



Enabling  
& Transboundary Cooperation  
& Integrated Water Resources Management  
in the extended **DRIN RIVER BASIN**



## **Terms of Reference for development of Drin Information System**

In the framework of:

Memorandum of Understanding  
for the Management of the Extended Transboundary Drin Basin

GEF Project “Enabling Transboundary Cooperation and Integrated Water  
Resources Management in the Extended Drin River Basin”

The Coordinated Action for the implementation of the Memorandum of Understanding for the management of the Drin basin (Drin CORDA) is supported by the GEF Drin Project. The latter is implemented by the United Nations Development Programme (UNDP) and executed by the Global Water Partnership (GWP) through GWP-Mediterranean (GWP-Med), in cooperation with the United Nations Economic Commission for Europe (UNECE). GWP-Med serves as the Secretariat of the Drin Core Group, the multilateral body responsible for the implementation of the Memorandum of Understanding.

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# 1. Introduction

## 1.1 Purpose and Context



The purpose of this software requirements specification (SRS) is to define functions and non-functional requirements for a Drin Information System (DIS) for the extended Drin river basin.

[Global Environment Facility](#) (GEF) [project](#) *Enabling transboundary cooperation and integrated water resources management in the extended Drin River Basin* (Drin Project) is implemented by the United Nations Development Programme (UNDP) and executed by the [Global Water Partnership - Mediterranean](#) (GWP-Med).

One of the main outputs of the project is development of the [Transboundary diagnostic analysis](#) (TDA) which is backed up by development of six specific thematic reports.

In the process of developing the TDA during the last three years, vast amount of information has been collected and processed from four countries. Information was used/processed in a structured manner, and GIS files are stored in an internal project database as an [ArcGIS Online](#) application. Contents of the database follows the thematic division from thematic reports.

The new DIS shall be a web application with interactive maps as a major vehicle for database queries. The database itself shall interact with existing systems and databases within the riparian countries. It shall initially be populated with data and map layers from the Drin Project internal application.

## 1.2 Intended Audience and Reading Suggestions

This document is the technical part of the tender dossier for a Drin Information System. During and after the DIS is being developed and launched, the document will serve as a two-way insurance policy that assures that both the GEF Project and the software developer understand the other's requirements.

The specifications can be read sequentially but to ease communication and negotiations between contractor and the developer, Chapter 3 describing features of the new system initially required, has been annotated with codes for each requirement. Hopefully this will make it easier to refer to the specific detailed functional requirements. The electronic versions of the document (Word and PDF) also hold many cross-references and external links to make non-linear navigation through the document easier.

### 1.3 Product Scope

The scope of the DIS is to give easy access to Drin basin information at different levels:

- The general Public shall be able to retrieve information, such as graphs, photos and tables as processed data from the DIS database using map clicks;
- Government staff may use the DIS in their daily work, which include document preparation, [Water Framework Directive](#) (WFD) assessments, preparation of Excel or XML files submitted to the [European Environmental Agency](#) (EEA) annually, as well as decision support and planning efforts;
- GEF Project staff will use the system for disseminating results of the TDA; and
- Specially trained staff shall be enabled to keep the database updated as well as the overall system maintained and responsive to changes in the real environment that the DIS describes. Besides encoding and data upload, this includes such functions as map maintenance and definition of new river basin parameters within the DIS.

### 1.4 References

Prior to preparation of this specification document, three tasks were carried out:

1. Describe characteristics and services offered by the new DIS application
2. Analyze existing datasets, current GIS use and propose adjustments
3. Advise on technical solutions for the DIS

The main conclusion from Task 1 has been a list of map layers and a proposed database structure as outlined in *Annex 1* and *Annex 2*. It was considered important to populate the new system with real data and maps from day one, and the developer will gain access to 27 layers and their attributes to do so.

A main conclusion from Task 2 was that an accurate river network and a sub-sub catchment map layer shall be provided in addition to the 27 layers mentioned above. Downloaded layers for land cover and a road network will also be made available for the developer. All layers will be in UTM zone 34N projection with WGS84 as spheroid.

The main conclusion from Task 3 has been to give the developer as free hands as possible when it comes to selection of technology . The technology chosen by the developer, however, must be clearly described in the bid document. The exact choice of hosting facilities is still open, see Section 2.4.

## 2. Overall Description

### 2.1 Product Perspective

The DIS is a new product but shall link to upcoming systems in the riparian countries. Among those are environmental information systems, planned and under development. Issues to be addressed by the developer are therefore

- Integration of these systems with the DIS and timing of implementation
- Since the linkage between national systems and the DIS shall be simple file transfer initially, organization of these files must be considered

Regarding timing, it is recommended to start with a minimum system, but a system that is prepared for expansion and linkage to national information systems not yet completely implemented when DIS 1.0 is launched.

Regarding the type of linkage, the recommendation is to use Excel file export and import. However, future versions of DIS will most likely need upgrades to more advanced and automatic data sharing mechanisms using XML and/or database replication.

### 2.2 Functions of DIS

The main function of the DIS shall be to retrieve water- and basin-related information from a database using web technology and interactive maps. Maps can be clicked, and database query results returned to the webpage. Data can be exported both for internal use and in formats requested by EEA. Despite there may be more than one data source behind the scenes, end-users will experience the system as retrieving data from one repository.

In order to keep the system updated, a series of encoding functions shall be implemented. A logged-in user with the privilege to do so shall be able to do minor updates by right-clicking a data item and next update it, or for more comprehensive updates, upload an Excel file with the new data. The Excel file might be generated from the system, populated with existing data and ready for being updated and populated with new data by a power user. That way a power user becomes responsible for QA of data from one riparian country.

Not only numbers and texts, but photos and map layers as well, shall be maintained via one or both mechanisms.

To secure authorized access to updates and uploads, user administration shall be part of the system.

In summary, the product will have these main components:

- Web mapping
- Database
- User interface with tools.

### 2.3 User Classes and Characteristics

Users of DIS can be divided into

- The general Public and Government staff retrieving information, i.e. visitors to the DIS website who are not logged-in

- Logged-in users:
  - A user administrator (GWP-Med)
  - Power users (one per country)
  - Specialized encoders and updaters of the DIS database and maps
  - Developers who maintain the DIS remotely

Encoders and updaters will further be divided into subgroups depending on what they encode and update. The developer access via the application can be skipped if the hosting facility allows for remote desktop. See also DB 7.

