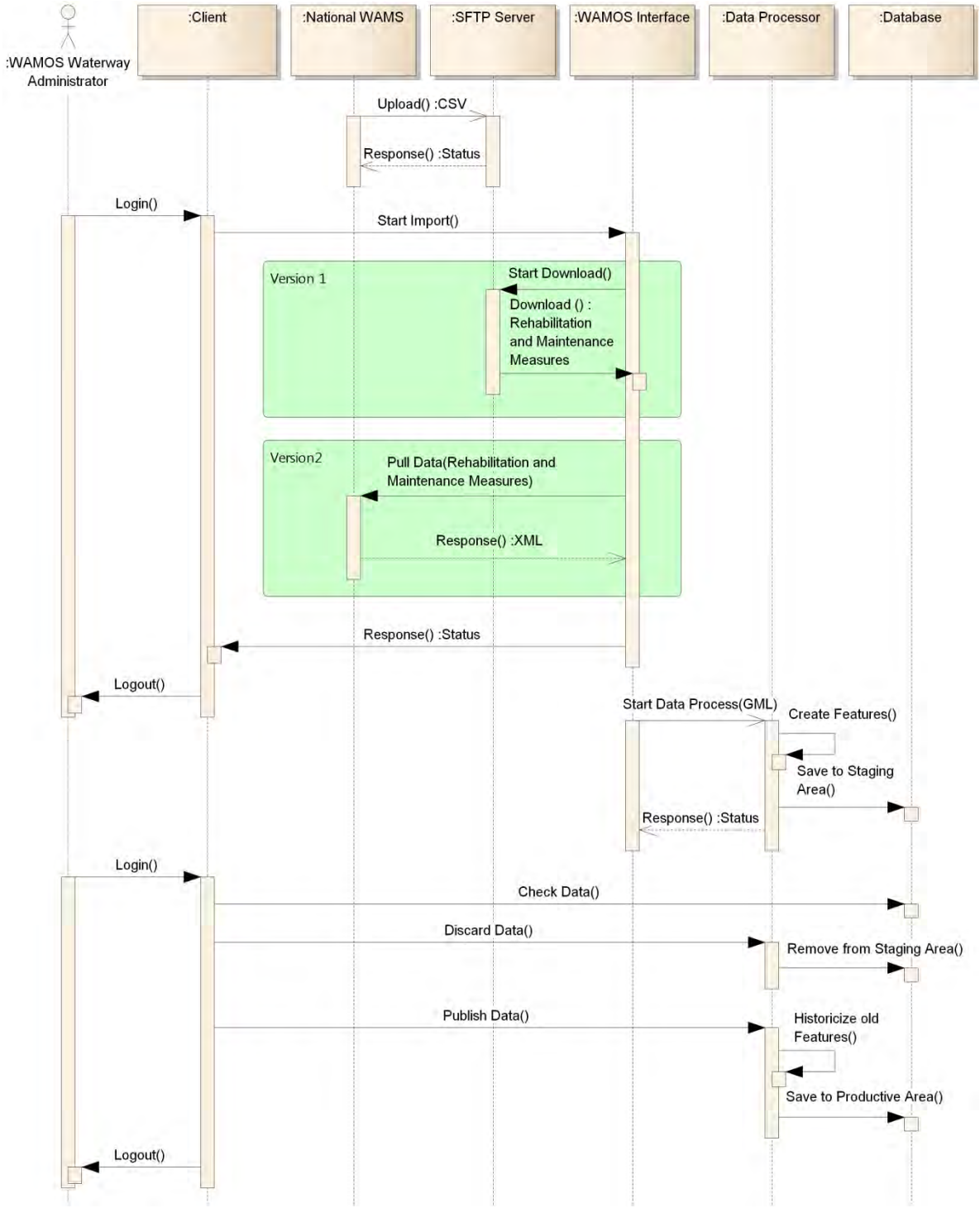


Figure 31: Sequence Diagram of the Rehabilitation and Maintenance Measures Import Process

ID	SUC13
Title:	Import Fairway Marks

Description: The Fairway Marks are imported from D4D/IENC and are used to display current and historic Fairway Marks [SPUC11]. To identify changes the current Fairway Marks have to be compared with the Fairway Marks available on the D4D-Portal.

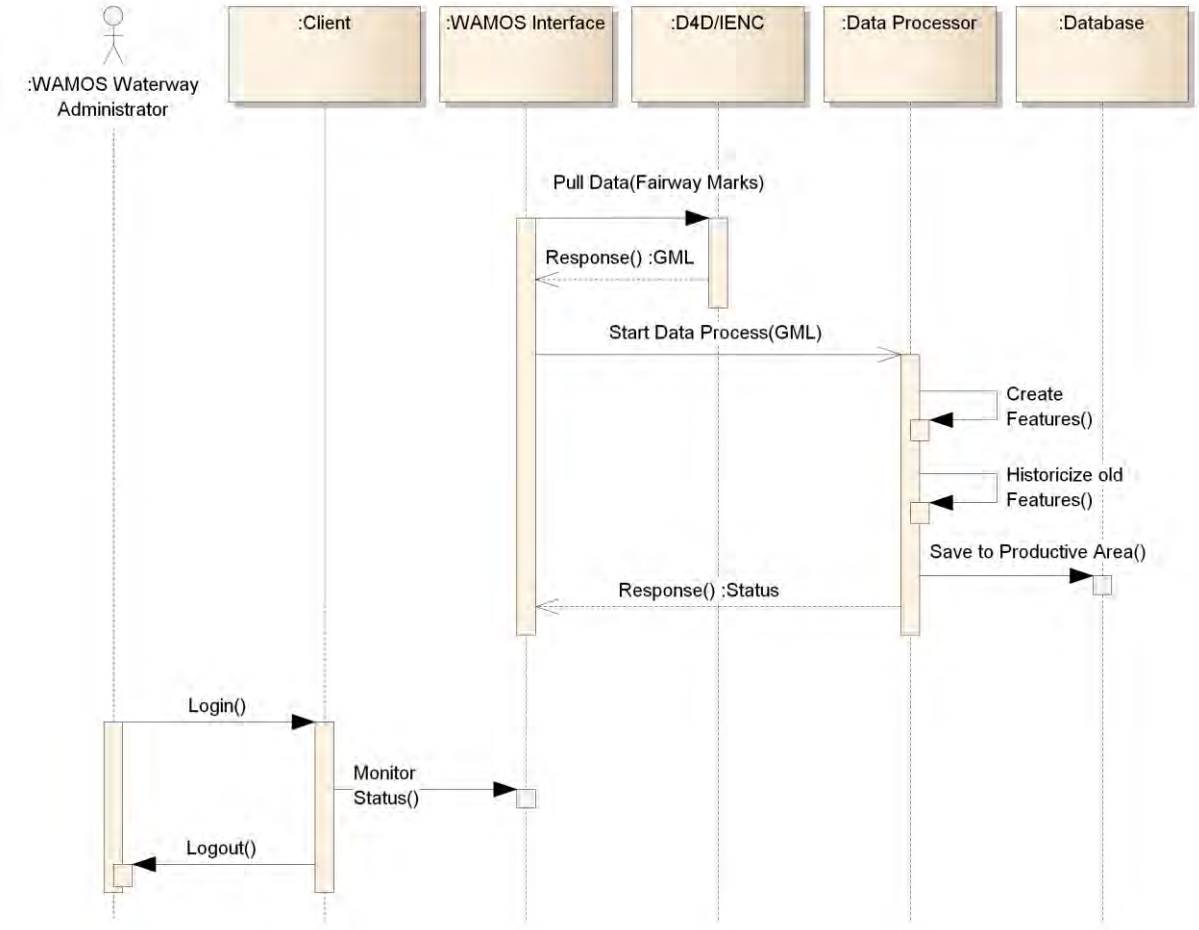


Figure 32: Sequence Diagram of the Rendering Marks Process

ID	SUC14
Title:	Import Waterway Profiles

Description: The Waterway Profiles are uploaded from the National Providers and will be transferred as csv file. They are needed when displaying the Fairway Dimensions [SPUC3] and Process Data [SUC16].

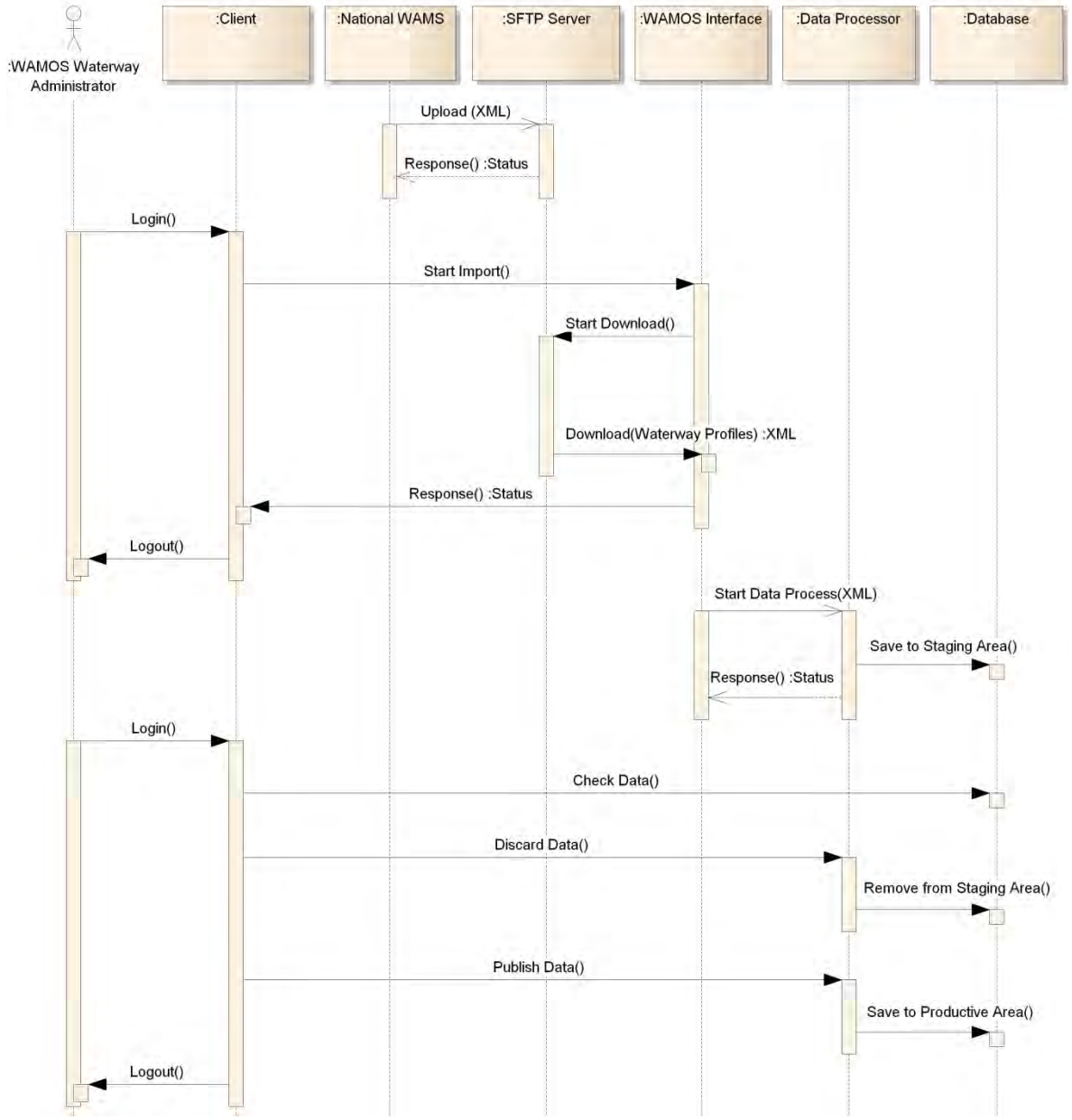


Figure 33: Sequence Diagram of the Waterway Profiles Import Process

ID	SUC15
Title:	Check and Consolidate Data

Description: All imported data must be checked for the following criteria.

- General Validation
    - Check if all needed attributes fully filled out.
    - Check correct extent
    - Check file structure (e.g. when transferring CSV files)
- Rough Water Level Validation
    - Sample rate / communications level as configured (see [APUC10])
    - Expected range of the measurements (historic data, sensor specification)
    - incorrect values (e.g. negative values have been transferred, which are not possible for this gauge)
    - Trend level detects unusual rapid changes-e.g. values don't rise or drops 1m within an hour.
    - Spatial consistency detects interaction between different spatially related sensors

Only after a successful consolidation, the data is written to the database or used for further calculations.

ID	SUC16
Title:	Process Data

Description: Additional values have to be calculated for the map presentation required in the special primary use cases

Extract information out of D4D/IENC Data

- All information which is not available in the IENC Data has to be provided by default-values and automatic calculations (e.g. if the country code is optional and not encoded in the IENC but needed to narrow the source of information).

Reproject Spatial Data

The system shall handle data in two different Coordinate Systems WGS84 (EPSG:4326) and Web Mercator (EPSG:3857). Both coordinate systems have their field of application and therefore WAMOS must be able to transform datasets between these coordinate systems.

Length measurements should be performed without further transformations in WGS84. If meters are necessary for more complex calculations, national systems should be used.

Derive geometries:

Generate the Bottlenecks, Sections and Stretches and Rehabilitation and Maintenance Measures geometry according to the ISRS location code by cutting out the geometry from the Waterway Area or Fairway LOS3. The layer which is used for the production is configurable for each country (see [APUC10]).

Prepare Sounding Result data:

- Convert the xyz points of the riverbed scan to a raster data set.
- Interpolate of depth contours on the basis of the raster data set with reference to the LNWL of the reference gauge.
- Determine the shallowest spots/measurement within the fairway LOS1 and LOS3.
- As defined in the Data Requirement Catalogue each critical section or sounding result dataset must have a unique vertical reference (absolute and relative). The reference gauge should have the same reference as the sounding result dataset. This allows quick and easy transformation between the absolute and vertical heights. A special case of the height reference can be used if the optional Water Level Reference is available (e.g. in Austria). Here a more precise water surface can be used to define the measured depths.

Analyse Sounding Result data on demand:

- Calculate the differences between two raster data sets.
- Calculate vertical profiles in 100m steps out of the raster dataset.
- Show different water levels (e.g. LNWL, HWNL, other reference water level) in Profile diagrams.

Calculate statistics values for descriptive statistics

- Calculate the % of days per the year the fairway depth was below a selectable value e.g. within selectable depth ranges (e.g. <23 dm, >23.1dm and <25 dm, >25dm 22 dm,…)
- Calculate the % of the days per year with water level was above the LNWL.
- Calculate the % of the days per year with water level was below the LNWL.

Calculation of fairway availability:

- Calculate the fairway availability for each bottleneck.

Dataset Monitoring:

- Calculate riverbed surveys up-to-date status for each bottleneck.
- Calculate current and continuous water level measurements availability status for each bottleneck.
- Calculate water level forecast accuracy status for each bottleneck.

Prepare Reports and Statistics data

- All report related calculations can be restricted to an area of interest, for example a particular bottleneck, section, stretch or a whole country.

3.2. Non-functional Requirements

3.2.1. Server Infrastructure

The hosting of the WAMOS System has to be provided by an external operator which stores and processes the data within the European Union and shall have one of the following certifications:

- ISO 27001 certification for information security standard
- ISO 9001 certification for quality management

The system can roughly be divided into the following components:

- Web Server Hardware
- Application Server Hardware
- DBMS Server Hardware
- Network Components

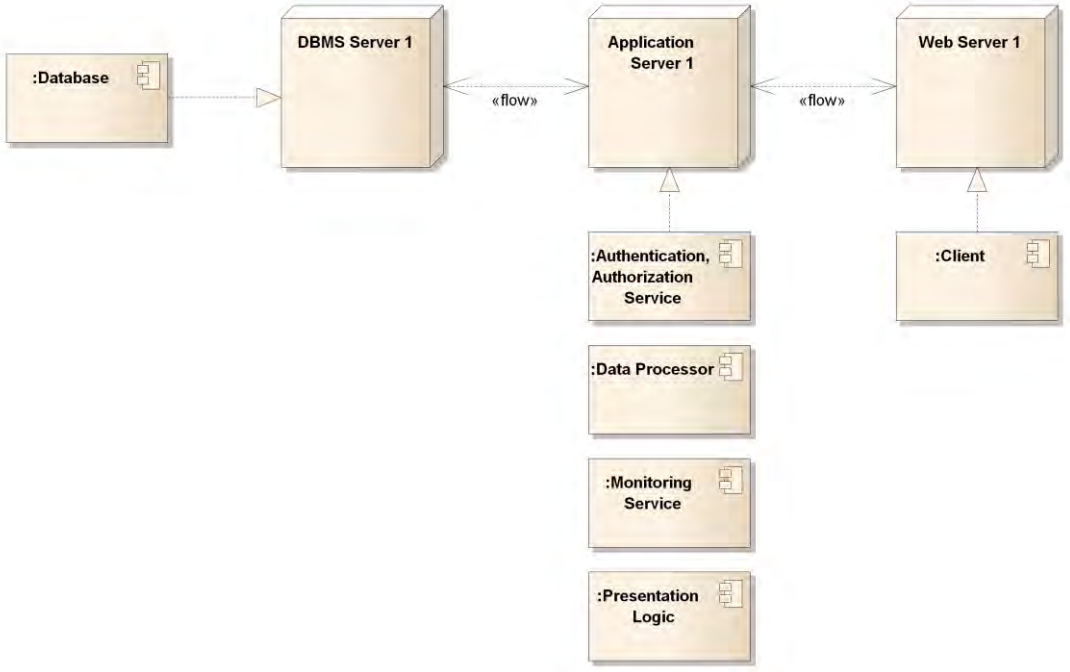


Figure 34: Deployment Model of the WAMOS System

3.2.2. Licensing

Licensed or open source software components may be used for the implementation of the WAMOS System. All licences shall be of type concurrent and perpetual. In case the solution contains open source software, the support and maintenance by the contractor must be ensured and will be considered during the evaluation of the offers.