## 2.4 Operating Environment

DIS as a web application shall be operational on all major browsers. Specifically, it must successfully be tested on recent versions of browsers which are [HTML 5](#) compliant. Any dependency on Adobe's [Flash](#) must be avoided.

Although not a strict requirement to run the app on all types of mobile devices, DIS 1.0 must at least be prepared to be upgradable to for example understand gestures in addition to mouse events.

On the server side there are no restrictions except technical constraints caused by the selected hosting facilities. The developer can choose platform by operating system (*Linux, Windows, ...*) and database system (*MySQL, SQL Server, Oracle, ...*), **and after that a host can be selected**. Among the candidates are:

- UN server or UN-related server, such as hosts for the domains [drincorda.iwlearn.org](http://drincorda.iwlearn.org), [geonode.iwlearn.org](http://geonode.iwlearn.org) and [ihp-wins.unesco.org](http://ihp-wins.unesco.org)
- Local company: dedicated server
- International company with cloud services: [AWS](#) (Amazon), [GCP](#) (Google), [Azure](#) (Microsoft)

A [https](#) domain is highly recommended over http.

DIS should be fully compatible to utilize data already available as described in chapter 1.1

## 2.5 Design and Implementation Constraints

Having in mind importance of sustainability of the product, further development and time-constrain, Web mapping platform should be out of the box proprietary solution with condition that all necessary licenses are perpetual (and included in the offer).

Regarding choice of digital maps format and services, there are also very few constraints except that their projection must be UTM 34N. In the following [shapefiles](#) are assumed to be the source of maps on the server to be shown as raster images in the client's browser. However, rather than shapefiles, [Google Maps JavaScript API](#) objects or something else with similar functionality might be used to implement web mapping.

A similar freedom for the developer is the choice of standard software to produce graphs, charts and widgets on the client side. The examples shown in Section 3.1.3 under WM 8 were produced by [Google Chart](#) with Google Visualization API.

## 3. System Features

The mandatory features of the first version of DIS (*DIS 1.0*) are

- Web mapping *WM*
- Database queries and updates *DB*
- User interface and tools *UI*

This chapter describes each feature, first its overall functionality, then how a user might perform some of its functions (“use cases”) and finally gives a formal list of functional requirements for the feature. Each requirement is given a code and it is suggested to refer to that code when negotiations between developer and beneficiary/contractor take place.

### 3.1 Web Mapping

#### 3.1.1 Web Mapping – Description

Interactive maps shall be embedded on the DIS webpage. Each map is a set of superimposed layers in UTM 34N projection that can be switched on and off by the user. Some layers can be queried, for example points representing monitoring stations; others cannot, for example a land cover layer with polygons in different colors indicating areas with forest, agriculture, urbanization, etc. The latter is an example of a thematic map layer with several classes (*forest, agriculture and urbanization*). Layers which can be queried retrieve data from the DIS database and show results of the query as graphs, tables, hyperlinks and photos. Layers which are thematic shall show its classes on a legend.

Map layers shall be grouped into main groups, like *Admin Units, Water, Soil and land-use, and Industries and emissions*, which further may be divided into subgroups and sub-subgroups, such as { *Water { Surface water { Monitoring stations { River water quality, Lake water quality, Gauging stations, ...} ... } ... } ...* }. This hierarchy invites for a tree-view control as the tool for selecting map layers by the user.

A complete tree with map layers known to exist and which should be a first version is shown in Annex 1. This tree, however, will need to be expanded and modified in the future, and it is mandatory that maintenance of the tree-view and the map layers is easy to carry out. It is therefore suggested that the DIS developer stores the tree as a self-referencing table in the database. See also Annex 2, *Layer Tree*.

The map itself can be controlled by the user with operations like pan and zoom and a *View all*-function that brings the zoom level back to its initial state, possibly after several zoom-in operations.

Similarly, to let users better know what they see after many zoom-ins, a reference map shall indicate with a rectangle over which part of the country the current viewport is.

Besides letting users zoom and pan to find a specific map feature, there shall be a text search box, which allows for automatic zoom in to a point, line or polygon that represents a named entity, like a specific municipality or a specific monitoring station. The search will usually be for the *name* of the object, but for some layers, *codes* in addition to names of the map object should be searchable.

#### 3.1.2 Web Mapping – Stimulus/Response Sequences

A typical use case scenario would be this. When the DIS webpage has loaded, a map of the Drin basin appears showing its boundary, main rivers, sub-basins and municipalities. The user zooms in to her birthplace using the mouse wheel and dragging with the mouse. To see more details, she switches a village and a road network layer on. When she clicks the municipality polygon, demographic data pops up as



graphs, including a population forecast for the next 5, 10 and 15 years. A dropdown menu allows her to switch forecast method from exponential to linear or logistic.

Next, the user wants to inspect the water quality in the river near the village where she was born. She turns on a river water quality layer. Then she clicks the monitoring station at the river nearest her village. Graphs pops up showing pH versus year as well as its two standard limits as horizontal lines on the graph.

She can choose between around 30 other water quality parameters than pH from a dropdown. Parameters that never were measured at the selected station, but which are part of the monitoring program, are shown greyed out on the dropdown list.

A complete list of parameters and their properties (name, symbol, unit, standard limits, [limit of detection](#), min and max for what define an [outlier](#), inter-parametric constraints, [CAS](#) number, analytical method, etc.) can be seen by switching to another panel temporarily covering the query result panel. From here other kinds of parameters than water quality can be selected, possibly with different properties. As an example, switching to hydrology with parameters like flow and water level, wouldn't show CAS numbers.

Besides viewing water quality as line graphs or bar charts, the user may choose to see the real numbers as a table. The table can be downloaded as an Excel file, which would include all parameters observed and optionally observations from all stations, not just the one that she has selected.

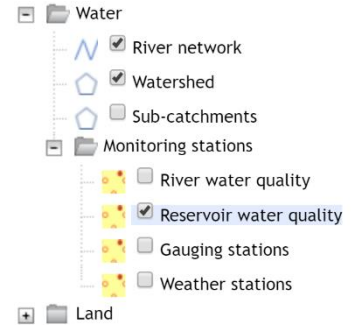
Also, she may be interested in statistics or other results of a calculation based on the raw observations, and she can view these derived results both as a table and graphs. Finally, she makes a note on when the station was established, if it is still working, its geographic coordinates and clicks a link to visit a website describing the source of information for the data shown.



### 3.1.3 Web Mapping – Feature Requirements

The following controls shall be available to describe and manipulate the map:

- WM 1 A [legend](#) shall show each layer and its optional classes with a symbol and a short label.
- WM 2 Dragging the mouse cursor over the map shall activate [pan](#) operations. It shall not be possible to drag the map completely outside the viewing panel.
- WM 3 A [slider](#) tool to [zoom](#) in and out and a visual indication of the zoom level (e.g. a [scale bar](#) and a [scale ratio](#)) shall also be shown on or besides the map. [Pinch](#) gestures and the mouse [wheel](#) shall have a similar function as the zoom slider. The software shall put an upper and lower value on zoom levels, e.g. max zoom out meaning full basin view plus 20% and max zoom in meaning a scale ratio around 1:1000. A [View all](#) control shall bring the zoom level back to neutral. [Complex map layers](#), like the river network layer shall show [more details after zoom-in](#) compared with the neutral zoom level.
- WM 4 A [reference map](#) shall indicate the current visible part of the map as a rectangle overlaid the full map.
- WM 5 [Coordinate values](#) corresponding to mouse cursor location shall be shown and updated at each mouse move.
- WM 6 A [search box](#) shall allow users to let the software zoom in to labelled map features – or let the user know that the searched feature does not exist. All visible layers shall be searched. The search shall start before typing of the full label has been completed.

WM 7 Except for one or two permanent layers, layers can be switched on and off from a tree-view, like the control shown here. The layer that cannot be switched off is a layer with the Drin basin boundaries and optionally a raster backdrop.



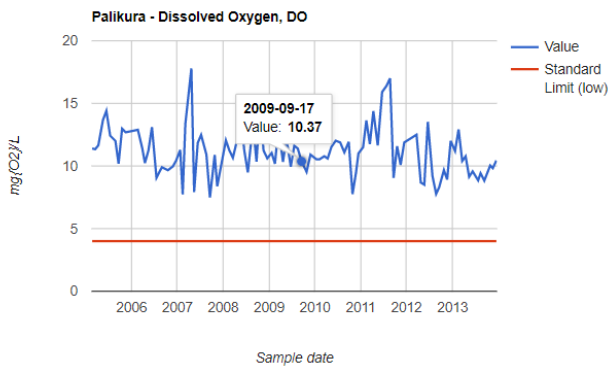
Branches of the tree can be expanded (with a click on ) or collapsed (click on ). End-nodes correspond to map layers and a checkbox or similar shall open or close the layer.

When more than one layer is visible, layers are stacked in a predefined order. Layers at the top may make parts of the layers near the bottom invisible. Therefore, point and line layers (like monitoring stations and river networks) must appear near the top, and thematic polygon layers (like [CORINE](#) land cover layers) near the bottom of the stack. The interior of admin unit polygons (countries and municipalities) should be transparent.

The question remains which layers should be switched on initially, i.e. when a user visits DIS or reloads the page. Best would be to show layers which were switched on last time the user visited the page using cookies. A fixed set of default map layers is also acceptable. It is recommended to let countries, municipalities and a river network layer be switched on initially in addition to the Drin basin boundaries.

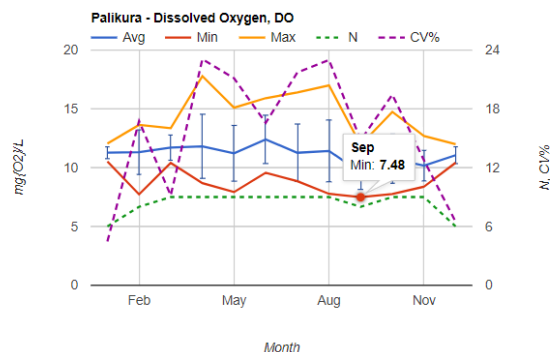
WM 8 A click on map objects shall initiate a database query for the clicked object. If no other, at least the Drin basin map layer is switched on and queryable. Clicks outside the Drin basin boundary shall have no effect. Depending on a user choice, either one layer or all queryable layers are searched. If successful, a database lookup is carried out and query results shown on a special panel on the webpage.

Query results can be shown as charts, tables, hyperlinks and photos or combinations thereof. Time-series and depth profiles shall normally be shown as graphs initially, but with an option to view data as tables.



The proposed graph types are line graphs and bar charts, but others like area charts and step charts could be considered by the developer. Here is an example of a line graph with dissolved oxygen time-series observed at a user-selected monitoring station. Notice the horizontal line showing the lower limit for acceptable values. Each parameter may have one, two or zero such standard limits.

Besides plotting raw data as line graphs and bar charts, whenever possible, the webpage shall offer calculation of various statistics. As a minimum, for time-series, average, standard deviation, min, max, N and [coefficient of variation](#) (CV %) shall be derived and shown as graphs or tables.



For some parameters, more advanced statistics and derived information shall be displayed:

- For precipitation, an [SPI](#) index shall be an option for the user and shown as a stacked bar diagram with different colors for dry, wet and normal periods.
- For river flows and water levels, [Q-H curves](#) shall be an option as well as [flow duration curves](#).

WM 9 For each map selection, a query result shall include [baseline data on the object selected](#). In the example above that would include a photo of the monitoring station and a list of its properties, like name, type, geographical coordinates, elevation, river name, distance to river mouth, status of the station (functioning, suspended, terminated etc.), date for its construction, a water quality index if applicable (see WM 11), etc. Also, for monitoring stations with more than one parameter being monitored, users must be able to select another parameter from a list, which will affect the charts and tables showing time-series or depth profiles.

Each query result shall further be accompanied by [source of information](#) details, like one or more hyperlinks combined with a short narrative. These metadata are retrieved from the database just as the query results themselves (monitoring data in the example above).

WM 10 A special panel, replacing the query result panel when selected, shall show [parameter and indicator details](#). As a minimum the following types of parameters and indicators shall be defined, but it must be a simple, table-driven process to add more:

- Hydrology
- River water quality
- Lake water quality
- Wastewater discharge
- Meteorology
- Industrial emissions

Examples of parameter properties shown as a table on the parameter panel are:

- Name of the parameter or indicator
- Symbol, chemical formula or another short identifier
- Unit of measurements
- Code or label, such as IDs used on water sample bottles
- How to format values of the parameter or indicator when shown on the webpage or a report: number of decimals, percent, etc.
- For laboratory data, [limit of detection](#) and/or [limit of quantification](#).
- For parameters that are substances or physical/chemical properties, [CAS](#) number or EEA code.
- Method of determination. Often a [CEN or ISO](#) code.
- Ambient standard limits and effluent standard limits (0, 1 or 2 numbers per parameter)
- Inter-parameter constraints, such as “ammonia-N < total N” or “BOD < COD”
- Outlier limits (such -1 and 14 for pH), used to catch typos during encoding

Limit of detection or quantification, standard limits, outlier limits and inter-parameter constraints shall be used to draw visual attention to observed values outside these limits or values otherwise breaking the rules. The attention could be special background colors and a tooltip when such extreme values are shown as tables.