3.2.3. Quality

The collection of basic fairway information from the national databases needs to be done via a standardized interface. Thus data must be transformed in a unified form (e.g. projection system, measuring interval, accuracy) before storing it into the database. Therefore some pre-processing has to be carried out by the national partners (see chapter 2.5) and in WAMOS the data has to be checked and consolidated automatically so that only valid data is written to the system (see [SUC16]). Invalid data which did not pass the quality check needs to be logged and reported to the WAMOS System Administrator and to the WAMOS Waterway Administrator (see [APUC7]).

3.2.4. Staging

The staging area is an intermediate storage area used for validating and testing the imported and processed data before it is transferred to the productive area. In WAMOS the staging area shall be an additional database or an additional schema in the productive area. The staging area gives the WAMOS Waterway Administrator the possibility to check the imported data before going live. If the data is not valid the WAMOS Waterway Administrator dumps the import and the live data is not being affected. Data sets which need a manual validation (see chapter2.1):

- Import Fairway Dimensions [SUC2]
- Import Sections and Stretches [SUC4]
- Import Bottleneck [SUC8]
- Request Approved Gauge Measurement [SUC9]
- Import Sounding Results [SUC10]
- Import Rehabilitation and Maintenance Measures [SUC12]
- Import Waterway Profiles [SUC14]

3.2.5. Historicisation

For meaningful and efficient data storage, it is only necessary to keep the data of the last three years in the productive area of the WAMOS Database. Older data is kept in a slower and thus more cost-effective storage medium. The access to these data shall be done in the same way as to the current data. For the user, it does not make any difference which database is used, only but the access speed is different.

3.2.6. Performance

The dimensioning of the system must be designed with regard to the expected speed, availability, response time and recovery time. Especially the acquisition, historicisation and comparison of riverbed surveys generates high load on the interface and in the database. Data must be stored in a relational database for quick queries and storage.

For that reason, the estimated quantity must be determined prior to the design, also system scalability has to be taken into account.

The performance values are defined as response time e.g. total time spent from the submission of the request until the completion of the response, where defined including the rendering at the client or writing a status in a log file. The maximum system response time excludes network latency time and depends on the action type as well as on the number of concurrent user requests (see Table 6).

Table 6: System Response Time

Level	**Action**	**System Response Time** *(assuming of only one concurrent request from the user)*	**System Response Time(for data older than 3 years)** *(assuming of only one concurrent request from the user)*
GUI	Map Rendering, Zoom in/out, Feature Search	< 2 sec	< 6 sec
GUI	Displaying Riverbed Morphology in the Map and Riverbed Changes in the Map	< 5 sec	< 15 sec
GUI	Calculating Riverbed Changes	< 20 sec	< 60 sec
Data Interface	Import Waterway Gauge Measurement Raw Data (real and predicted measurements)	< 5 sec	-
Data Interface	Import Distance Mark Along Waterway Axis or Import Distance Marks Ashore	< 30 min	-

Data Interface	Import Available Fairway Depths	< 10 sec	-
Data Interface	Provide Available Fairway Depths	< 10 sec	-
Data Interface	Import Waterway Gauge Measurement Approved Data	< 30 min	-
Data Interface	Import Sounding Results	< 24 h	-
Data Interface	Import Bottlenecks	< 30 min	-
Data Interface	Import Sections and Stretches	< 30 min	-
Data Interface	Import Water Level Reference Data	<30 min	-
Data Interface	Import OGC WMS/WFS based Data	< 30 min	-

The above mentioned response times are applied to data access that was stored within the last three years and in case of one concurrent user request, for older data or in case of more concurrent user requests the response times may be higher (see chapter 3.2.5).

Additionally all WAMOS Interfaces define a specific response timeout for an external interface call. If no answer is received within this time limit, all outstanding requests to the external data source are canceled.

3.2.7. Capacity

It is expected that two users from each national authority will work with WAMOS when commissioning the system. That would be about 14 users at system start. Based on the expected number of users, WAMOS Web Based Services shall at minimum support 4 concurrent requests. In the course of the operation, however, the user circle will increase and this will result in an increase of the workload. This additional load has to be able to be processed by means of improved or additional hardware; software adaptations must not be necessary (see chapter 3.2.17).
Regarding the data capacity, riverbed scans are the most important decisive factor.
Assuming that scans are available for Bottlenecks only, the following table estimates the data volume needed for the entire Danube. The base units (kb/m^2 and m^2 of bottlenecks) are based on the available statistics of the current Austrian WAMS Project[16] and a cumulated list of the bottlenecks of the Danube River (length and width). These values shall only serve as rough estimates since the actual data size might change due to different data storage structures and algorithms within WAMOS.

Table 7: Estimated Data Volume of all Riverbed Surveys

Bottlenecks of the River Danube [m^2]	Size in the WAMS Database [kB]/[m^2]	Total Size [kB]
41.445.100	0,1	4.144.510

The frequency of surveying depends on the type of the Bottleneck. Some stretches of the Danube have been scanned 27 times in 2015, in other areas once a year was sufficient.

Table 8: Number of Bottlenecks

RB / LB	Name of location	Bottleneck [m^2]	No. of Bottle-necks
AT / AT	Wachau valley	724.000	6
AT / AT	East of Vienna	938.000	10
AT / SK	AT/SK border stretch	252.000	3
SK / SK	SK strecth	744.000	2
HU / SK	HU/SK common sector (Szap - Szob)	1.027.000	11
HU / HU	Szob - HU/HR/RS border	3.104.200	29

[16] In the Austrian WAMS Project the sounding results are stored in triangulation format, in WAMOS it is planned to use raster datasets. Thus the estimation of the memory size can only be seen as an approximate guideline value.

HR / RS	HR/RS common sector (Bezdan - Bačka Palanka)	13.478.000	16
RS / RS	Serbian Stretch	6.090.000	6
BG / RO	RO/BG common sector (Timok confluence - Călăraşi)	6.708.000	28
RO / RO	Călăraşi - Brăila	3.221.000	15
RO/RO	Braila-Chatal Izmail (maritime Danube)	3.123.000	7
RO / RO	Chatal Izmail - Sulina branch (maritime Danube)	1.195.900	3
RO / RO	Bala-Borcea alternative route	240.000	1
RO / UA	Chilia and Bystroe	200.000	1
RO / RO	Danube - Black Sea Canal	400.000	4

Based on the number of surveys[17] in 2015 it can be estimated that each bottleneck is surveyed 3 times per year in average. This results in an estimated total data volume of about 15 GB per year.

3.2.8. Security

All WAMOS actors have to log-on before consuming the functionality. E.g. if a user tries to log in to the web application with a non-existing account then the user must not be logged in. The user shall be notified about log-in failure.

Interface calls must use HTTPS using TLS with a strong encryption.

The WAMOS web server will need a valid and trusted SSL certificate (e.g. globalsign.com[18]) to ensure the servers authenticity to other systems.

All components especially those on the Web server need to be implemented and configured in a way that IT-security against external threats is ensured.

As part of the acceptance tests of the WAMOS System IT-security tests have to be performed in order to assess the robustness of the system. In case of problems, proper counteractions and corrections must take place.

3.2.9. Availability

All WAMOS services that collect data shall provide an availability of 98% at minimum (measured based on the 7 days, 24 hours, 365 day) service provision. Components of the Presentation Tier and the Presentation Logic (see figure 3) may also be used day and night throughout the entire year but the required availability of 98% refers to office hours between 09:00 and 17:00 (Central European Time, CET) excluding national holidays.

3.2.10. Reliability

A major role in this project is the collection of data. The system providing such a continuously running process must be reliable and serviceable. A reliable system shall not silently continue and accept invalid data. In the case of data failure auto-generated information is sent to the administrator to detect and eliminate errors to ensure correct data transmission.

WAMOS shall take care of data integrity with the following approach: In case of an export all data is read before the data set is delivered (i.e. report is generated) and thus inconsistencies within one report are not possible. Data in the production tables is only changed, if all data has been successfully imported. So WAMOS needs to transfer the data listed in chapter 3.2.4 to a staging area and then adds/replaces the production

[17] Data source is 2017-07-24_Bottleneck_m2.xlsx. The number of surveys is a range from the critical location with the smallest number of measurements to the critical location with the highest number in 2015 per section.

[18] https://support.globalsign.com/customer/portal/articles/1426602-globalsign-root-certificates

dataset, when all checks were passed successfully. If a replacement of existing data is conducted, WAMOS makes sure this is done in a transaction, leaving the system always in valid state.

3.2.11. Maintainability

The expectation towards the serviceability is that the system which is easy to maintain and quickly repaired in a case of emergency without data loss. An increase of repair time will end up in a decrease of availability. The worst case would be a loss of data.

The maintainability can be measured in the mean-time to fix a bug or to add a new functionality. This is primarily relevant when in the course of a service level agreement certain response and recovery times must be guaranteed.

A further aspect is the compatibility in case of different interface versions. In this case, a downward compatibility must always be guaranteed in order to ensure the data transfer of all external systems in case of a new version.

3.2.12. Recoverability

The WAMOS System must be able to be restored within 48 hours, in the event of a complete system failure; this includes all data that needs to be stored, e.g. vector data, raster data, metadata, personalization data, processed data, and the system configuration and all application files for the Database Tier, the Business Tier and the Presentation Tier. For this reason, an incremental backup of the database is created every night and every second weeks a full backup is made. In addition, all software components must be available in an installation directory in the latest, stable version. A backup and recovery documentation must be available (see chapter 3.2.14).

The reboot time of the system must be less than 15 minutes.

3.2.13. Portability

Since all WAMOS components shall have the ability to run on virtualized workstations, dedicated servers or in a cloud, the elements shall be specifically implemented considering the deployment to operating systems of different versions and varying hardware configurations.

3.2.14. Documentation

The following documentation is required:

- All elements of the documentation need to be delivered in English language, as pdf and in formats, which are editable by standard off-the shelf products (e.g. MS Office, Visio)
- User Manual: For the WAMOS web application user manuals, which described all functionalities, must be delivered, for each group of users (see Table 3).
- Training Documentation: Since the introduction of the WAMOS System is intended to provide training, appropriate training documents must be provided for the role of the WAMOS Waterway User and the WAMOS Waterway Administrator.
- Installation and Configuration Manual: The installation and configuration manual shall provide clear and detailed step by step instruction for the installation of the software, including any configuration required for the installation. It describes a bare installation procedure, e.g. also includes the scripting of the WAMOS Database.
- Operating Manual: The operating manual describes and provides instructions for the operation of the WAMOS System. This shall include the documentation to start up, shutdown, monitor and troubleshoot the system and the maintenance of data or system configuration parameters.
- Backup and Recovery Documentation: The Backup and Recovery Plan shall describe a strategy for the backup and recovery of all data being part of the WAMOS Database. In addition, the documentation must cover all individual steps to backup and recover the entire WAMOS System.
- Interface Control Document: The implemented interfaces must be described in such detail, that developers are able to get all required information, needed to develop applications that allow to use the interface services.
- Code Documentation: The documentation of the code shall be carried out in a corresponding granularity so that a further development by a third party is possible without great effort. The programming shall be carried out according to recognized guidelines (e.g.

https://blogs.msdn.microsoft.com/brada/2005/01/26/internal-coding-guidelines/), thus contributing significantly to the readability of the code.

3.2.15. Usability

Since WAMOS is a professional application and the users are experts, the preparation of the information in the maps and diagrams can be made suitable to the specific subject. Nevertheless, some design guidelines must be considered.

- As shown in the mockups in chapter 3.3.1 the user interface elements are clearly arranged divided into map display, legend control, function board, navigation controls and any other control to fulfil the functional requirements.
- The ability shall exist to hide or unhide the legend control and the function board to enlarge or reduce the area of the map display.
- The handling of these interfaces must be simple and intuitive, e.g. the one field search function in the toolbar or the dynamic legend automatically synchronizes with the map content.
- The symbolisation of the map layers is based on common harmonized standards taking the IENC standard and international projects into account.
- All delays in the web application longer than 1 second will be signalized by changing the cursor icon to a progress symbol.
- All delays in the web application longer than 10 seconds have to be processed asynchronous, so the user does not have to wait.
- The WAMOS client has to be developed as a web application. This will limit the ability for real time updates to the system.
- The WAMOS client must run on top of Mozilla Firefox, Internet Explorer, Opera and Chrome, all in the latest stable version at the start of the pilot operation at the start of the pilot operation.
- The WAMOS client shall not require specific installation on the desktop (e.g. Installation of Fonts, Symbol Libraries, etc.).
- The WAMOS client shall be able to consume OGC compliant WMS in version 1.3.0 (ISO 19128) and OGC compliant WFS in version 2.0 (ISO 19142).
- The desktop on which the WAMOS client is running is hardware-equipped accordingly and supports minimally a resolution of 1440 x 900.
- The controls of the WAMOS client shall be automatically adapt to different screen-resolutions.
- All login pages as well as the administration main page and the WAMOS client pages show all required programme and project logos (see INEA publicity guidelines).

3.2.16. Internationalization capability

The support of multilingualism must be implemented in such a way, that all labels/messages designed to be read by WAMOS users, are easily replaceable by additional languages, the base language is English (see also GPUC4). A new list of translations may be imported into the system at any time. The WAMOS System Administrator is in charge of translating the language configuration files into other languages. Cyrillic letters must also be supported.
The services responsible for data processing and data integration shall use character sets which cover all the languages for which data will be used (e.g. Unicode).

3.2.17. Scalability

The WAMOS System components (e.g. database, interface, validation, processing, consolidation service, presentation service, etc.) need to be implemented in such way, that they fulfil the requirements concerning reaction time (see chapter 3.2.6) and availability (see chapter 3.2.9).

This could be solved by servers in the cloud or a stand-alone system and with a cold standby. It is not assumed that a cluster solution is required to fulfil the requirements.

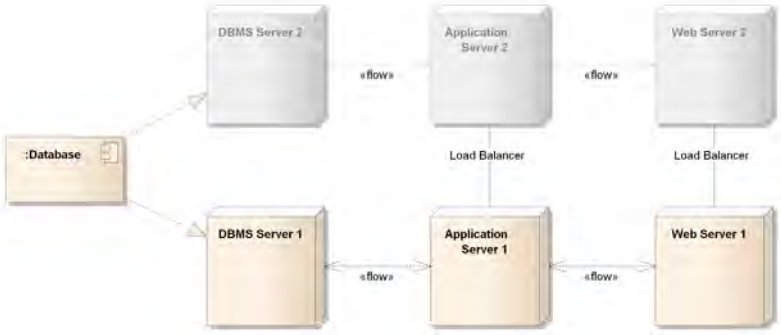


Figure 35: Scalability of the WAMOS System

3.2.18. Monitoring

All services (database, business and client tier services) shall have the ability to be monitored, so that a critical system status and system failures can be assessed. The ability to trigger warnings and alarms shall be provided, in order to enable the automatic notification of support staff in case the service is about to reach limits (warning) or the service fails (error). The status is also written to the WAMOS System logs. The WAMOS system shall be able to calculate the "availability", "downtime", "health" as listed below for each system/interface and for a timeframe (if applicable), which is configurable by the system administrator. The monitoring activity can be divided as follows:

- Server
  - CPU load
  - memory used
  - disk capacity
  - downtime
- Network
  - response time
  - packet lost
  - transfer rate (Mbit/sec)
  - roundtrip-time (time for a defined package from a defined source to a target and back)
- WAMOS Database
  - CPU load
  - memory used
  - db size on disk
  - disk capacity
  - locks
  - processes
- WAMOS Services and Interface
  - availability
  - downtime
  - health (test requests)
  - import processes
- WAMS Services
  - availability
  - downtime
  - health (test requests)
- NtS
  - availability
  - downtime
  - health (test requests)
- D4D/IENC
  - availability
  - downtime
  - health (test requests)
- RIS Index

    - availability
    - downtime
    - health (test requests)
- User Action
    - users logged in
    - export requests

Each interaction with WAMOS must be logged containing a reference to the responsible user or system e.g. interface calls (export and import) and user interactions. This can be used for creating an audit trail for a certain user.

3.2.19. Domain

The domain name of the WAMOS platform shall uniquely identify the platform and its services by a meaningful name. It shall be constant so that the platform can be transferred to another server (IP-address) without losing access to the services. The top level domain shall be a general abbreviation as ".eu", "info" or ".net". No internationalisation of Domain names is needed.

3.3. External Interface Requirements

3.3.1. User Interfaces

In order to get a better impression of the usability of the software in this chapter presents, the use cases [GPUC5], [GPUC6], [GPUC10] and [SPUC1] in the form of mock-ups are shown. In general the WAMOS client shall include at minimum the following control elements:

- map display - to display maps
- legend - to control the information displayed in the map display (map and alphanumeric data)
- function board - to start the thematic functions and map content
- navigation controls - to navigate on top of the map
- any other controls required to fulfil the functional requirements
- the client layout must be conform to the EU guidelines[19]

The ability shall exist to distinctively hide legend control and function board in order to enlarge the area of the map display. Conversely, the elements shall also be able to be unhidden.

First the User needs to login.

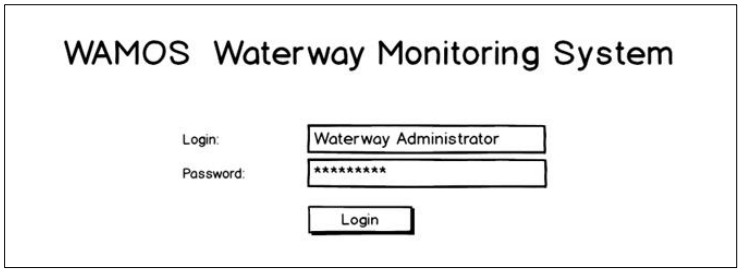


Figure 36: WAMOS Login Screen

Then the map display shows the whole extent of the river Danube and the Danube Black Sea Canal.

[19]https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/beneficiaries-info-point/publicity-guidelines-logos

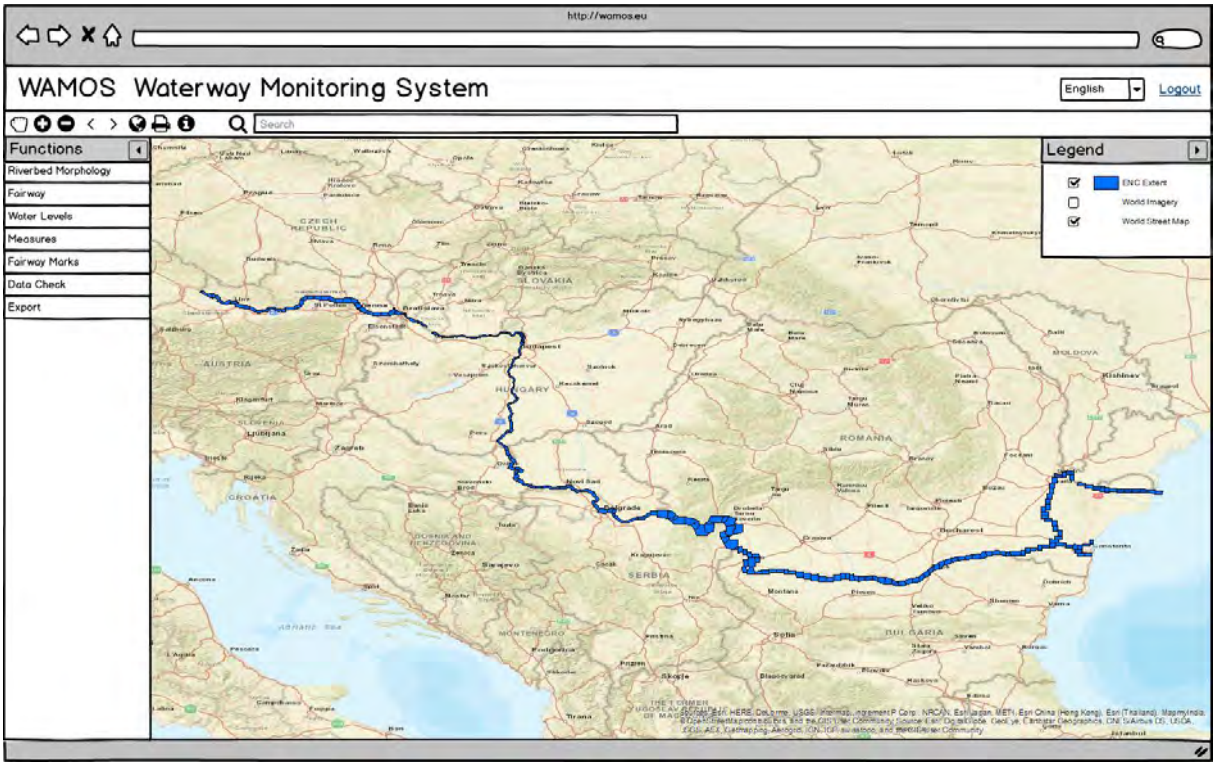


Figure 37: Overview after Login

Now the user can start to search for certain features over several rivers or canals. Therefore the user enters a word or a phrase and gets a result list ordered by the match score.

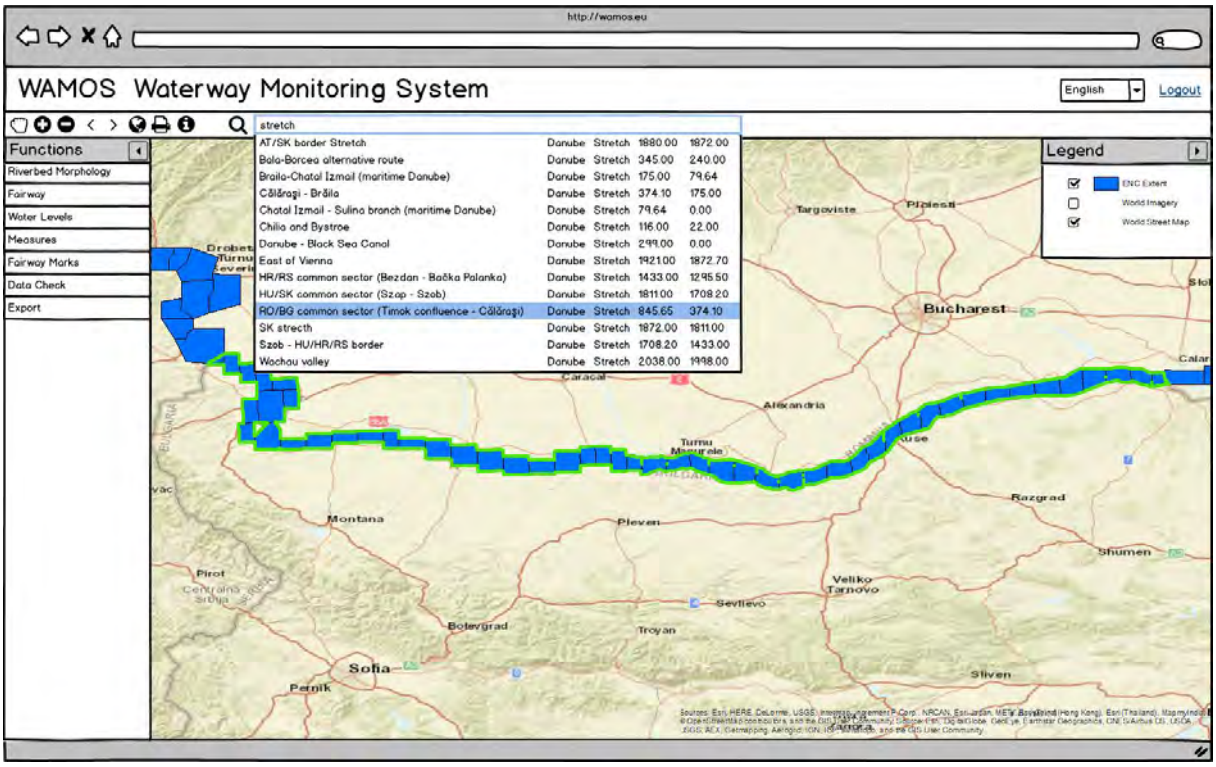


Figure 38: Searching Stretches

Selecting one element in the list causes a zoom to the feature. Typing only a few letters will start the search again. Depending on the scale, the map and the legend content change automatically.

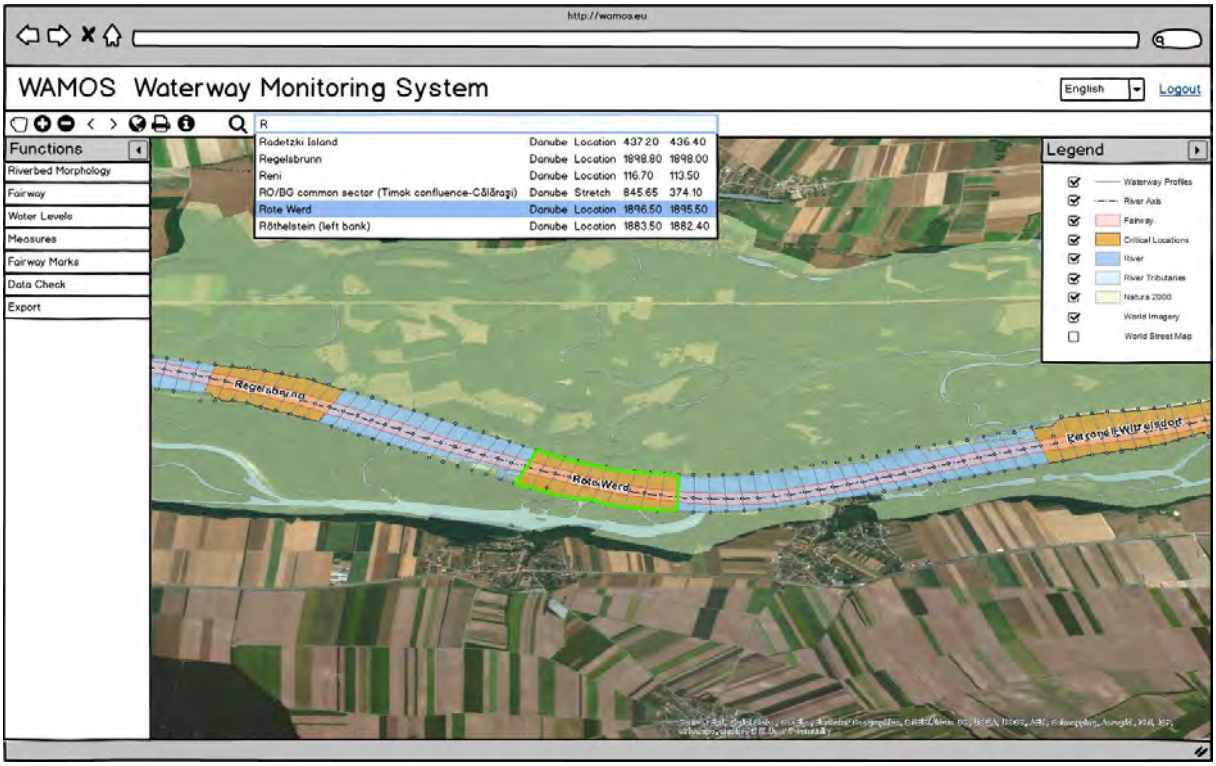


Figure 39: Searching Bottlenecks

On the left side - on the function board - of the application the user can choose between different thematic blocks. Each block consists of separate functions which allow the user to display certain data in the map.

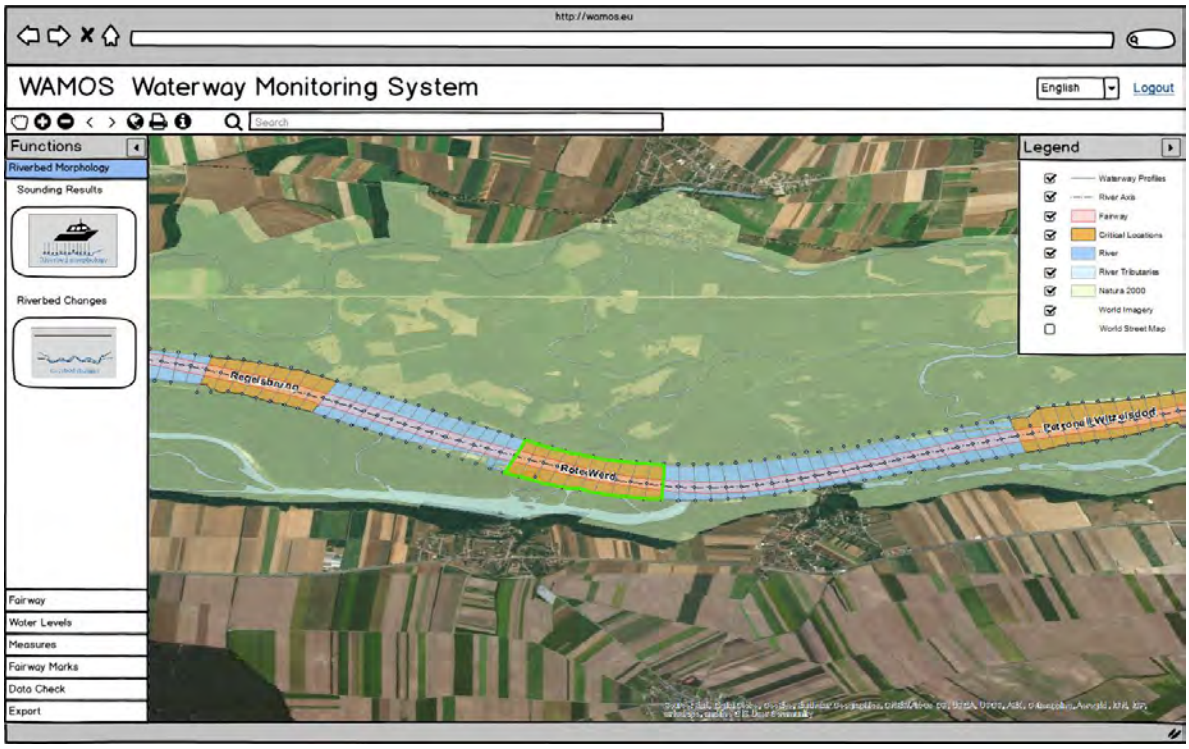


Figure 40: Function Board

When selecting the Sounding Results functions a list with all Bottlenecks, sorted by river-kilometre with the latest survey for this Bottleneck is shown. This list can be sorted by all available fields and it is also possible to change the content,

- to show all surveys sorted by date
- to search one Bottleneck with all surveys

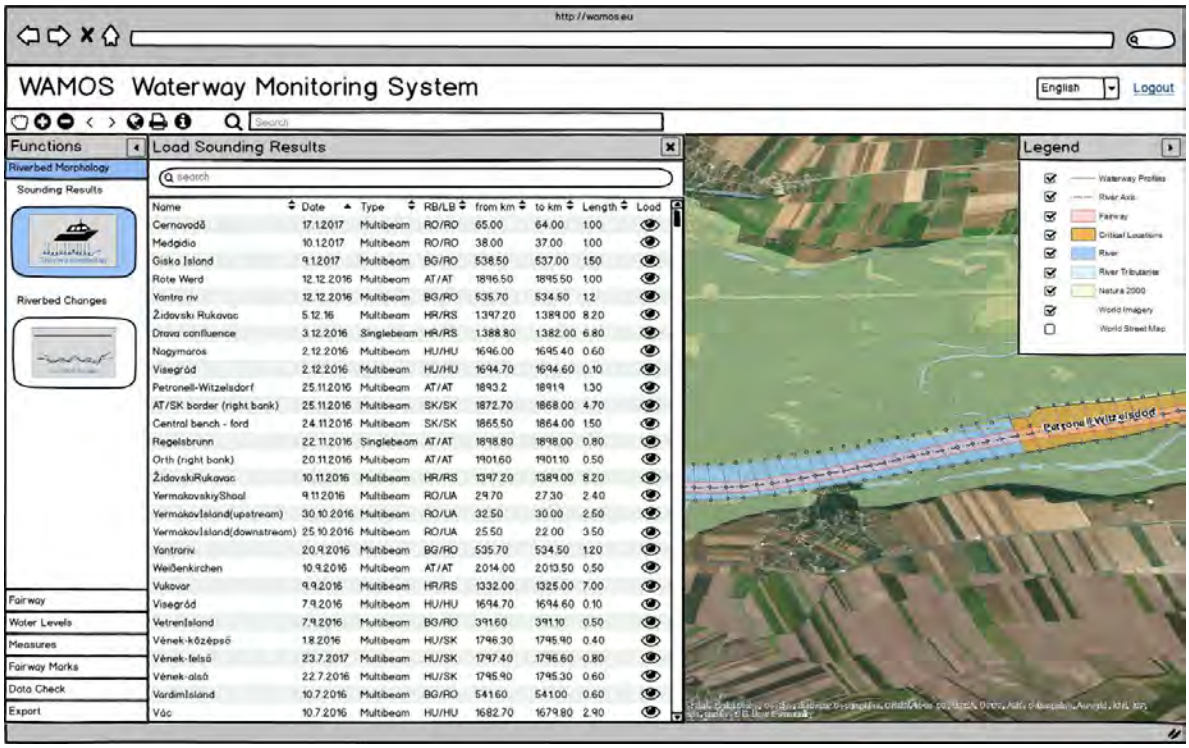


Figure 41: Searching Sounding Result

It can be searched the same way as the general search; the results can be sorted by all displayed fields.