For derived parameters, a formula can appear as a parameter property stored as text. An example would be this formula for calculation of ammonia concentration [NH<sub>3</sub>] from total ammonium concentration ([NH<sub>3</sub>] + [NH<sub>4</sub><sup>+</sup>]), pH and water temperature T (°C):

$$[\text{NH}_4]/(1+10^{(2727.9/([T]+273.15) + 0.0902 - [\text{pH}])})$$

In this example, strings between square brackets are parameter symbols, in particular [NH<sub>4</sub>] means total ammonium as measured in the lab. The formula could be used by a downloaded Excel sheet to calculate a column with NH<sub>3</sub> concentrations (which is a fish poison).

Again, the list of parameter properties must be easy to update, preferably by making changes to a database table. It is not the responsibility of the developer to maintain this table but the responsibility of a logged-in user with proper credentials.

- WM 11 For water quality, both in rivers and in lakes and reservoirs, an overall indicator shall be derived from monitoring data and used to make the monitoring map layers thematic. One water quality index per monitoring station shall translate into a *Good/Medium/Low/Unknown* compliance status for that station. The status is used to color the stations on the map.

The recommended water quality index is the relative number of compliances averaged over all parameters that have standard limits. A compliance means a sampled parameter falling within the ambient standard limits mentioned under WM 10, like *DO > 6 mg/l* or *pH* between 5 and 9. With this example, assuming *DO* and *pH* to be the only parameters with ambient standard limits, if 100 samples were taken at a given station and 80 of those had *DO > 6* and 90 had *pH* between 5 and 9 then the water quality index (or compliance ratio) for the station would be  $(0.8 + 0.9)/2 = 0.85$ .

Over time, as more samples are taken, the index may change. The index shall be used to color a water quality station on its map layer using four classes: good (index > 0.66), medium (index between 0.67 and 0.33), low (index < 0.33) and unknown (insufficient data to calculate an index). Logged-in users can edit standard limits (zero, one or two) for each water quality parameter.

Aggregation of [IPPC/IED](#) emission exceedances of standard limits into one index per water discharge point, industrial or wastewater, follows the same algorithm, but now using emission standard limits rather than ambient water quality limits.

If legend, zoom slider, zoom level indicator, reference map and search box (WM 1, 3, 4 and 6), or just some of these, are chosen by the developer to overlap the map area, these controls shall dim out after users have hovered over each control by the mouse. The tree-view layer selector should not overlap the map but stay in a special panel on the webpage.

## 3.2 Database Queries and Updates

### 3.2.1 Database Queries and Updates – Description

Since clicking a map object as described in the previous section is the primary method for querying the DIS database, this section is more about database updates than database queries.

For a normal DIS visitor, another way of querying besides map clicks, is download of Excel files with data for a selected map object or for all map objects belonging to a queryable map layer. In addition, some user roles as defined in DB 7 are allowed to prepare Excel or XML files ready to be submitted to EEA, a process that also involves database queries. Thus, DIS shall offer at least these three types of database queries:

- Click a map object and receive query results typically as graphs, a table and a photo (see WM 8 and WM 9)
- Download an Excel file with data for the current map object or for all map objects at the same layer (see DB 2)
- Groups of logged-in users shall be able to prepare Excel or XML files in special EEA formats (see DB 2).

Database updates can take place in two ways:

- Right-click a data field on the webpage and select context menu items like *Edit row*, *Add row* and *Delete row*, when the mouse cursor is over a selected table row with time-series data.
- Upload an Excel file in a predetermined format. This format shall be the same as for Excel downloads. In that way a downloaded Excel file becomes a template for encoders, and they may

modify the downloaded data, add new and in some cases indicate that records shall be deleted from the database. Only data different from existing database content shall affect the database after an upload. Validation of changed data shall take place both in the Excel file itself during encoding and on the server. After upload the logged-in user receives either statistics, like *33 records updated, 10 records added and 12 map points changed position*, or an error message with enough details to let the encoder correct the mistakes.

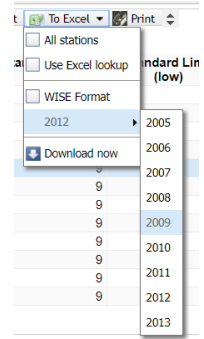
In addition, a special logged-in user, *Admin*, shall be able to create and remove user accounts, grant and revoke permissions to update, and reset passwords.

A general requirement for design of the database is that it is normalized to at least 3<sup>rd</sup> normal form (3NF).

### 3.2.2 Database Queries and Updates – Stimulus/Response Sequences

Use cases for map click queries were given above in Section 3.1.2. See also WM 8, WM 9 and WM 10.

An Excel download could be initiated from a menu like what is shown here. When logged in, a user with rights to prepare EEA/WISE Excel would see a *WISE format* option with a year selector. For users not logged in, the *WISE format* and year selector would be disabled.



For point data (monitoring data and water discharge/abstraction data) there could be an option for download of all stations or points on the current map layer. Also, a checkbox labelled *Use Excel lookup* could appear. Other ways of obtaining the same functionality are also welcomed.

When *Download now* is clicked, the query takes place on the server and an Excel file with query results is downloaded. What it contains depends on the *All stations*, *Use Excel lookup*, the *WISE* options or similar.

Our user ticks the *All stations* and the *Use Excel lookup* checkboxes but not the *WISE* checkbox. The current map selection is a water quality station. What she receives as download is an Excel file with several sheets, one with water quality data from all river monitoring stations in the basin plus one for every lookup. A lookup sheet holds data from lookup tables in the database such as a list of water quality parameters and a list of monitoring stations:

Station	Sample date	Color	T	T-air	Turbidity	pH	Eh	EC	CO2-free	CO2-agr	Residue total, 105 oC	Residue filtered, 105 oC	Resid
2 Basino Selo	2005-02-20	2.5	7.5	13.5	7.5	7.84	-72	340	0.00		326	258	
3 Basino Selo	2005-03-16	2.0	10.8	19.5	7.5	7.52	-54	315	0.00		305	250	
4 Basino Selo	2005-04-10	5.0	13.6	19.4	7.5	7.69	-64	298	0.00		302	205	
5 Basino Selo	2005-05-17	2.0	17.2	27.0	7.5	7.41	-38	291	0.00		265	192	
6 Basino Selo	2005-06-13	5.0	15.7	28.0	7.5	7.76	-60	302	0.00		278	235	
7 Basino Selo	2005-07-13	2.5	20.6	26.7	7.5	7.83	-58	376	0.00		345	292	
8 Basino Selo	2005-08-23	5.0	19.5	26.5	7.5	8.02	-60	375	0.00		427	260	
9 Basino Selo	2005-09-18	5.0	18.6	25.0	2.5	7.92	-60	393	0.00		376	237	
10 Basino Selo	2005-10-16	5.0	11.0	12.0	5.0	7.92	-51	345	0.00		372	228	
11 Basino Selo	2005-11-13	2.5	9.5	13.0	5.0	7.88	-48	304	0.00		258	194	
12 Basino Selo	2006-02-19	5.0	8.0	13.0	5.0	7.96	-57	327	0.88		282	231	
13 Basino Selo	2006-03-26	2.5	11.4	22.0	7.5	7.91	-50	285	0.00		408	228	
14 Basino Selo	2006-04-15	2.5			5.0	7.64	-36	294	0.00		254	201	
15 Basino Selo	2006-05-14	2.5	13.2	23.0	6.0	7.93	-53	299	0.00		278	228	
16 Basino Selo	2006-06-11	5.0	15.0	20.0	4.0	7.90	-51	310	0.00		225	201	
17 Basino Selo	2006-07-17	10.0	20.2	30.0	2.5	8.03	-57	375	0.00		270	262	
18 Basino Selo	2006-08-28	5.0	19.0	30.5	3.0		-55	385	0.88		280	270	
19 Basino Selo	2006-10-16	2.5	10.8	15.0	6.0	7.29	-17	294	2.64		222	204	
20 Basino Selo	2006-11-25		8.5	7.5	7.5		-45	308	0.88		207	193	
21 Basino Selo	2006-12-20	5.0	6.2	4.0	5.0		-46	320	0.00		232	219	
22 Basino Selo	2007-01-22	5.0	8.0	10.0	3.0	7.71	-46	334	1.50		221	196	
23 Basino Selo	2007-02-11	2.5	8.6	11.3	6.0	8.06	-46		0.00		238	223	
24 Basino Selo	2007-03-04	2.5	8.8	11.5	7.5	7.73	-45	351	0.00		258	225	

In this case station names on the river water quality sheet are taken from the *Monitoring\_Stations* sheet and parameter symbols or names used as column headings are taken from the *Parameters* sheet. Without ticking the *Use Excel lookup*, the Excel book would only hold one sheet (*River\_water\_quality*).

The same Excel file could now be edited and returned to DIS and thereby update the database. For example, our user might change some of the many numbers shown above and add a couple of new rows with data for an existing station but with new sample dates. She could even add a new station (at the *Monitoring\_Stations* sheet) or a new parameter (at the *Parameters* sheet).

Excel upload is well suited for more comprehensive database updates. If the changes are minor another method is more appropriate, namely using context menus. Let’s assume the user wants to move a weather station 100 meters East of where it is now.

First she switches the weather station map layer on and locates the station for example by typing its code in a search box (see *WM 6*). A click on the station on the map triggers a database query and results are shown on the webpage. Among those are the geographical coordinates X, Y and zone. She right-clicks these coordinates and gets an opportunity to edit their values (since she is logged in as a meteorologist). Then she increases the X value by 100 and clicks a *Save* button. After a while she notices with pleasure that the point on the map moves a bit eastward.

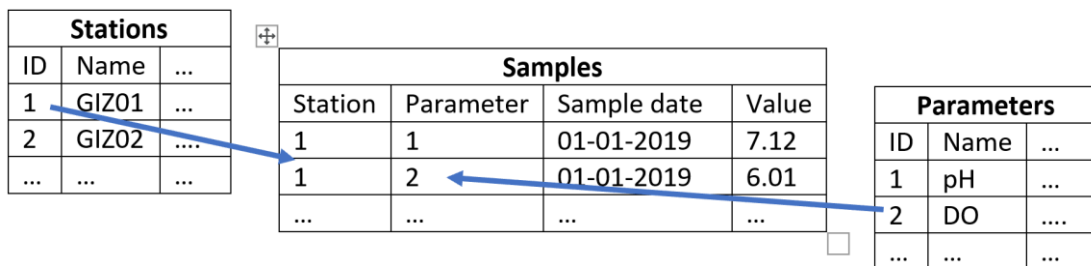
**3.2.3 Database Queries and Updates – Feature Requirements**

**DB 1**    Map queries

As described under *WM 8* a click on a queryable map, triggers a database query. Depending on the map layer three situations can be distinguished:

- No time-series or depth profiles; only a record with data about the clicked site is retrieved from the database
- Time-series as well as site data are retrieved as a 1-many relation: typically, 1 monitoring station, many samples
- Two independent variables, time and depth: typically, depth profiles in a lake or reservoir.

In order to make adding and deleting of stations as well as parameters flexible, the recommended database table structure is to use three tables when time is an independent variable:



The same structure can be used for depth profiles, except that the *Samples* table should be replaced by a *Profiles* table with one more column: *Depth*. See Annex 2 for details.

**DB 2**    Excel downloads

Two types of Excel files will be relevant to download:

- DIS data for the general user; these files shall also function as templates for uploads by logged-in users
- Excel files in special formats requested by EEA for uploads to [WISE](#) and [Eionet](#)

The normal DIS data Excel files shall be able to handle 0, 1 and 2 independent variables, that is site data only, time-series and depth profiles.

The user shall be able to select between downloads

- for the current site only or for all sites (or stations) in the current map layer
- with or without Excel lookup

These choices were illustrated above in Section 3.2.2.

Since the downloaded files also shall act as uploads, [VBA](#) code in the files shall implement formatting, data validation and locking of cells that cannot be edited. Ideally only one Excel file should exist, which handles all special cases via VBA code running only once when the file is first downloaded.