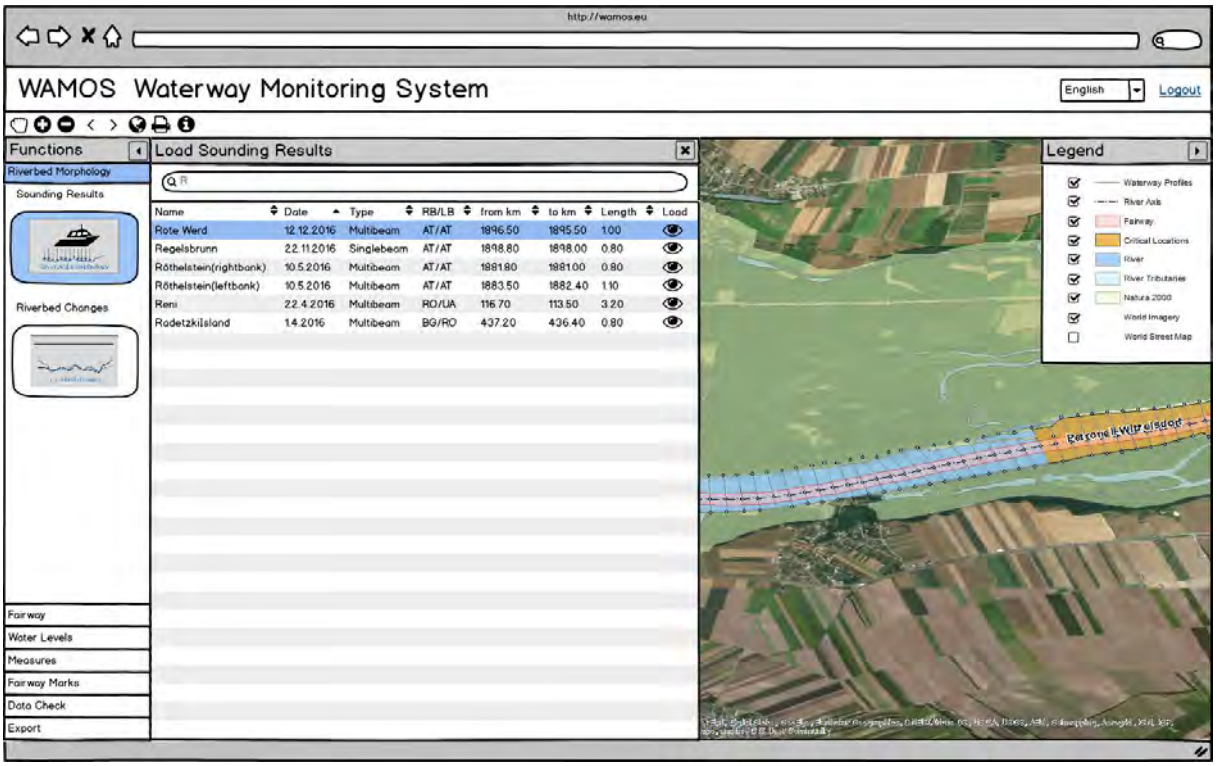


Figure 42: Loading Sounding Result

After selecting a certain sounding result the data is displayed in the map, the legend also changes.

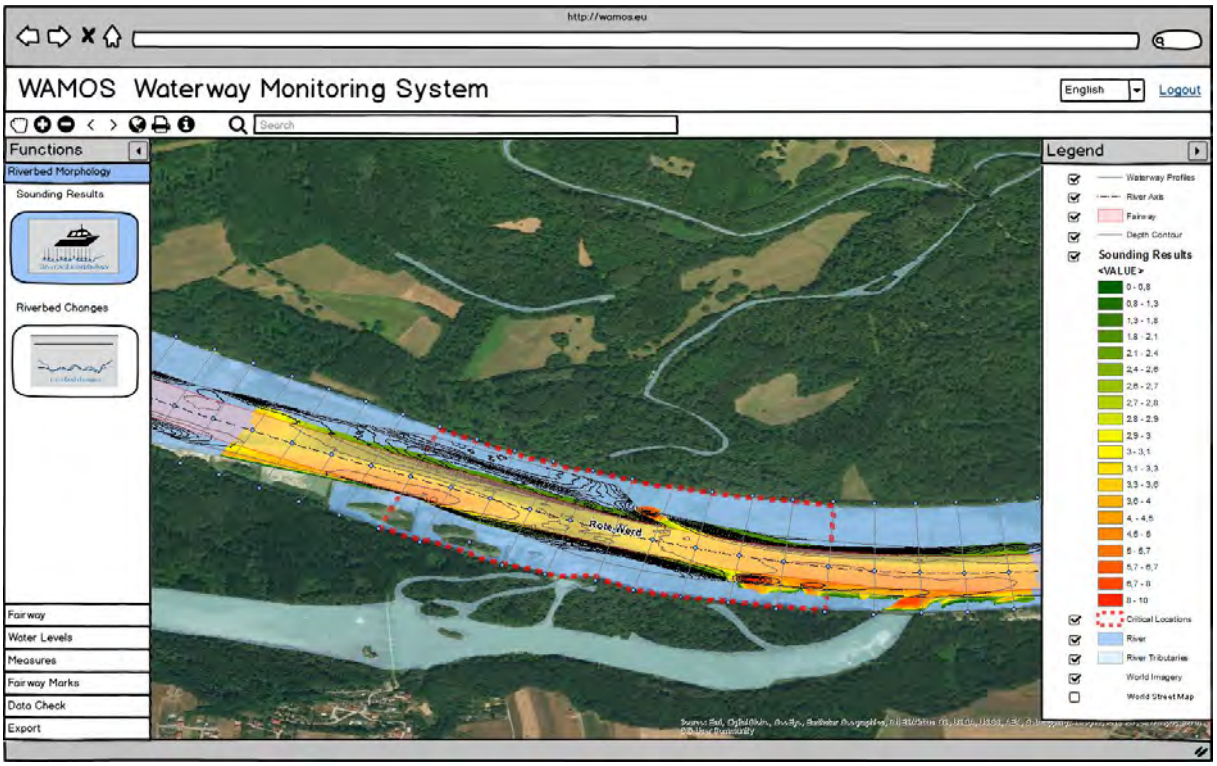


Figure 43: Display Sounding Result

Again, the map content changes depending on the map scale.

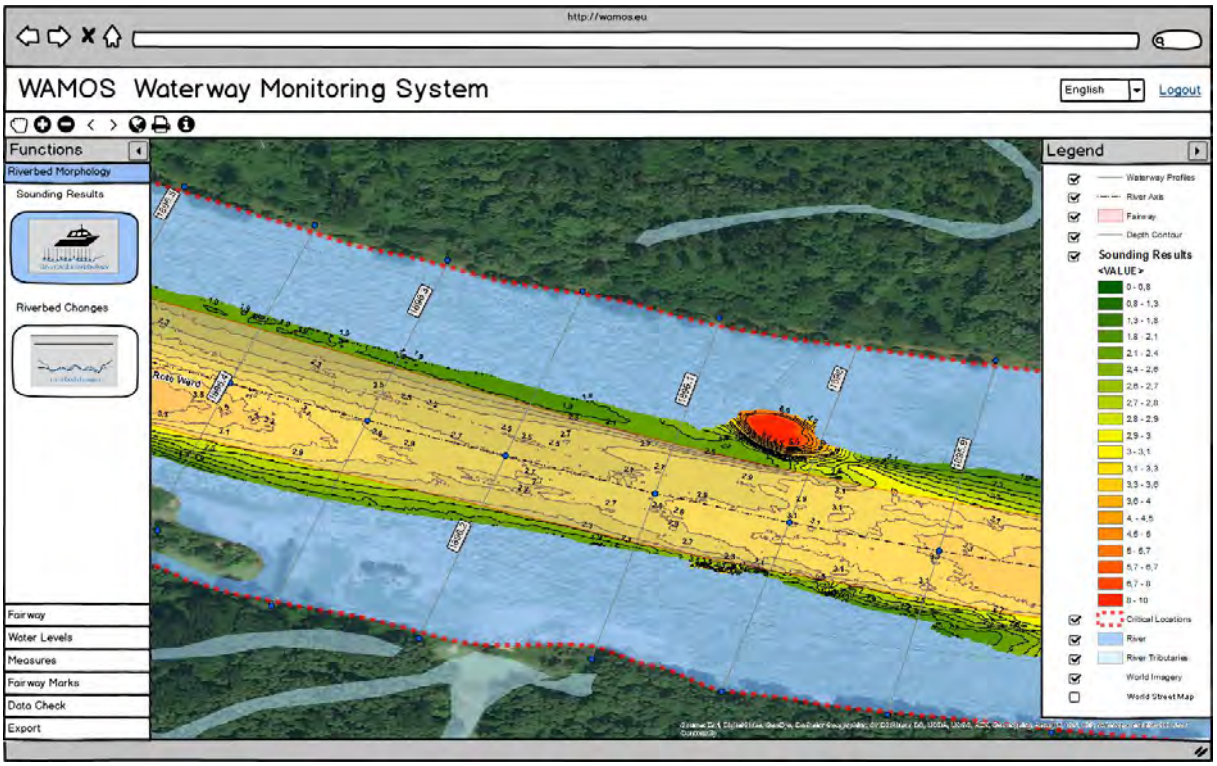


Figure 44: Display Isobaths

3.3.2. External System Interfaces

WAMOS will use existing Interfaces (e.g. NtS, RIS Index, D4D/IENC) provided by already available systems (see Table 2: Referenced Documents). For cartographic purposes this interface relies on OGC standards (WMS and WFS). All non-existing interfaces e.g. the national WAMS applications will be implemented as SOAP Interfaces.

As described in chapter 3.2.9 all WAMOS Interfaces shall be available 24/7 and thus depend on the availability of the external services. For performance reasons, WAMOS Interfaces have a specific response timeout for an interface call. If no response is received within this time limit, all outstanding requests to the external data source are cancelled.

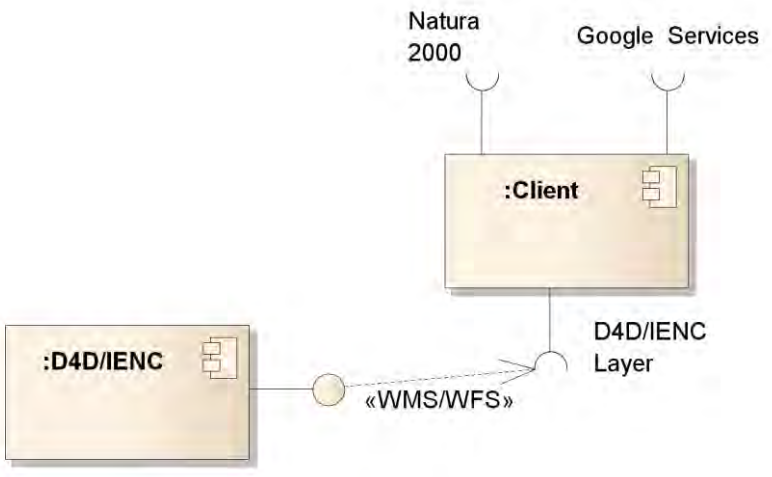
All interface calls must use HTTPS using TLS with a strong encryption. Requests must be transferred using the HTTP POST method. Static files shall be exchanged using the SSH protocol and SFTP requests.

Data transferred via the WAMOS Interface will be switched to production automatically, when all data was imported successfully (transferred and processed). If a critical error occurs during the processing which would result in corrupt datasets, no data will be imported. This means that the defect import must not have an effect on the WAMOS System. Additionally on some dataset imports the WAMOS Waterway Administrator has to check the data manually before publishing it. For this purpose, the datasets are transferred into a staging area (see chapter 3.2.4).

Detailed Interface Requirements

Based on the general considerations and interface requirements all WAMOS Interfaces are now defined in detail.

3.3.2.1. Background Maps

Identity	**IFBM** (Interface Background Maps)
Description	WAMOS will display a Background Map using standard OGC web services (WMS, WMTS and TMS) as defined in the Data Requirement Catalogue chapter 2.1.1. Orthophotos and topographic maps by commercial data providers (Google Maps or equivalent) and other public available sources shall be used (Natura 2000, D4D-Portal).  *Figure 45: Information Flow Background Maps*
Assumptions	Data of external sources are provided by OGC services in the EPSG: 3857 coordinate system. The availability and performance of the services shall fit the requirements of chapter 3.2.6 and 3.2.9
Requires	OGC WFS/WMS for Background Layers
Provides	none
Usage Constraints	The WAMOS background map interface methods will be called user-driven by the WAMOS client.
Operations	The web services will be directly integrated into the web client, therefore no further processing is needed (provided that the service supports the used EPSG: 3857 projection).
Quality	The response time of the OGC services database WMS must correspond to the performance indicators mentioned in chapter 3.2.6.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL (Secure Sockets Layer) certificate to ensure the servers authenticity to other systems.
Import	Pull
Export	none

Request

(The request URL parameters and response data set only serves as an example and might change when the services are in place)

Method	URL	
OGC Service	https://www.d4d-portal.info/geoserver/wms?request=GetCapabilities&service=WMS&version=1.1.0 http://discomap.eea.europa.eu/ArcGIS/rest/services/Bio20 googlemaps	
Type	**Params**	**Values**
GET	OGC WMS/TMS parameters as defined in the OGC Standards	

Response

The file layout is defined by WMS, WMTS or TMS. The content of all requests (files) must match the standard's service definition definded by the Open Geospatial Consortium[21].

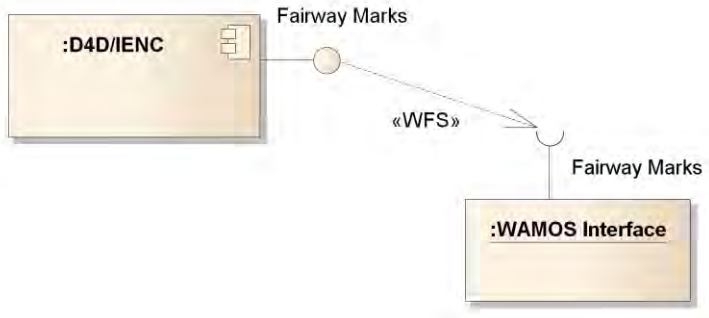
WMS provides the methods "GetCapabilities", "GetMap" and optionally "GetFeatureInfo", "DescribeLayer" and "GetLegendGraphic". To enable search functionality on the external data sets OGC Filters (filter encoding) has to be supported by the service.

Status	Response
200	
400	Not Found
401	Unauthorized
500	Internal Server Error

[20] http://ec.europa.eu/environment/nature/natura2000/access_data/index_en.htm

[21] http://www.opengeospatial.org/docs/is

3.3.2.2. Fairway Marks

Identity	**IFFM** (Interface Fairway Marks)
Description	The WAMOS Fairway Marks interface imports the Fairway Marks of the river Danube. The interface is used by use case [SUC13]. In this case more than one WFS Service is needed to retrieve all needed layers: • BCNISD-Beacon, isolated danger • BCNLAT - Beacon, lateral • bcnlat - Beacon, lateral • BOYCAR - Buoy, cardinal • BOYISD - Buoy, isolated danger • BOYLAT - Buoy, lateral • boylat - Buoy, lateral • BOYSAW - Buoy, safe water • BOYSPP - Buoy, special purpose/general • DAYMAR – Daymark • Daymar - Daymark • LIGHTS- Light • RTPBCN- Radar transponder beacon • TOPMAR- Topmark • Notmark- Notice mark Relevant attributes and attribute values for the Fairway Marks are defined in the in the Inland ENC Encoding Guide Fairway Marks are transferred by accessing a transnational OGC web service (e.g. https://www.d4d-portal.info) publishing current IENC data of all participating countries.  *Figure 46: Information Flow Fairway Marks*
Assumptions	Data is provided by an OGC service in the EPSG: 4326 coordinate system. The web service contains all Fairway Marks encoded in the IENC files.
Requires	OGC WFS web service
Provides	none
Usage Constraints	The update frequency of the data sets depends on the update frequency of the source data behind the OGC Web-Service. To enable performant spatial operations the data shall be persisted in the database. This enables high performance visualisation, spatial operation and processing. The Fairway Marks will be updated and integrated into WAMOS daily.
Operations	The Fairway Marks interface is based on the OGC WFS web service. These service types provide a XML Document describing the feature.

	If an error occurs during the retrieval of data the server shall request the data after a certain interval again. Each Marking-dataset stored in WAMOS is time enabled meaning that every Mark gets a calculated start and end timestamp.
Quality	The response time of the WFS/ WMS must be corresponding to the performance indicators mentioned in chapter 3.2.6.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull
Export	none

(The request URL parameters and response data set only serves as an example and might change slightly when the services are in place)

Request

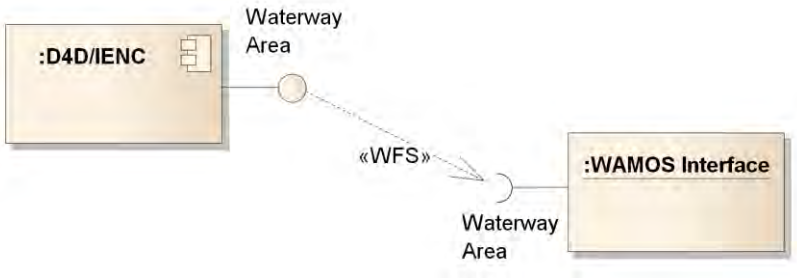
Method	URL
WFS	https://www.d4d-portal.info/geoserver/wms?request=GetCapabilities&service=WFS&version=1.0.0

Response

The OGC interfaces are defined by the Open Geospatial consortium (http://www.opengeospatial.org/docs/is). The format of the data itself is based on the IENC file layout which is defined by the IENC Product Specification. See also the IENC Product Specification in Table 2 Referenced Documents. The dataset is transferred using GML (XML) file layout. The file structure is based on IENC standard.