For Excel files intended to be submitted to EEA, file templates following the, sometimes changing, formats defined by EEA must be used. As many fields in these files as possible should be filled automatically with data from the DIS database before download. Due to the volatile nature of the EEA templates, it is important to isolate server code that extracts DIS data into one easy-maintainable module for each EEA template. In DIS 1.0 only one of the EEA-defined templates shall be implemented for automatic filling with monitoring results from the DIS database, namely disaggregated water quality data ([WISE-4](#)).

### DB 3 Right-click updates

Each control on the DIS webpage panel holding query results, which are not derived information but raw data, will correspond to a field in a database table and shall be updateable after password verification. The user right-clicks the control and is offered choices on a context menu like *Edit*, *Add* and *Delete*. Upload a photo may also be one of the context menu items, see DB 5 for more details.

Whether the editing shall take place directly in the control or inside a popup dialog is up to the developer. In any case a pair of *Save* and *Undo* (or *Cancel*) options shall exist. *Undo* could just be a click outside a dialog without hitting *Save*. Any errors during updates on the server shall be shown to the user.

### DB 4 Excel uploads

After proper login, bulk database updates can be carried out by uploading Excel files. Typically, data in these files originate from a laboratory, field instruments, manual encoding or as downloads from a national system in one of the riparian countries.

It is vital that validation of these data from inhomogeneous sources is very strict. Some validation shall take place via VBA code in the Excel file itself, but even more important is the validation at the server side. Data type shall be checked for validity, values for being outliers as well as uniqueness, for example for sampling dates. Some parameters are monthly values, some daily and some continuous in time, and that affects the validation algorithm.

As an example, precipitation should probably be stored as accumulated monthly values in mm. To prevent duplicates, the Excel sheet with precipitation data therefore might show columns with month names and rows with station and year, despite the database table with these data must be normalized and therefore hold columns with sampling time, station ID, parameter ID and value only.

**DB 5**     Photo uploads

At least one photo per site (monitoring station, discharge point, water abstraction site, hotspot, administrative unit or village) shall be able to be uploaded and shown on the query result panel of the website. The user shall see the upload option as a context menu item after proper login verification.

**DB 6**     Map uploads and downloads

Whether digital maps will be implemented as shapefiles, Google Maps API JavaScript objects or something else, coordinates and a few attributes (ID, label and optionally a class) of points, lines or polygons need to be uploaded when a new map layer has been produced, for example by a GIS department. The upload option shall appear as a menu item enabled after proper login and when selected, show a dialog.

A logged-in user shall also be able to select and download a map layer in a relevant format, such as zipped shapefiles. An alternative would be to establish a web feature service, [WFS](#), but including password verification (which is not standard for WFS).

**DB 7**     User administration

A user role defines which activities a logged-in user can perform:

- Update monitoring data, stations, parameters and photos for a specific topic (river water quality, lake water quality, groundwater, hydrology, meteorology, wastewater, solid waste, industries, etc.)
- Upload and download vector maps
- Prepare files to be submitted to EEA and Eionet
- Translate texts used by DIS to other languages than the native language used for its design
- Create/remove user accounts, grant/revoke user roles, and reset passwords

The last role can only be taken by one user (*Admin*) and *Admin* cannot remove himself. All users can change their own password after login.

Information on the uploader and the uploaded content should be immediately reported by the system to the power users and administrator after upload/changes made.

A user with one or more of these roles has a user profile, which means a user ID, an email address, a mobile phone number and a password, all stored in the DIS database. Passwords shall be hashed. See also Annex 2 under *Users*.

Users with none of these roles are either normal visitors to the DIS webpage who have no user ID or password, or they do have a user ID and password in which case they can see what a logged-in user can do but they cannot do it.

For registered users, email and/or mobile phone number shall be used by a “Forgot password” function to return a temporary password via email or SMS to a forgetful user.



## 3.3 User Interface

### 3.3.1 User Interface – Description

Besides navigating and updating the DIS database using clicks on map objects or Excel uploads as described above, the user interface shall allow for several functions and tools.

Functions include the following:

- The user interface language can be switched to one of four (Albanian, Macedonian, Montenegrin, Greek) besides English, for example with a click on a national flag
- Users shall be assisted with tooltips that show when hovering over non-obvious options or concepts
- Links to posting on social media accounts used by GEF and their partners (mainly Twitter, Facebook and YouTube)
- Printing tables and exporting charts and map selections for publishing with Word and as PDF.

Tools should be made available in order to:

- Do simple statistics: average, min, max, N and [CV](#) as line chart and standard deviation and other percentiles as [box-whisker](#) or similar
- [Flow duration curves](#) and Q-H curves as line chart and table
- [Standardized precipitation index](#) as stacked bars and table
- Forecast models for demography: linear/exponential/logistic
- Login with validation, change password, reset password via SMS or email, and logout

### 3.3.2 User Interface – Stimulus/Response Sequences

A user is in the process of reviewing WFD pressure-impact assessments for Lake Ohrid using DIS.

Initially he inspects population growth in the area by running the demographic models in DIS based on combined census data for Albania and North Macedonia.

From that he makes an estimate of sewage discharge to the lake and its tributaries. These figures are then compared with treatment facilities in the area by querying the WWTPs map layer.

Finally, some river and lake water quality monitoring results are used to estimate nutrient loading on Lake Ohrid and used to evaluate the risk for eutrophication.

### 3.3.3 User Interface - Feature Requirements

*UI 1*     Panels on the webpage shall make room for the map, a layer switcher, query results, parameters, links to social media and a header with logo

*UI 2*     Menus or other widgets shall allow users to:

- Handle map navigation, switching and querying as described under *WM 2, 3 and 6 – 10*.
- Switch language for the user interface
- Get help via tooltips
- Prepare tables ready to be inserted into Word or to be printed out

- Export maps in a predefined layout, as exemplified by the map in Section 1.1, as PDF or JPG files
- Export charts and other graphs, including a logo, as PDF or JPG files

UI 3 For charts and tables representing time-series or depth profiles, dropdowns or similar widgets shall allow for parameter selections, switching between calculations (statistics, demography, etc.) and chart types, and selection and grouping of series.

UI 4 A *Login* toggle-button starting a user verification, and when successful, enables an *Admin*-menu with at least these options:

- User administration (only enabled when the logged-in user is *Admin*)
- Map uploads and downloads
- Online translation

Further, after login, a *From Excel* menu shall show subjects like Water Quality, Hydrology etc. enabled or disabled depending on the logged-in user's credentials. Also, context menus for editing, adding and deletions shall be enabled depending on user credentials.