Status	Response
200	Example for BCNLAT- Beacon, lateral: <wfs:FeatureCollection xsi:schemaLocation="at.d4d https://www.d4d-portal.info:443/geoserver/D4D_AT/wfs?service=WFS&version=1.0.0&request=DescribeFeatureType&typeName=D4D_AT%3AIENC_BCNLAT http://www.opengis.net/wfs https://www.d4d-portal.info:443/geoserver/schemas/wfs/1.0.0/WFS-basic.xsd"> <gml:boundedBy> <gml:null>unknown</gml:null> </gml:boundedBy> <gml:featureMember> <D4D_AT:IENC_BCNLAT fid="IENC_BCNLAT.4864"> <D4D_AT:GEOM> <gml:Point srsName="http://www.opengis.net/gml/srs/epsg.xml#4326"> <gml:coordinates decimal="." cs="," ts=" ">15.2523795,48.2231408</gml:coordinates> </gml:Point> </D4D_AT:GEOM> <D4D_AT:HYDRO_BCNSHP>1</D4D_AT:HYDRO_BCNSHP> <D4D_AT:IENC_CATLAM>12</D4D_AT:IENC_CATLAM> <D4D_AT:HYDRO_SCAMIN>22000</D4D_AT:HYDRO_SCAMIN> </D4D_AT:IENC_BCNLAT> </gml:featureMember> </wfs:FeatureCollection>
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.2.3. Waterway Area

Identity	**IFWA** (Interface Waterway Area)
Description	The WAMOS Waterway Area interface imports the Waterway Area of the river Danube. The interface is used by use case [SUC1]. Relevant attributes and attribute values for the Waterway Area are defined in the Data Requirement Catalogue chapter 2.1.3. Waterway areas are transferred by accessing a transnational OGC web service (e.g. https://www.d4d-portal.info) publishing current IENC data of all participating countries. If wtware is not available SEAARE may be used.  *Figure 47: Information Flow Waterway Area*
Assumptions	Data is provided by an OGC service in the EPSG: 4326 coordinate system. The web service contains all Waterway Areas encoded in the IENC files. If the preferred feature Code 17066 (feature acronym = “wtware”) is in one country not available, the feature Code 119 (feature acronym = “SEAARE”) can be used for this country instead. Only the attributes catccl and dirimp will be stored in WAMOS
Requires	OGC WFS web service
Provides	none
Usage Constraints	The update frequency of the data sets depends on the update frequency of the source data behind the OGC Web-Service. To enable performant spatial operations the data shall be persisted in the database. This enables high performance visualisation, spatial operation and processing. The Waterway Area will be updated and integrated into WAMOS on the first of every month.
Operations	The Waterway Area interface is based on the OGC WFS web service. These service types provide a XML Document describing the feature. The Import always removes the dataset for the whole country with the available dataset. If an error occurs during the retrieval of data the server shall request the data after a certain interval again.
Quality	The response time of the WFS/ WMS must be corresponding to the performance indicators mentioned in chapter 3.2.6.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull
Export	none

(The request URL parameters and response data set only serves as an example and might change when the services are in place)

Request

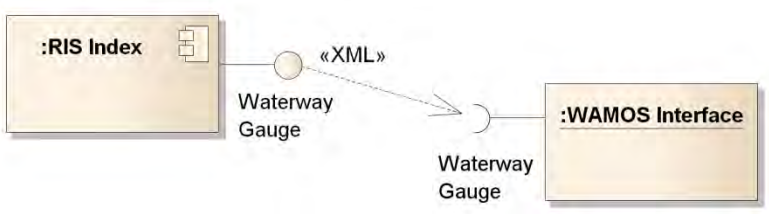
Method	URL
WFS	https://www.d4d-portal.info/geoserver/wms?request=GetCapabilities&service=WFS&version=1.0.0

Response

The OGC interfaces are defined by the Open Geospatial consortium (http://www.opengeospatial.org/docs/is). The format of the data itself is based on the IENC file layout which is defined by the IENC Product Specification. See also the IENC Product Specification in Table 2 Referenced Documents. The dataset is transferred using GML (XML) file layout. The file structure is based on IENC standard.

Status	Response
200	<wfs:FeatureCollection xsi:schemaLocation="at.d4d https://www.d4d-portal.info:443/geoserver/D4D_AT/wfs?service=WFS&version=1.0.0&request=DescribeFeatureType&typeName=D4D_AT%3AIENC_WTWARE http://www.opengis.net/wfs https://www.d4d-portal.info:443/geoserver/schemas/wfs/1.0.0/WFS-basic.xsd"><gml:boundedBy><gml:null>unknown</gml:null></gml:boundedBy><gml:featureMember><D4D_AT:IENC_WTWARE fid="IENC_WTWARE.1423"><D4D_AT:GEOM><gml:Polygon srsName="http://www.opengis.net/gml/srs/epsg.xml#4326"><gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="," ts=" ">16.3689821,48.2592687 16.3693775,48.2593182 16.3693761,48.2593229 16.3693752,48.2593412 16.3693752,48.259362 16.3693784,48.2593808 16.3693853,48.2593959 16.3694003,48.2594175 16.36943,48.2594539 16.3694478,48.2594777 16.3694426,48.2594914 16.3694436,48.259493 16.3694632,48.2594964 16.3694475,48.2595523 16.3694278,48.2595498 16.3694076,48.2596233 16.3693772,48.2597327 16.3693677,48.2597694 16.3693493,48.2598371 16.369324,48.2599318 16.3693074,48.259992 16.3693,48.2600196 16.3692788,48.2600988 16.369278,48.2601028 16.3692775,48.260105 16.3692829,48.2601077 16.3692864,48.2601082 16.3692966,48.2601087 16.3692998,48.2601102 16.3693024,48.2601125 16.3692964,48.2601353 16.3692936,48.2601413 16.3692918,48.2601481 16.3692917,48.2601541 16.3692941,48.2601645 16.3692999,48.2601825 16.3693106,48.2602119 16.3693193,48.2602439 16.3693253,48.2602679 16.3693283,48.260293 16.3693312,48.2603231 16.3693314,48.2603506 16.3693298,48.2603863 16.3693264,48.2604115 16.3693205,48.2604363 16.3693157,48.2604587 16.3693117,48.2604739 16.3692991,48.2605093 16.369285,48.2605375 16.369265,48.260572 16.3692528,48.2605889 16.3692313,48.2606181 16.3692173,48.2606347 16.3692057,48.2606473 16.3691941,48.2606591 16.3691669,48.2606877 16.3691599,48.2606961 16.3691552,48.2607024 16.3691532,48.2607079 16.3691511,48.2607156 16.3691487,48.2607264 16.3691447,48.2607422 16.3691186,48.2608086 16.3690759,48.2609752 16.3690623,48.2610664 16.3690585,48.2610841 16.3690616,48.2610954 16.3690658,48.2611027 16.3690791,48.2611179 16.3691026,48.2611358 16.3691179,48.2611458 16.3691161,48.2611497 16.3691073,48.2611694 16.369073,48.2612809 16.3690665,48.261301 16.3690311,48.261414 16.3690009,48.2614845 16.3690013,48.2615002 16.3690072,48.2615269 16.3690162,48.2615363 16.3690304,48.2615422 16.3690453,48.2615449 16.3690639,48.2615487 16.3690102,48.2615901 16.3679886,48.262482 16.3680036,48.2624409 16.3680609,48.2622371 16.3680747,48.2621782 16.3680885,48.2621348 16.3681159,48.2620239 16.368121,48.2619534 16.3681311,48.261912 16.3681376,48.2618884 16.3681589,48.2617754 16.3681726,48.2616898 16.3681892,48.2616102 16.3682171,48.2615203 16.3682485,48.2614179 16.3682639,48.26135 16.3682616,48.2613006 16.368257,48.2612525 16.3682629,48.2612322 16.3682621,48.2612218 16.3682693,48.2611669 16.368271,48.2611541 16.3682805,48.2610965 16.3682836,48.2610709 16.368286,48.2610532 16.3683288,48.2610395 16.3683423,48.2610341 16.3683489,48.2610307 16.3683634,48.2610207 16.3683705,48.2610137 16.3683792,48.2610021 16.3683859,48.260982 16.3684243,48.2608313 16.3684659,48.2606737 16.3684737,48.2606454 16.368472,48.2606343 16.3684659,48.2606173 16.3684603,48.2606085 16.3684831,48.2605118 16.3684965,48.2604572 16.3685471,48.2602471 16.3685658,48.2601674 16.3685715,48.2601651 16.368583,48.2601584 16.3685948,48.2601482 16.3686061,48.2601339 16.3686391,48.2600828 16.3686443,48.2600715 16.3686507,48.2600465 16.3686528,48.2600382 16.3686642,48.260005 16.3686696,48.2599942 16.3686734,48.2599858 16.3686865,48.2599394 16.3686922,48.2599192 16.3687901,48.2595637 16.3688023,48.2595152 16.3688134,48.259473 16.3687935,48.2594704 16.3688111,48.2594151 16.3688289,48.259418 16.3688335,48.2594021 16.3688805,48.2593777 16.368909,48.2593617 16.3689361,48.2593434 16.3689453,48.2593352 16.3689555,48.259324 16.3689657,48.2593111 16.368971,48.2593032 16.3689821,48.2592687</gml:coordinates></gml:LinearRing></gml:outerBoundaryIs></gml:Polygon></D4D_AT:GEOM><D4D_AT:IENC_CATCCL>11</D4D_AT:IENC_CATCCL><D4D_AT:IENC_DIRIMP>2</D4D_AT:IENC_DIRIMP><D4D_AT:IENC_UNLOCD>AT00025</D4D_AT:IENC_UNLOCD><D4D_AT:HYDRO_SCAMIN>45000</D4D_AT:HYDRO_SCAMIN><D4D_AT:HYDRO_SORDAT>20110314</D4D_AT:HYDRO_SORDAT></D4D_AT:IENC_WTWARE></gml:featureMember></wfs:FeatureCollection>
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.2.4. Waterway Gauge

Identity	**IFWG** (Interface Waterway Gauge)
Description	The WAMOS Waterway Gauge interface exchanges data of waterway gauges as defined in the Data Requirement Catalogue chapter 2.1.4. This interface is based on the RIS Index Encoding Guide and is used by use case [SUC6].  *Figure 48: Information Flow Waterway Gauge*
Assumptions	RIS Index contains all waterway gauges. RIS Index objects obtained by the European Reference Data Management System (ERDMS) have to be filtered to objects relevant for WAMOS (e.g. filtering all gauges by function code "wtwgag" The Web Service (API) interface functions of the so-called RIS Data Management Service (RDMS) can be used (as defined in Platina RIS-API).
Requires	RIS Index Interface (ERDMS)
Provides	none
Usage Constraints	Waterway gauges from ERDMS must be filtered to elements monitored with WAMOS. Therefore Waterway Gauges from RIS Index need to be filtered only to those relevant for WAMOS. This can be achieved by either a spatial selection or a directly defining the ISRS Location Code of the relevant gauges.
Operations	The data set is transferred as defined by the SOAP interface containing all Waterway Gauges. Each Waterway Gauge is identified uniquely by the ISRS Location Code which is a 20 digit alphanumerical code defined in the RIS Index Encoding Guide. The data is processed depending on the ISRS Location Code and the start date, end date and last modified date. Depending on these attributes the Waterway Gauge is updated or created. All existing WAMOS Waterway Gauges which are not in the data set or have an expired end date will be deleted (historicized) after a successful import of the current data set. Thus the ERDMS master dump service always needs to contain a complete list of all Waterway Gauges from the area of interest.
Quality	The WAMOS interface must import all Waterway Gauges in less than one minute. The EVRF2007 shall be the preferred vertical coordinate system for defining gauge zero.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull (interval as configured/manually, per default quarterly)
Export	none

Request

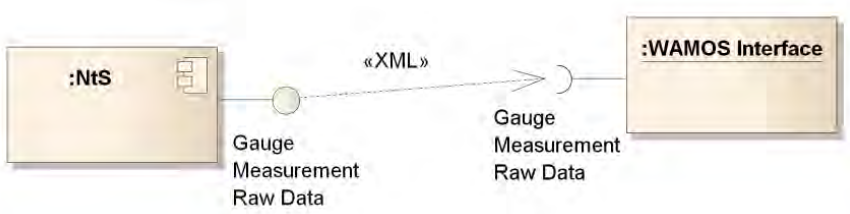
Method	Sample
WSDL	Web service XSD file in document Platina RIS-API (Annex\References\RIS Index\2011-0415 PLATINA RISDataManagement Service API Interface Final 20110728....doc)

Methods	getRisDataXML

Response

Status	Response
200	getRisDataXMLResponse as defined in the Platina RIS-API
404	Not Found
500	Internal Server Error

3.3.2.5. Waterway Gauge Measurements Raw Data

Identity	**IFWGMRD** (Interface Waterway Gauge Measurement Raw Data)
Description	The WAMOS Waterway Gauge Measurement Raw Data interface exchanges real and predicted measurements of waterway gauges as defined in the Data Requirement Catalogue chapter 2.1.5. This interface is based on the NtS interface. The interface is used by use case [SUC5].  *Figure 49: Information Flow Raw Data*
Assumptions	All attributes, the attribute definition and possible values are based on the Notices to Skippers specification (see NtS). All values which are not in the allowed value range must raise an error. NtS contains all Gauges Measurements relevant for WAMOS. WAMOS can use a transnational NtS containing the gauge measurements for all national authorities if available (e.g. RIS COMEX). Precondition: NtS objects from a national authority (e.g. https://nts.doris.bmvit.gv.at) can be filtered to a certain waterway gauge filtered by its geo_object.id (i.e. the ISRS Location Code in RIS Index) only relevant for a specific gauge measurement interface of WAMOS.
Requires	NtS interface
Provides	none
Usage Constraints	All Waterway Raw Gauge Measurements are retrieved by individual requests using ISRS Location Code.
Operations	Every Gauge Measurement references a Waterway Gauge using the field "id" of the element "geo_object". This mandatory id is a unique identifier of a waterway gauge, as defined in the RIS Index Encoding Guide as the ISRS Location Code which is a 20 digit alphanumerical code. The data is received as POST body of a service request. The data is processed depending on the ISRS Location Code and the validity period: Each Gauge Measurement creates a new record set in the database.
Quality	The interface must be able to import one Gauge Measurement (real and predicted measurements) of one waterway gauge in less than 5 seconds.
Security	Connections to NtS will be secured via HTTPS using TLS. Additionally the NtS certificate is checked (used for a certificate pinning) to ensure that WAMOS gets the data from a certain national system.
Import	Pull (interval as provided, the default is 15 minutes)
Export	none

Request

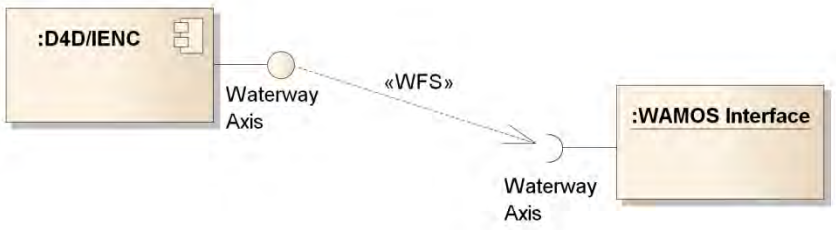
Method	Sample
WSDL	Annex\References\NtS\NtS-MS_v2-0-4-0.wsdl

Response

For Raw (real and predicted) measurements the XML file layout is defined by the XML Schema of NtS (WRM). See also NtS in Table 2 Referenced Documents. The content of all files must match this schema.

Status	Response
200	<?xml version="1.0" ?> <S:Envelope xmlns:S="http://schemas.xmlsoap.org/soap/envelope/"> <S:Body> <ns2:get_messages_result xmlns="http://www.ris.eu/nts/4.0.4.0" xmlns:ns2="http://www.ris.eu/nts.ms/2.0.4.0"> <ns2:result_message> <identification> <from>via donau</from> <originator>via donau</originator> <country_code>AT</country_code> <language_code>DE</language_code> <date_issue>2017-06-02T06:05:04+02:00</date_issue> </identification> <wrm> <validity_period> <date_start>2017-06-02+02:00</date_start> <date_end>2017-06-02+02:00</date_end> </validity_period> <geo_object> <id>ATFRB00001G000122231</id> <name>Achleiten</name> <type_code>GAU</type_code> <coordinate> <lat>48 34.9140 N</lat> <long>13 030.1920 E</long> </coordinate> <fairway_name>Donau</fairway_name> </geo_object> <reference_code>ZPG</reference_code> <measure> <predicted>false</predicted> <measure_code>WAL</measure_code> <value>324.0</value> <unit>cm</unit> <measuredate>2017-06-02T05:45:00+02:00</measuredate> <difference> <value_difference>3.0</value_difference> <time_difference>PT23H59M</time_difference> </difference> </measure> </wrm> </ns2:result_message> <ns2:paging_result> <ns2:count>1</ns2:count> </ns2:paging_result> </ns2:get_messages_result> </S:Body> </S:Envelope>
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.2.6. Waterway Axis

Identity	**IFWA** (Interface Waterway Axis)
Description	The WAMOS Waterway Axis interface exchanges the centreline of the waterway of the river Danube. The interface is used by use case [SUC3]. Relevant attributes and attribute values for the Waterway Axis are defined in the Data Requirement Catalogue chapter 2.1.6. Waterway Axis is transferred by accessing a transnational OGC web service (e.g. https://www.d4d-portal.info) publishing current IENC data of all participating countries.  *Figure 50: Information Flow Waterway Axis*
Assumptions	The data is provided by an OGC service in the EPSG: 4326 coordinate system. The web service contains all Waterway Axis encoded in the IENC files.
Requires	OGC WFS web service
Provides	none
Usage Constraints	The update frequency depends on the update frequency of the source data behind the OGC Web-Service. To enable performant spatial operations the data shall be persisted in the database. This would enable high performance visualisation, spatial operation and processing. The Waterway Axis will be updated and integrated into WAMOS on the first of every month.
Operations	The Waterway Axis interface is based on the OGC WFS web service. These service types provide either a XML document describing the feature. If an error occurs during the retrieval of data the server shall request the data after a certain interval again.
Quality Attributes	The response time of the WFS must be corresponding to the performance indicators mentioned in chapter 3.2.6.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull
Export	none

(The request URL parameters and response data set only serves as an example and might change when the services are in place)

Request

Method	URL
WFS	https://www.d4d-portal.info/geoserver/wms?request=GetCapabilities&service=WFS&version=1.0.0

Response

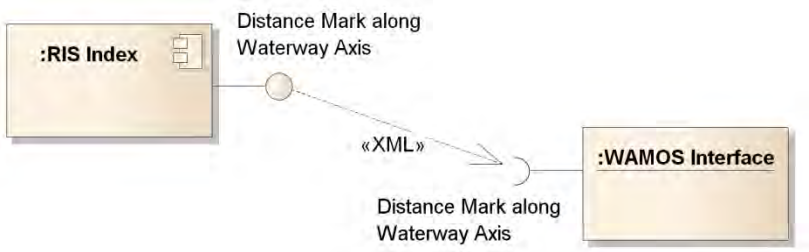
The OGC interfaces are defined by the Open Geospatial consortium (http://www.opengeospatial.org/docs/is). The format of the data itself is based on the IENC file layout which is defined by the IENC Product Specification. See also the IENC Product Specification in Table 2 Referenced Documents. The dataset is transferred using GML (XML) file layout. The file structure is based on IENC standard.