## 4. Nonfunctional Requirements

### 4.1 Delivery and error control

The DIS web application itself, including database and maps, shall be installed by the successful bidder, on a server during delivery. Installation includes web server configuration and setup of scheduled backup. It is required that fully operational DIS will be installed on the location of contractors choice (any of the Drin project countries, Athens, cloud etc.) Hosting facility will be chosen by contractor based on the operating environment selected by the developer, see Section 2.4. Anyhow, for initial testing and presentation developer should secure own hosting environment until delivery is made.

Any discrepancy between specifications given in this document (the SRS) and the actual behavior of the delivered system is considered a software error, which shall be corrected when discovered, free of charge up to one year after delivery.

Corrections to the software after delivery, which are considered new features, shall be implemented based on negotiations between contractor and developer.

### 4.2 Training Plan

It is the responsibility of the developer to deliver training for selected staff. Normal visitors of the DIS webpage obviously should not need any training assuming the web design to be intuitive and tooltips to be abundant.

Training is only needed for Government staff functioning as

- Administrator
- Power user
- Encoder

One or two user administrators need to practice creation, updating and removal of user profiles, and how to reset passwords. Simple instructions on why passwords must be kept secret and how to secure that, is part of the training, but most important is learning-by-doing. Probably the training would take around one hour and it stops when the trainees can create three successful user profiles in a row.

A 1-day training of staff assigned to update sections of the database requires a bit more attention and planning. Everybody in the group of power users and encoders must learn how to

- Login and logout
- Update query results shown on the web page using context menus (right-click menus)
- Download, update and upload Excel files for all media covered by DIS (water quality, hydrology, meteorology, etc.)
- Download and upload map layers
- Upload photos
- Update coordinates for point maps

Again learning-by-doing is the preferred teaching method. Relevant exercises should dominate the training plan. It is suggested to clone the DIS server and create a “sandbox” where trainees can test their skills without risk for destroying the datasets, photos and maps used for production.

It is further recommended to use real-life data during the training to enhance motivation, and hopefully even do some serious work that way. The training can stop when each trainee has uploaded and updated at least three datasets of their own without any assistance.

Handouts are prepared for the encoders as a booklet (virtual or real) that describes all steps during encoding and updating, see next section.

### 4.3 Documentation

Two pieces of DIS documentation shall be prepared by the developer:

- Guide for Encoders
- DIS Technical Reference

These documents can be prepared as electronic documents (HTML, PDF etc.) or on paper.

The guide for encoders is a simple step-by-step reference on how to update the DIS database whether it is via the webpage directly or via Excel. This guide shall be used as handouts during training of encoders.

The DIS Technical Reference is a more comprehensive document, which shall hold enough details to allow transfer of maintenance of the mapping system, database and not least the user interface (JavaScript) to another developer.

### 4.4 Reporting and deliverables

It is required that consultant closely liaise with the GWP-Med officer during implementation of this assignment.

The consultant is expected to deliver the following tasks/deliverables:

- 1) Inception (any clarifications needed must be finalized during inception; maps and data will be handed over to the designer in this phase)
- 2) Operating environment requirement specification to be used for contractor decision on hosting
- 3) Design of a DIS 1.0
- 4) Launching DIS 1.0
- 5) Installation and server configuration
- 6) Prepare and deliver training
- 7) Prepare documentation
- 8) Error control

### 4.5 Schedule of activities and milestones

Task	Deliverables	Deadline
------	--------------	----------

Inception	Inception status note	Two weeks from contract signing
Operating environment requirement	Operating environment requirement specification for hosting	Two months from contract signing
Design DIS 1.0	A working prototype	Five months from contract signing
Launch and presentation	A demo at the GWP-Med premises or on Skype	Five months from contract signing
Installation and server configuration	DIS available on the Internet	Six months from contract signing
Prepare and deliver training	Trained user admin, power users and encoders	One month after installation
Prepare documentation	<ul style="list-style-type: none"> <li>• Guide for Encoders</li> <li>• DIS Technical Reference</li> </ul>	One month after installation
Error control	Error corrections based on the contractor requests	one year after installation

## 4.6 Qualification and Experience

### Qualification Requirements

**The Consultant** shall have:

- experience in developing and managing complex projects preferably in all the following areas, geographical information systems (GIS), web-based information management systems, database design and water resources / watershed management.
- a record of successfully implemented projects of this kind in the last 10 years with minimum 1 GIS portal developed (see note below).

An interdisciplinary Team of skilled experts with previous experience in IT and data/information management projects is required to carry out the tasks described above. The team of experts has to demonstrate ability to closely cooperate with GWP-Med; in this regard, the consultant has to demonstrate ability to communicate in English.

**Expertise and Experience of the team of experts:** The areas of expertise and experience that the team of experts is expected to cover to carry out the tasks described above, is listed below: (NOTE: there is no limitation on the number of experts per area of expertise). Failure to provide relevant minimum expertise is considered a ground for disqualification. The minimum experience is considered to be 3 projects /assignments in the respective area of expertise in last 5 years.

- Working experience in design of spatial information systems, databases and web applications
- Working experience in software and hardware that should be used to carry out the assignment
- Working experience in analyzing spatial data and doing statistical analysis

## 4.7 Evaluation

### 4.7.1 Evaluation criteria

Criteria - min. 100 points, max 150 points per Criterion:

- *Number of relevant to the assignment implemented projects over the past 10 years.*  
If the development of a 1GIS portal is not part of the projects implemented, then the proposal will be disqualified. A list of projects shall be submitted, stating the Project, the end clients, the budget of the Project and its duration, along with contact details for reference checking purposes (please indicate the e-mail addresses of contact persons). In so listing the end clients, the Participant is giving his consent to MIO ECSDE, to contact the relevant clients for reference checking purposes.
- *Qualifications note (five pages maximum).*  
The Note will:

- Explain the synthesis of the team as well as its qualifications and experience in relation to the requested services; the Note should indicate (in a Tasks Table) the experts that will be used for each of the tasks listed above (point 4.5) and provide a break-down of planned man-days per task and expert under each task. Failure to provide relevant expertise as indicated in the respective section under 4.6 is considered as ground for disqualification.
- Clearly describe the technology chosen by the developer and components to be utilized
- Describe level of compatibility of the technology chosen with the format and type of data already available to be utilized (as described in 1.1)
- Provide list of the software/component to be delivered along with the statement that necessary licenses are perpetual and included in the offer *and* that error control will be performed one year after delivery at no additional costs to the contractor

**Failure to provide any of the above is considered a ground for disqualification**

- *Expertise and Experience of the team (proven through the CVs of experts).* Failure to provide relevant expertise as indicated in the respective section under 4.6 is considered a ground for disqualification.