Status	Response
200	<?xml version="1.0" encoding="UTF-8"?> <wfs:FeatureCollection xsi:schemaLocation="at.d4d https://www.d4d-portal.info:443/geoserver/D4D_AT/wfs?service=WFS&version=1.0.0&request=DescribeFeatureType&typeName=D4D_AT%3AIENC_WTWAXS http://www.opengis.net/wfs https://www.d4d-portal.info:443/geoserver/schemas/wfs/1.0.0/WFS-basic.xsd"> <script/> <gml:boundedBy> <gml:null>unknown</gml:null> </gml:boundedBy> <gml:featureMember> <D4D_AT:IENC_WTWAXS fid="IENC_WTWAXS.1476"> <D4D_AT:GEOM> <gml:LineString srsName="http://www.opengis.net/gml/srs/epsg.xml#4326"> <gml:coordinates decimal="." cs="," ts=" ">16.508107,48.160586 16.5073765,48.1597871 16.5054924,48.1601912 16.5046434,48.1603736 16.5036169,48.1605883 16.5024971,48.160711 16.5009806,48.160665 16.4939817,48.1599442</gml:coordinates> </gml:LineString> </D4D_AT:GEOM> <D4D_AT:HYDRO_OBJNAM>port Albern</D4D_AT:HYDRO_OBJNAM> <D4D_AT:HYDRO_NOBJNM>Hafen Albern</D4D_AT:HYDRO_NOBJNM> <D4D_AT:HYDRO_SCAMIN>22000</D4D_AT:HYDRO_SCAMIN> </D4D_AT:IENC_WTWAXS> </gml:featureMember> <gml:featureMember> <D4D_AT:IENC_WTWAXS fid="IENC_WTWAXS.1477"> <D4D_AT:GEOM> <gml:LineString srsName="http://www.opengis.net/gml/srs/epsg.xml#4326"> <gml:coordinates decimal="." cs="," ts=" ">16.4905895,48.1693419 16.490103,48.169582 16.489452,48.169888 16.489451,48.169888 16.488872,48.170158 16.488344,48.17041 16.4873944,48.1708734 16.487255,48.170941 16.487254,48.170941 16.486716,48.171212 16.486161,48.171488 16.485591,48.171771 16.48507,48.17204 16.484003,48.172608 16.48345,48.172914 16.48295,48.173191 16.482949,48.173191 16.482433,48.173501 16.48195,48.173805 16.481437,48.174147 16.480987,48.174448 16.480021,48.175084 16.480016,48.175087 16.47907,48.175721 16.478105,48.176367 16.477139,48.177014 16.476177,48.177659 16.475216,48.178303 16.474279,48.178961 16.473378,48.179642 16.472494,48.180337 16.472493,48.180338 16.471616,48.181045 16.470776,48.181759 16.470772,48.181762 16.469937,48.182466 16.469936,48.182467 16.469107,48.183179 16.468296,48.183903 16.467489,48.184633 16.467063,48.185008 16.466654,48.18534 16.466268,48.185652 16.465788,48.186027 16.465389,48.186325 16.464893,48.186692 16.464443,48.187013 16.46397,48.18734 16.463028,48.187974 16.463027,48.187974 16.462089,48.188612 16.461138,48.189251 16.460186,48.189893 16.459238,48.190537 16.459237,48.190537 16.4583953,48.1911091 16.458291,48.19118 16.457344,48.191825 16.45733,48.191834 16.456858,48.1921584 16.456402,48.192472 16.455462,48.193119 16.455461,48.19312 16.454512,48.193763 16.454511,48.193764 16.453571,48.194414 16.452636,48.195064 16.452635,48.195065 16.451692,48.195711 16.450787,48.196333 16.449811,48.197005 16.44981,48.197005 16.448868,48.19765 16.447928,48.198296 16.447927,48.198297 16.446983,48.198943 16.44603,48.199581 16.445069,48.200211 16.445068,48.200212 16.444522,48.20057 16.444095,48.200835 16.4440934,48.2008364 16.4440591,48.2008577 16.4435231,48.2011913 16.4434126,48.2012593 16.443106,48.201448 16.443105,48.201449 16.4428474,48.2016295 16.442396,48.20189 16.442116,48.202054 16.442115,48.202054 16.441592,48.202359 16.441095,48.202651 16.441094,48.202652 16.44008,48.203248 16.440079,48.203249 16.439059,48.20384 16.439058,48.20384 16.438031,48.204434 16.43803,48.204435 16.437005,48.205029 16.436464,48.205342 16.436033,48.205592 16.435984,48.205625 16.4355271,48.2059888 16.4351312,48.2062985 16.4351101,48.206319 16.434294,48.207051 16.433703,48.20763 16.433486,48.207779 16.433105,48.20804 16.432537,48.20841 16.432535,48.208411 16.4320815,48.2087376 16.431623,48.209068 16.430707,48.209717 16.430706,48.209718 16.429799,48.210377 16.428914,48.211048 16.428913,48.211049 16.428034,48.21173 16.42716,48.2124 16.427159,48.212401 16.426691,48.212755 16.426263,48.213069 16.425781,48.213421 16.425346,48.213732 16.424428,48.214389 16.424427,48.21439 16.423461,48.215084 16.422571,48.215728 16.421665,48.216389 16.420722,48.21707 16.419794,48.217743 16.419793,48.217744

16.418857,48.218421 16.418856,48.218422 16.417944,48.219084 16.417943,48.219085
16.417019,48.219767 16.417018,48.219768 16.41611,48.220453 16.416109,48.220454
16.415193,48.221135 16.414318,48.221787 16.413448,48.222445 16.412571,48.223105
16.412193,48.223391 16.411668,48.223777 16.411667,48.223778 16.41118,48.22413
16.4107758,48.2244528 16.4098729,48.22515 16.4091109,48.225739 16.4090613,48.225777
16.408249,48.226413 16.408248,48.226414 16.407403,48.227105 16.407402,48.227106
16.406535,48.227828 16.4059951,48.2282902 16.40568,48.228527 16.405374,48.228771
16.4052531,48.2288646 16.404814,48.229205 16.404813,48.229205 16.403956,48.229893
16.403953,48.229895 16.403093,48.230583 16.402224,48.231273 16.402223,48.231274
16.401363,48.231956 16.400475,48.232648 16.400471,48.232651 16.399598,48.233331
16.399597,48.233332 16.39871,48.234024 16.398709,48.234025 16.39829,48.23436
16.3978555,48.2347146</gml:coordinates>
</gml:LineString>
</D4D_AT:GEOM>
<D4D_AT:HYDRO_OBJNAM>Donau</D4D_AT:HYDRO_OBJNAM>
<D4D_AT:HYDRO_SCAMIN>22000</D4D_AT:HYDRO_SCAMIN>
</D4D_AT:IENC_WTWAXS>
</gml:featureMember>
</wfs:FeatureCollection>

Type	Params	Values
GET	OGC WFS parameters as defined in the OGC Standards	

3.3.2.7. Distance Marks along Waterway Axis

Identity	**IFCDM** (Interface Distance Marks along Waterway Axis)
Description	The WAMOS Distance Marks along Waterway Axis Interface exchanges data of distance marks as defined in the Data Requirement Catalogue chapter 2.1.7. This interface is based on the RIS Index Encoding Guide and is used by the use case [SUC7].  *Figure 51: Information Flow Distance Marks along Waterway Axis*
Assumptions	RIS Index contains all Distance Marks along Waterway Axis. RIS Index objects from European Reference Data Management System (ERDMS) can be filtered to objects only relevant for WAMOS. The Web Service (API) interface functions of the so-called RIS Data Management Service (RDMS) can be used (as defined in Platina RIS-API).
Requires	RIS Index Interface
Provides	none
Usage Constraints	Distance Marks along Waterway Axis from ERDMS must be filtered to elements monitored with WAMOS. Therefore distance marks from RIS Index need to be filtered only to those relevant for WAMOS.
Operations	The data set is transferred as defined by the Platina RIS-API SOAP interface containing all Distance Marks along Waterway Axis. Each mark is identified uniquely by the ISRS Location Code which is a 20 digit alphanumerical code defined in the RIS Index Encoding Guide. The data is processed depending on the ISRS Location Code; each distance mark is updated or created. All existing WAMOS Distance Marks which are not in the dataset will be deleted after a successful import of the current data set. Thus the ERDMS master dump service always needs to contain a complete list of all distance marks from the area of interest.

Quality Attributes	The WAMOS interface must import all Distance Marks in less than 60 seconds.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull
Export	none

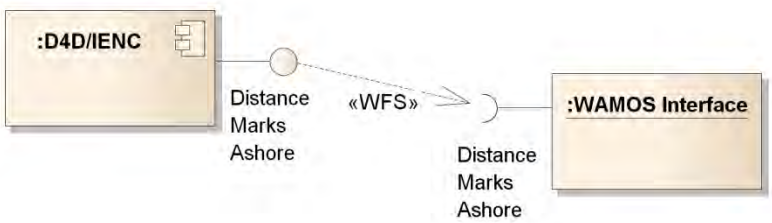
Request

Method	Sample
WSDL	Web service XSD file in document Platina RIS-API (Annex\References\RIS Index\2011-0415 PLATINA RISDataManagement Service API Interface Final 20110728....doc)
Methods	getRisDataXML

Response

Status	Response
200	getRisDataXMLResponse as defined in the Platina RIS-API
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.2.8. Distance Marks Ashore

Identity	**IFDMA** (Interface Distance Marks Ashore)
Description	The WAMOS Distance Marks Ashore Interface exchanges the hectometre points positioned every 100 meters on the left and right riverside of the entire river Danube. The interface is used by use case [SUC7]. Relevant attributes and attribute values for the distance marks are defined in the Data Requirement Catalogue chapter 2.1.7. Distance Marks Ashore are transferred by accessing a transnational OGC web service (e.g. https://www.d4d-portal.info) publishing current IENC data of all participating countries.  *Figure 52: Information Flow Distance Marks Ashore*
Assumptions	The data is provided by an OGC service in the EPSG: 4326 coordinate system. The web service contains all Distance Marks encoded in the IENC files.
Requires	OGC WFS/WMS web service
Provides	none
Usage Constraints	The update frequency depends on the update frequency of the source data behind the OGC Web-Service. If spatial operations are required the data set can be persisted in the database as well. This would enable high performance visualisation, spatial operation and processing.
Operations	The distance marks interface is based on the OGC WFS/WMS web service. These service types provide a XML Document describing the feature. The Distance Marks Ashore will be used for searching in the map or as background information, therefore the features or tiles will be called on demand. If an error occurs, the client has to request the data again.
Quality Attributes	The response time of the WFS/ WMS must correspond to the performance indicators mentioned in chapter 3.2.6.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull
Export	none

(The request URL parameters and response data set only serves as an example and might change when the services are in place)

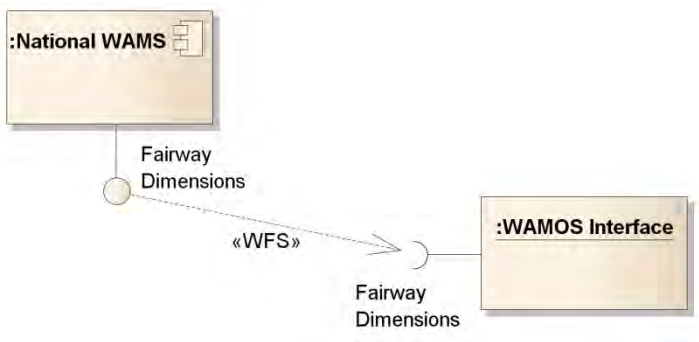
Request

Method	**URL**	
WFS	https://www.d4d-portal.info/geoserver/wms?request=GetCapabilities&service=WFS&version=1.0.0	
Type	**Params**	**Values**
GET	OGC WFS parameters as defined in the OGC Standards	

Response

Status	Response
200	<wfs:FeatureCollection xsi:schemaLocation="at.d4d https://www.d4d-portal.info:443/geoserver/D4D_AT/wfs?service=WFS&version=1.0.0&request=DescribeFeatureType&typeName=D4D_AT%3AIENC_DISMAR http://www.opengis.net/wfs https://www.d4d-portal.info:443/geoserver/schemas/wfs/1.0.0/WFS-basic.xsd"> <script/> <gml:boundedBy> <gml:null>unknown</gml:null> </gml:boundedBy> <gml:featureMember> <D4D_AT:IENC_DISMAR fid="IENC_DISMAR.244501"> <D4D_AT:GEOM> <gml:Point srsName="http://www.opengis.net/gml/srs/epsg.xml#4326"> <gml:coordinates decimal="." cs="," ts=" ">16.995213,48.16086</gml:coordinates> </gml:Point> </D4D_AT:GEOM> <D4D_AT:HYDRO_CATDIS>1</D4D_AT:HYDRO_CATDIS> <D4D_AT:IENC_HUNITS>3</D4D_AT:IENC_HUNITS> <D4D_AT:IENC_UNLOCD>ATXXX000010000018782</D4D_AT:IENC_UNLOCD> <D4D_AT:IENC_WTWDIS>1878.2</D4D_AT:IENC_WTWDIS> <D4D_AT:HYDRO_SCAMIN>22000</D4D_AT:HYDRO_SCAMIN> </D4D_AT:IENC_DISMAR> </gml:featureMember> </wfs:FeatureCollection>
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.2.9. Fairway Dimensions

Identity	**IFF** (Interface Fairway Dimensions)
Description	The WAMOS Fairway Dimensions interface exchanges the Fairway Dimensions as defined in the Data Requirement Catalogue chapter 3.2.2. The interface is used by use case [SUC2]. Fairway Dimensions are transferred by accessing a national OGC web service (from WAMS) which publishes a geometric representation of the navigable channel and provides this feature with a Level of Service (LOS).  *Figure 53: Information Flow Fairway Dimensions*
Assumptions	Data is provided by OGC services in the EPSG: 4326 coordinate system. The availability and performance of the services fit the requirements of chapter 3.2.6 and 3.2.9
Requires	OGC WFS/WMS web service
Provides	none
Usage Constraints	When importing Fairway Dimensions features, all previous features of that country must be historicised.

Operations	The Fairway Dimensions Interface is based on the OGC WFS web service. These service types provide a XML Document describing the feature.
Quality Attributes	The response time of the Fairway Dimensions WFS/ WMS must be corresponding to the performance indicators mentioned in chapter 3.2.6.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull
Export	none

Request

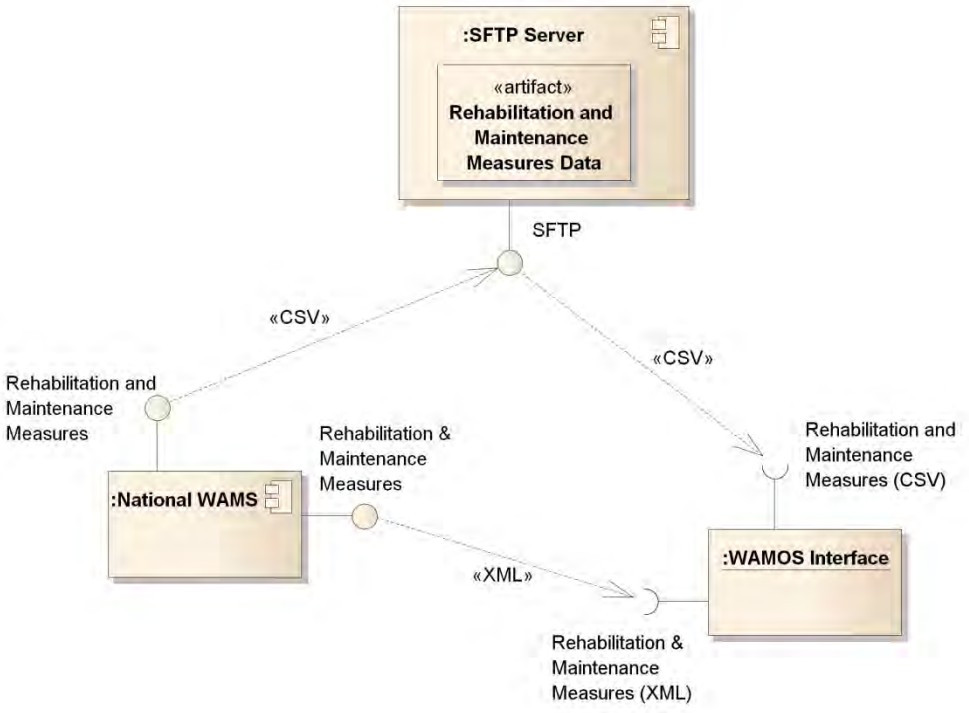
The data layout is defined by WFS. The content of all requests (files) must match the standard's service definition.

Method	**URL**	
GET	http://<server>?service=WFS&version=1.0.0&request=GetFeature&typeName=WAMOS:FAIRWAYDIMENSIO	
Type	**Params**	**Values**
GET	token	string
GET	OGC WFS parameters as defined in the OGC Standards	

Response

Status	**Response**
200	<wfs:FeatureCollection xsi:schemaLocation="http://www.opengis.net/wfs http:// viadonau.org/geoserver/schemas/wfs/1.0.0/measures.xsd http://viadonau.org/geoserver/wamoswfs?service=WFS&version=1.0.0&request=Describe FeatureType&typeName=wamos%3Afairway_dimensions"> <gml:boundedBy> <gml:null>unknown</gml:null> </gml:boundedBy> <gml:featureMember> <wamos:fairway_dimensions fid="fairway_dimensions .32974563"> <wamos:service_level>0</wamos:service_level> <wamos:min_width>1</wamos:width> <wamos:max_width>1</wamos:width> <wamos:depth>0</wamos:depth> <wamos:Date_Info>0</wamos:Date_Info> <wamos:Source>0</wamos:Source> <wamos:shape> <gml:Point srsName="http://www.opengis.net/gml/srs/epsg.xml#3857"> <gml:coordinates decimal="." cs="," ts=" ">500260.87889776,5586032.094103</gml:coordinates> </gml:Point> </wamos:shape> </wamos:fairway_dimensions> </gml:featureMember> </wfs:FeatureCollection>
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.2.10. Rehabilitation and Maintenance Measures

Identity	**IFRMM** (Interface Rehabilitation and Maintenance Measures)
Description	The WAMOS Rehabilitation and Maintenance Measures interface exchanges the measures as defined in the Data Requirement Catalogue chapter 3.2.5. The interface is used by use case [SUC12]. Rehabilitation and Maintenance Measures are transferred in two 2ways: By SOAP request as XML response or - in case the National WAMS is not yet available - via CSV download which publishes current data of dredging, surveying and river engineering measures.  *Figure 54: Information Flow Rehabilitation and Maintenance Measures*
Assumptions	The XML-response contains all – for WAMOS relevant - referenced data. In case of a CSV download th data exchange shall use an SFTP server using a predefined well known folder structure and data format.
Requires	CSV-File with approved data uploaded to the defined directory of the SFTP server XML – SOAP interface
Provides	none
Usage Constraints	When importing Rehabilitation and Maintenance Measures new features are created and existing ones are updated.
Operations	Version 1 Data shall be received from an SFTP Server Version 2 Data shall be received from a SOAP service.
Quality Attributes	The interface must be able to import all Rehabilitation and Maintenance Measures of the National Waterway Authority in less than 30 minutes.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull (from SFTP) Pull (via SOAP)

Export	none

Request_1

Method	Sample
SFTP- URL	<WAMOS_SFTP_Server>/ IFRMM /<CountryCode>/<YYYY><MM><DD>_ Measures. csv ftp://wamos/ IFRMM /AT/20170525_Measures.csv
File Format	as defined in the interface example Annex\System_Interfaces\20170525_ Measures.csv

Request_2

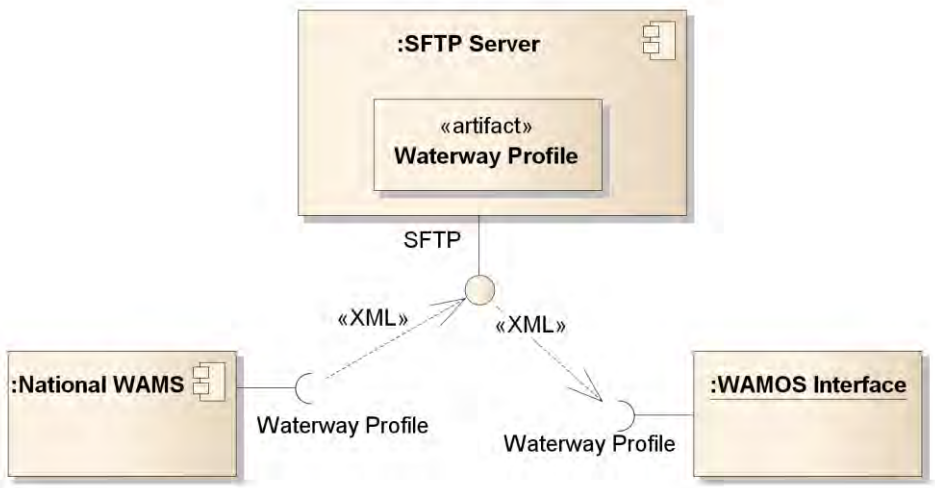
Method	Sample
WSDL	Annex\System_Interfaces\WAMOS_WSDL\IFRMM\ IFRMM.wsdl
Methods	sendMeasuresXML

Response_2

The data layout is defined by WFS. The content of all requests (files) must match the standard's service definition.

Status	Response
200	IFRMM_response.xml
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.2.11.Waterway Profile

Identity	**IFWP** (Interface Waterway Profile) (optional)
Description	The WAMOS Waterway Profile interface exchanges profiles as defined in the Data Requirement Catalogue chapter 2.2.6.. The interface is used by use case [SUC14]. The Watereay Profiles can be manually transferred as XML-file.  *Figure 55: Information Flow Waterway Profile*
Assumptions	The XML-File contains all – WAMOS relevant – Waterway Profiles. Data exchange shall use an SFTP server using a predefined well known folder structure and data format.
Requires	XML-File with Waterway Profiles uploaded to the defined directory of the SFTP server
Provides	none
Usage Constraints	When importing Waterway Profiles, all previous measurements must be historicised.
Operations	Data shall be received from a static online accessible source (SFTP Server). The data is processed depending on the ISRS Location Code and the validity period: Each Waterway Profile updates a record set in the database. All values which are not in the allowed value range must raise a warning.
Quality Attributes	The interface must be able to import all Waterway Profiles of the National Waterway Authority in less than 30 minutes.
Security	Connections to the interface require authentication using username and password. WAMOS serves its interfaces via SSH using TLS. So all interface calls will be encrypted. The WAMOS server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull (from SFTP)
Export	none

Request

Method	Sample
SFTP- URL	<WAMOS_SFTP_Server>/ **IFWP** /<CountryCode>/<YYYY><MM><DD>_profiles.XML ftp://wamos/ **IFWP** /AT/20170525_profiles.csv
File Format	as defined in the interface example Annex\System_Interfaces\20170525_profiles.csv

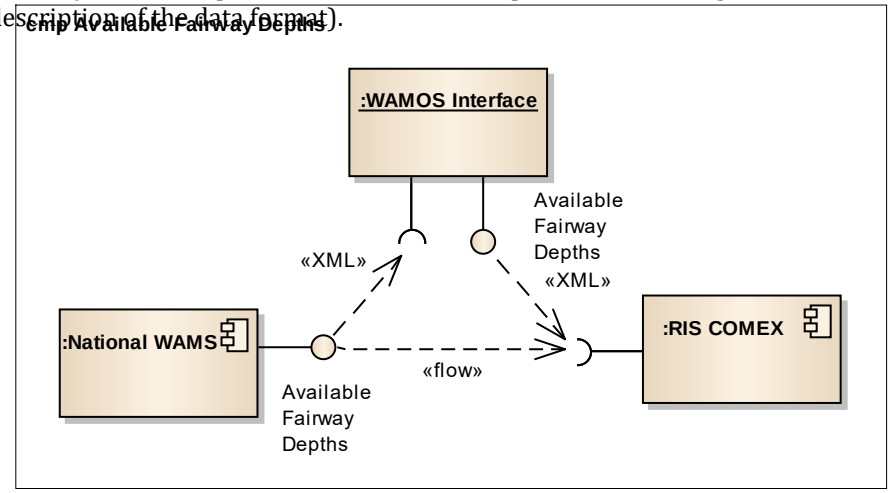
CSV Format Approved Measurements

For Waterway Profiles the XML format contains….

Status	Response
200	upload completed
430	Invalid username or password
434	Requested host unavailable.
530	Not logged in.

3.3.3. Internal System Interfaces

3.3.3.1. Available Fairway Depths

Identity	**IFAF** (Interface Available Fairway Depths)
Description	The WAMOS Available Fairway Depths import interface integrates the Available Fairway Depths determined by the national authorities in the WAMOS System. The export interface provides the current availability for each critical section to external systems. The information of Available Fairway Depth describes the Level Of Service of a particular Bottleneck as well as the current depth and width for this service levels. The interface is used by the use case [SUC11] for importing manually defined values (see also chapter 3.2.1. of the Data Requirements Catalogue for a detailed description of the data format).  *Figure 56: Information flow Available Fairway Depths*
Assumptions	All values concerning water depths are based on gauge zero of the reference gauge. All attributes, the attribute definition and possible values are based on the Data Requirement Document format. All values which are not in the allowed value range shall raise an error.
Requires	The national WAMS applications will implement a “Available Fairway Depths” Interface
Provides	XML- SOAP interface
Usage Constraints	The Available Fairway Depths will be published by the Waterway Authorities once per day stating the availability of the previous day. This data is updated using the import method of the interface. The current Available Fairway Depths must be provided using the semiautomatic calculation method. As the relevant measures of a bottleneck will only change, if waterway gauge measurements are updated, which is currently planned every 15 minutes, a change in availability can only be expected in this timeframe. The export contains the Available Fairway Depths of all bottlenecks, and it is possible to filter the bottleneck or waterway gauge by id.
Operations	In general the manual import takes place every day, publishing the availability of the day before. Manually calculated availability will replace the semi-automatic calculations created by WAMOS. If no manual calculation is available WAMOS will calculate the availability depending on the available data.
Quality	The WAMOS interface must provide all current Available Fairway Depths information in less than 10 seconds. The WAMOS interface must import Available Fairway Depths information of one waterway authority in less than 5 seconds.

Security	WAMOS serves it interfaces via HTTPS using TLS. So all interface calls will be encrypted. The WAMOS server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	This Service will be implemented by the waterway authorities and will be called via a synchronous request response message exchange pattern. WAMOS will periodically pull this interface to keep the database up to date.
Export	Pull (interval as requested by external sources)

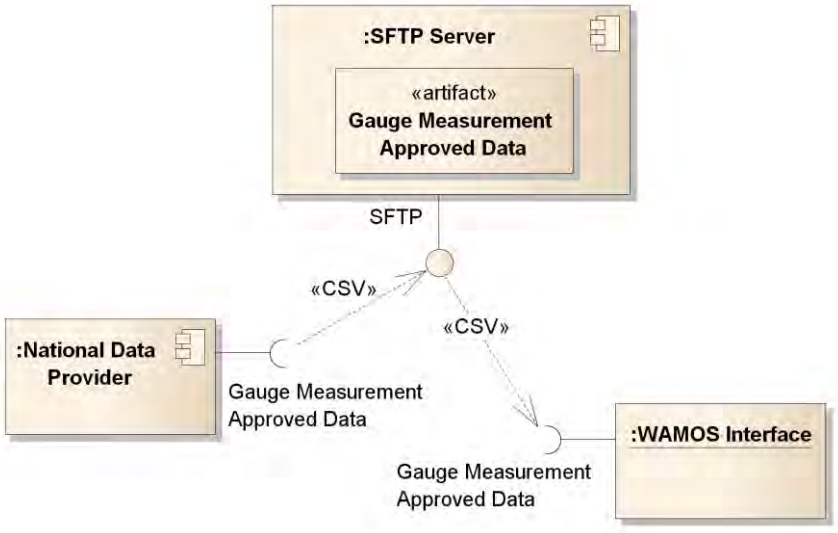
Request_ export

Method	**Sample**
WSDL	Annex\System_Interfaces\WAMOS_WSDL\IFAF\IFAF.wsdl
Methods	get_bottleneck_fa and get_stretch_fa response outputs as defined in the IFFA.wsdl file.

Response_export

Status	**Response**
200	Response types according to the defined IFAF.wsdl file.
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.3.2. Waterway Gauge Measurement Approved Data

Identity	**IFWGMAD** (Interface Waterway Gauge Measurement Approved Data)
Description	The WAMOS Waterway Gauge Measurement Approved Data interface exchanges approved measurements of Waterway Gauges as defined in the Data Requirement Catalogue chapter 3.1.5. The interface is used by use case [SUC5]. The Approved Gauge Measurements can be manually transferred as CSV-file. Additionally to Gauge Measurements (measure_code="WAL") also discharge (measure_code="DIS") can be transferred using this interface.  *Figure 57: Information Flow Approved Data*
Assumptions	The CSV-File contains all – WAMOS relevant – gauge measurements. Data exchange shall use an SFTP server using a predefined well known folder structure and data format.
Requires	CSV-File with approved data uploaded to the defined directory of the SFTP server
Provides	none
Usage Constraints	When importing Approved Measurements, all previous measurements – be it raw or approved data - of that period must be deleted.
Operations	Every Gauge Measurement references a waterway gauge using the field "id" of the element "geo_object". This mandatory id is a unique identifier of a Waterway Gauge, as defined the ISRS Location Code which is a 20 digit alphanumerical code. Data shall be received from a static online accessible source (SFTP Server). The data is processed depending on the ISRS Location Code and the validity period: Each approved gauge Measurement updates or replaces a record set in the database. All values which are not in the allowed value range must raise a warning. The completeness of the data can be validated if the number of values for one year are 35.040/35.136 15-min values
Quality	The interface must be able to import all Approved Gauge Measurements of the National Waterway Authority in less than 30 minutes.
Security	Connections to the interface require authentication using username and password. WAMOS serves its interfaces via SSH using TLS. So all interface calls will be encrypted. The WAMOS server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Pull (from SFTP)
Export	none

Request

Method	Sample
SFTP- URL	<WAMOS_SFTP_Server>/ifwgmad/<CountryCode>/<YYYY>_<gauge_id>.csv ftp://wamos/ifwgmad/AT/2017_ATHIA00001G001218792.csv
File Format	As defined in the interface example Annex\System_Interfaces\Waterway_Gauge_Measurement_Approved_Data.csv

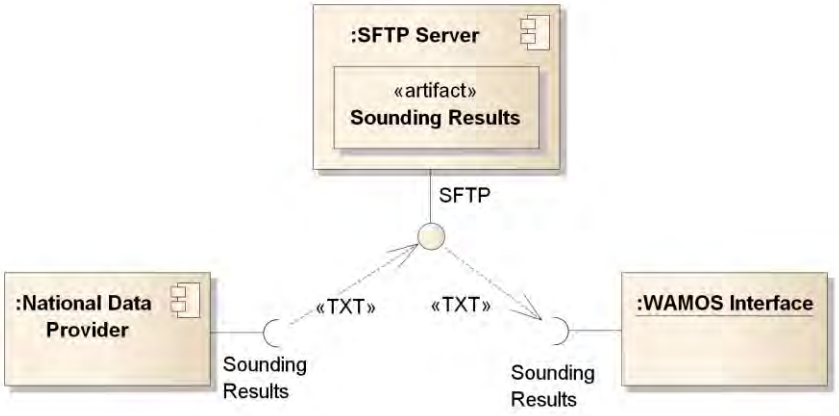
CSV Format Approved Measurements

For approved measurements in the CSV format, the header contains the column names separated by semi-colons. Additional columns are allowed, as long as the minimum data columns are present. Additional columns will be ignored.

```
fk_gauge_id;from;originator;country_code;language_code;date_issue;Reference code;value;predicted;measure code;measure date;Unit;value min;value max;Date_Info
```

Status	Response
200	Positive Completion reply
430	Invalid username or password
434	Requested host unavailable.
530	Not logged in.

3.3.3.3. Sounding Results

Identity	**IFSR** (Interface Sounding Results)
Description	The WAMOS Sounding Results interface exchanges quality checked and cleaned riverbed survey data as defined in the Data Requirements Catalogue chapter 2.2.3. The interface is used by use case [SUC10].  *Figure 58:Information Flow Sounding Results*
Assumptions	The name of the file provides some metadata to the Sounding Result dataset for example the vertical reference (e.g. ADR= Adriatic See). When stating absolute vertical heights the EFRF2007 is preferred, but also local heights are supported. The horizontal coordinates are given in WGS84 reference system (EPSG: 4326). All Sounding Result datasets must be quality checked and processed according the riverbed scan type. Data exchange shall use a SFTP server using a predefined well known folder structure.
Requires	Sounding Results as text file with the corresponding structure in the defined SFTP Folder
Provides	none
Usage Constraints	Depending on the length of the surveyed river section, the Sounding Results data sets may be quite big. Therefore processing and integrating the data can take some time and will trigger further processing that creates derived data sets, for example the depth contours.
Operations	The data is processed depending on the Date_Info and the geometry of the scanned area given in the metadata of the file: The existing active survey containing the old Sounding Results of this section is replaced by a new survey as primary source of current riverbed geometries. Thus the import data needs to contain always a complete sounding result dataset for a bottleneck. Old sounding results are still available for comparisons or calculations. At a vertex x, y and depth are written in one line using a space as separator. The x- and y-coordinates are given as decimal numbers in the coordinate system WGS84 (EPSG: 4326) with x containing the latitude and y the longitude. The depth is either defined in absolute altitude or relative depth to the LNWL or to the current water level, which is defined in the metadata encoded in the filename. When calling the import function, an outline polygon is passed. Subsequent calculations are applied to this (see [SUC10]). All metadata values which are not in the allowed value range will raise an error.
Quality	The WAMOS interface must import one Sounding Result data set in less than 24 hours. Parallel processing of multiple Sounding Results shall be possible if more than one dataset is available.

Security	Connections to the interface require authentication using username and password. The SFTP server is accessed via SSH using TLS. So all interface calls will be encrypted. The SFTP and WAMOS server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	(from SFTP)
Export	none

Request

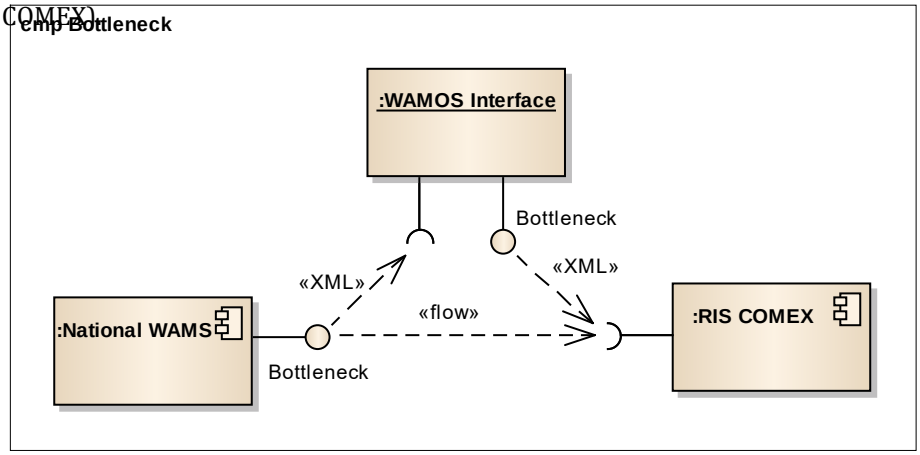
Method	Sample
SFTP- URL	Mandatory sounding result data: \wamos\ifsr\<CountryCode>\<Data set>_<Country>_<YearMonth>_<RunningNumber>.txt Example sounding result data: \wamos\ifsr\AT\20170517_LOB_F_MB_ADR.txt Optional sounding result clipping polygon: \wamos\ifsr\<CountryCode>\<Data set>_<Country>_<YearMonth>_<RunningNumber>.shp \wamos\ifsr\<CountryCode>\<Data set>_<Country>_<YearMonth>_<RunningNumber>.dbf \wamos\ifsr\<CountryCode>\<Data set>_<Country>_<YearMonth>_<RunningNumber>.shx \wamos\ifsr\<CountryCode>\<Data set>_<Country>_<YearMonth>_<RunningNumber>.prj Example clipping polygon: \wamos\ifsr\AT\20170517_LOB_F_MB_ADR.shp \wamos\ifsr\AT\20170517_LOB_F_MB_ADR.dbf \wamos\ifsr\AT\20170517_LOB_F_MB_ADR.shx \wamos\ifsr\AT\20170517_LOB_F_MB_ADR.prj
File Format	Mandatory sounding result data: 18,5774 48,7125 286,90 18,0294 48,2502 291,10 18,1204 48,2592 298,45 18,9336 48,7973 293,30 18,1088 48,0963 293,00 18,0294 48,2502 291,40 18,1204 48,2592 298,00 18,9336 48,7973 293,03 18,1088 48,0963 293,00 18,0294 48,2502 291,20 18,1204 48,2592 298,00 18,9336 48,7973 293,20 18,1088 48,0963 293,00 Optional sounding result clipping polygon: Shape file format according to the ESRI http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf

Response

The dataset consists of X, Y, Z coordinates/relative depth of the quality checked sounding result measurements.

Status	Response
200	Positive Completion reply
430	Invalid username or password
434	Requested host unavailable.
530	Not logged in.

3.3.3.4. Bottleneck

Identity	**IFBN** (Interface Bottleneck)
Description	The WAMOS Bottleneck interface exchanges the Bottlenecks attributes as defined in the Data Requirement Catalogue chapter 2.2.2. The interface is used by use case [SUC8]. Bottleneck export interface can also be called from external systems (e.g. RIS COMEX).  *Figure 59: Information Flow Bottleneck*
Assumptions	The availability and performance of the services fit the requirements of chapter 3.2.6 and 3.2.9.
Requires	The national WAMS applications will implement a "Bottleneck" Interface.
Provides	XML SOAP interface
Usage Constraints	When importing Bottlenecks new features are created and existing ones are updated. To identify existing features each area has its own stable unique identifier.
Operations	The Bottleneck interface is based on the SOAP web service standard. This interface provides two types of interfaces: one for writing and one for reading the data sets. When writing Bottlenecks, the data set of the whole country will be exchanged, therefore WAMOS will always has to query all bottlenecks.
Quality Attributes	The interface must be able to import all Bottlenecks of the National Waterway Authority in less than 30 minutes.
Security	WAMOS serves it interfaces via HTTPS using TLS. So all interface calls will be encrypted. The WAMOS server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	This Service will be implemented by the waterway authorities and will be called via a synchronous request response message exchange pattern. WAMOS will periodically pull this interface to keep the database up to date.
Export	Pull (from external systems)

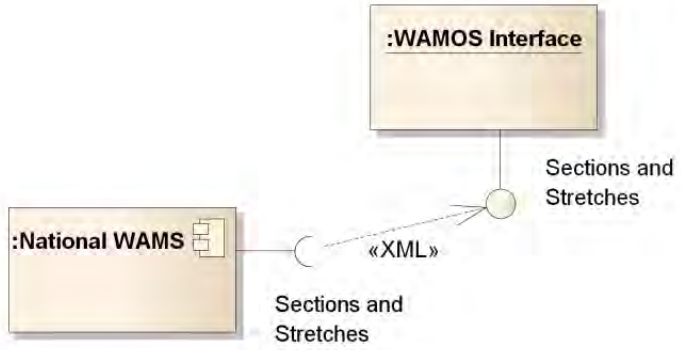
Request_ export (external systems)

Method	Sample
WSDL	Annex\System_Interfaces\WAMOS_WSDL\IFBN\IFBN.wsdl
Methods	export_bn_by_id export_bn_by_isrs

Response_export (external systems)

Status	Response
200	Response types according to the defined IFBN.wsdl file.
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.3.5. Sections and Stretches

Identity	**IFRD** (Interface Sections and Stretches)
Description	The WAMOS Sections and Stretches interface exchanges the well known locations along the river Danube as defined in the Data Requirement Catalogue chapter 2.1.8. The interface is used by use case [SUC4]. Sections and Stretches contain all sections and stretches of the Danube River. This data is transferred by calling the writing function of the SOAP interface for each country. The data shall also be available for other systems using the same interface for reading.  *Figure 60: Information Flow Sections and Stretches*
Assumptions	The XML-response contains all – for WAMOS relevant - Sections and Stretches.
Requires	none
Provides	XML – SOAP interface
Usage Constraints	When importing Sections and Stretches, all previous features of that country must be historicised.
Operations	Data shall be received from a SOAP service.
Quality Attributes	The interface must be able to import all Sections and Stretches of the National Waterway Authority in less than 30 minutes.
Security	WAMOS serves it interfaces via HTTPS using TLS. So all interface calls will be encrypted. The WAMOS server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	Push
Export	Pull

Request_ import (determined by waterway authority)

Method	Sample
WSDL	Annex\System_Interfaces\WAMOS_WSDL\IFSN\IFSN.wsdl

Methods	import_sn_request.xml

Response_import (determined by waterway authority)

Status	Response
200	import_sn_response.xml
400	Not Found
401	Unauthorized
500	Internal Server Error

Request_ export (external systems)

Method	Sample
WSDL	reference_data.wsdl
Methods	export_sn_by_id_request.xml export_sn_by_sirs_request.xml

Response_export (external systems)

Status	Response
200	export_sn_by_id_response.xml export_sn_by_sirs_response.xml
400	Not Found
401	Unauthorized
500	Internal Server Error

3.3.3.6. WAMOS OGC Services (Common View Layers)

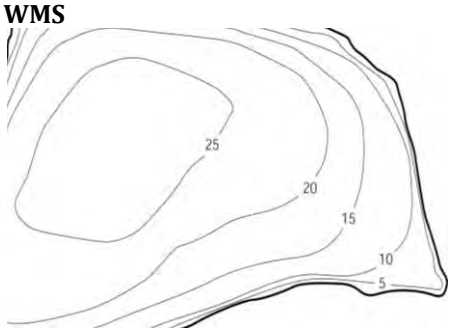
Identity	**ICV** (WAMOS OGC Services)
Description	These interfaces shall supply the national WAMS with a harmonized data source covering the area of interest. This shall lead to continuous improvement of data with border issues and will lead to a common understanding of the available data. The WAMOS Common View Layers (e.g. Depth contours or Sounding Results) publish WMS and WFS services of the current available dataset (e.g. Depth contours calculated from the current sounding results related to the LNWL values). This Interface shall use the commonly defined symbology and agreed values.
Assumptions	Data is provided by OGC services in the EPSG: 4326 geodetic coordinate system. The OGC WMS and WFS Services fulfil the required criteria especially the performance, capacity, security, availability and reliability defined in chapter 0.
Requires	none
Provides	OGC WFS/WMS web service
Usage Constraints	The WAMOS Common View Layers shall be used as basic geometries to derive additional information or create up to date IENC charts incorporating these data.
Operations	The WAMOS OGC Service Interface supports standard conform OGC WFS/WMS web service functionality.
Quality	The response time of the OGC Services must correspond to the performance indicators mentioned in chapter 3.2.6.
Security	WAMOS relies on secure interfaces via HTTPS using TLS. So all interface calls will be encrypted. The server will need a valid and trusted SSL certificate to ensure the servers authenticity to other systems.
Import	none
Export	Pull

Request

Method	**URL**
POST	http://<WAMOS Server>/geoserver?
Type	**Params**
GET	OGC WFS parameters as defined in the OGC Standards

Response

The Bathymetric Line Interfaces is based on WMS/WFS and supports all functions defined in the standard.

Status	**Response**
200	**WMS**  **WFS**:

	GML format depending on the transferred feature class. This format shall be compatible to the formats defined in OGC WFS.
400	Not Found
401	Unauthorized
500	Internal Server Error

3.4. Logical Data Model

In the following figure the Logical Data Model of WAMOS is shown. This data model represents only partly the classes and attributes defined in the data requirement catalogue as it already considers the processing and integration steps of the import routines. The model itself can be roughly separated into 4 major parts:

- User Management and System Settings
- Fairway information
- Supporting classes and geometries for calculations, positioning and intersections.
- Caching structures for calculated statistics and analysis.

Additionally to these parts all of the mentioned tables have to be historicized. This shall track changes of the system and assure transparent imports and operations throughout WAMOS.

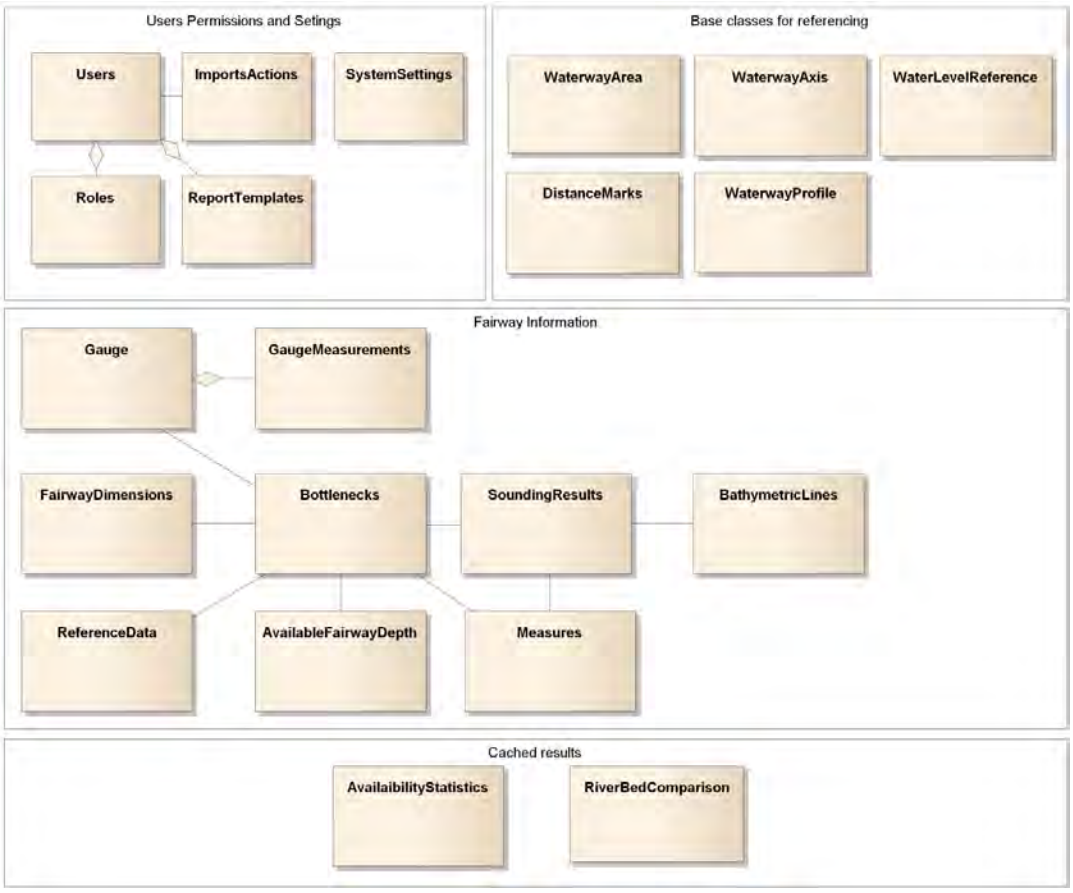


Figure 61: Logical Data Model

User Management and System Settings
Within these tables all user related information are stored. This includes users, contacts, logins, permissions, reporting templates and system settings

Fairway information
Here all fairways related information is stored. This includes most of the data sets defined in the Data Requirement Catalogue.

Supporting classes and geometries for calculations, positioning and intersections.
This group of tables is used to generate the geometry of Sections and Stretches, Bottlenecks and Rehabilitation and Maintenance Measures and supports navigation, positioning of referenced data and geometric analysis.

Caching structures for calculated statistics and analysis.
These tables support the quick display and calculation of descriptive statistics and the comparisons between different sounding results.

4. Appendix

4.1. Annex I – Documents

Table 9: Interface examples described in section System Interfaces.

interface example	Description	Reference
Waterway Gauge Measurement	An example of one WRM from NtS 4.0	Annex\System_Interfaces\WRM NtS 4.0.xml
Distance Marks Ashore	https://www.d4d-portal.info/geoserver/D4D_AT/ows?service=WFS&version=1.0.0&request=GetFeature&typeName=D4D_AT:IENC_DISMAR&maxFeatures=1	Annex\System_Interfaces\DISMAR_GetFeature.xml
Waterway Gauge Measurement validated	This sample CSV documents the structure needed to provide validated gauge measurements to WAMOS. The Document is based on the original WRM NtS messages.	Annex\System_Interfaces\Waterway_Gauge_Measurement_Approved_Data.csv
Available Fairway Depths	SOAP Interface for exchanging fairway depth availability.	Annex\System_Interfaces\WAMOS_WSDL\IFAF
Sections and Stretches	SOAP Interface for exchanging Sections and Stretches (sections, stretches).	Annex\System_Interfaces\WAMOS_WSDL\IFRD
Bottleneck	SOAP Interface for exchanging bottleneck.	Annex\System_Interfaces\WAMOS_WSDL\IFBN
Sounding Results	Two triangle in Austria including metadata	Annex\System_Interfaces\20170517_LOB_F_MB_ADR_WGS84.txt
Waterway Area	Example request to retrieve WTWARE Features: https://www.d4d-portal.info/geoserver/D4D_AT/ows?service=WFS&version=1.0.0&request=GetFeature&typeName=D4D_AT:IENC_WTWARE&maxFeatures=1 HYDRO_SEAARE Features: https://www.d4d-portal.info/geoserver/D4D_AT/ows?service=WFS&version=1.0.0&request=GetFeature&typeName=D4D_AT:HYDRO_SEAARE&maxFeatures=1	Annex\System_Interfaces\WTWARE_GetFeature.xml Annex\System_Interfaces\SEAARE_GetFeature.xml
D4D-Portal: Background Map	https://www.d4d-portal.info/geoserver/wms?LAYERS=D4D&STYLES=&FORMAT=image%2Fpng&TRANSPARENT=FALSE&TILED=true&SERVICE=WMS&VERSION=1.1.1&REQUEST=GetMap&SRS=EPSG%3A900913&BBOX=1740929.7559808,6173665.8996777,1741541.252207,6174277.3959039&WIDTH=256&HEIGHT=256	Annex\System_Interfaces\D4D_BackgroundMap_getMap.JPG
Shallow Section pdf	Guidelines for the contents of shallow section pdfs.	Annex\System_Interfaces\shallow-sections\ Shallow_section_example_Furt Rote Werd.pdf,

		Annex\System_Interfaces\References\shallow-sections\Shallow_section_info_Newada duo.docx
INEA	https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/beneficiaries-info-point/publicity-guidelines-logos	

4.2. List of Tables and Figures