**4.7.2 Award Criterion – Evaluation of Offers**

**Award criterion**

The Award criterion is the most economically advantageous tender on the basis of best price / quality ratio.

Offers shall be evaluated as follows:

Name of Firm / Participant:			
(1) Criterion	(2) weighting (w)	(3) points of criterion (c), 100-150	(4) Score = (2) x (3)
<i>Qualifications note</i>	20%		

<i>Expertise and Experience of the team</i>	20%		
<i>Number of relevant to the assignment implemented projects</i>	60%		
UTO	100%		

In case of equality of overall scores, the retained offer is the one whose corresponding technical Offer received the highest rating.

#### 4.7.3 Evaluation of Technical Offers

Scoring of each evaluation criteria varies within a range from 100 points up to 150 points (the latter awarded to the best qualified bidder for each criterion). Each evaluation criteria is evaluated autonomously, according to the respective technical offer submitted. The relative scoring of each evaluation criteria is the outcome of its scoring multiplied by its weighting. The overall score of the technical offer is the sum of the relative scoring of all the evaluation criteria.

The overall score of the technical offer is calculated on the basis of the following formula:

$$\text{UTO} = w_1 \times c_1 + w_2 \times c_2 + \dots$$

where  $w_1 + w_2 + \dots = 100$

**For the overall score which will determine the ranking of offers, technical evaluation will be weighted with 70%.**

#### Evaluation of the Financial Offer

Each financial offer is evaluated on the basis of the following formula:

$$\text{UFO} = 100 \times \text{max amount} / \text{financial offer}$$

**For the overall score which will determine the ranking of offers, financial evaluation will be weighted with 30%.**

Offers which have been rejected as inadmissible or as not meeting the minimum requirements shall not be evaluated.

#### Identification of the most economically advantageous offer on the basis of best price / quality ratio

The final listing of the most economically advantageous offers will be made on the basis of the following formula:

$$U = \text{UTO} \times 70\% + \text{UFO} \times 30\%$$

Where U is the total scoring if each offer

The most economically advantageous offers is the one with the greater value of U.

<b>Duration of the Contract</b>
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The overall duration of the contract will be maximum 6 months.

<b>Contract Price, Deliverables and Schedule of Payment</b>
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The maximum fee for this assignment is 60,000 USD. This amount includes all other costs, income taxes, VAT and any other amount payable or cost that may be required for the completion of the work/service.

All payments except the advance payment shall be upon reception and acceptance/verification of the deliverables, as laid out in the table below.























Task	Deliverables	Deadline	Payments
Contract Signing			10%
Inception	Inception status note	Two weeks from contract signing	
Operating environment requirement	Operating environment requirement specification for hosting	Two months from contract signing	
Design DIS 1.0	A working prototype	Five months from contract signing	
Launch and presentation	A demo at the GWP-Med premises or on Skype	Five months from contract signing	60%
Installation and server configuration	DIS available on the Internet	Six months from contract signing	
Prepare and deliver training	Trained user admin, power users and encoders	One month after installation	
Prepare documentation	(i) Guide for Encoders AND (ii) DIS Technical Reference	One month after installation	30%
Error control	Error corrections based on the contractor requests	1 year after installation	






## Annexes

### Annex 1. Map Layer Tree

Below is the hierarchy for map layers, proposed to be valid for a *DIS 1.0*. Map layers and datasets, which can be queried from the map layers in *DIS 1.0*, are reflected by what already is ready in a [prototype](#) for internal use plus new layers for river network and sub-sub-catchments. Layers with a link are not part of the prototype but can be downloaded and used for free (CORINE and a road network).

- Map layers
  - Admin units
    - Countries\* 
    - Municipalities\* 
    - Agglomerations\* 
  - Water
    - Surface water
      - River basins
        - DRB 
        - Sub-catchments 
        - Sub-sub-catchments\* 
      - River network\* 
      - Lakes and reservoirs\* 
      - Wastewater
        - WWTPs\* 
        - Wastewater outlets 
      - Aquaculture 
      - Monitoring stations:
        - River water quality sampling sites\* 
        - Lake water quality sampling sites\* 
        - Gauging stations\* 
        - Weather stations\* 
    - Groundwater
      - Hydrogeology 
      - Monitoring stations (wells)\* 
  - Soil and land-use
    - Geology 
    - Soil types 
    - [CORINE](#) Level II land cover 
    - [Road network](#) 
    - Solid waste
      - Waste disposal sites 

- Fly-tips •
- Industries and emissions
  - Enterprises\* •
  - Hotspots and mines\* •

All end-nodes in the tree are map layers. A star \* indicates that the layer can be queried (has attributes in a database which are shown with a click on the map object). A layer consists of either polygons, lines or points as indicated by these symbols:   

## Annex 2. Recommended Database Structure

The database structure shown below holds a minimum number of tables with their fields and relationships. Not all details are shown and not all lookup tables are listed. A boldface field means primary key, which is composite when there is more than one per table. If a *Layers*-clause appear under a table name it refers to map layers in Annex 1 that can query the table. WB means waterbody.

Table	Field	Type	Relationship / Comment
<b>Admin Units</b> Layers: • Countries • Municipalities • Agglomerations	<b>ID</b>	Int	
	Parent	Int	ID for admin unit to which this belongs
	Level	Int	Lookup: 1=Country, 2=Municipality, 3=Agglomeration
	Name	Text	Multilingual
	Area	Float	km <sup>2</sup>
<b>Population</b>	<b>AU</b>	Int	ID for Admin Unit
	<b>Year</b>	Int	Census year
	Total	Int	Total population within this Admin Unit
	Females	Int	Female population
<b>Basins</b>	<b>ID</b>	Int	
	Parent	Int	ID for basin to which this belongs
	Level	Int	Lookup: 1=Drin, 2=Sub-basin, 3=Sub-sub basin
	Name	Int	Lookup in a multilingual table
	Area	Float	km <sup>2</sup>
	Acc Area	Float	Accumulated upstream area
	Precipitation	Float	Mean annual precipitation in the basin
<b>Waterbodies</b> Layers: • River network • Lakes and reservoirs	<b>ID</b>	Int	
	Next	Int	ID for next downstream WB; 0 if mouth
	Main	Int	ID for upstream WB w/largest accumulated area; 0 if source
	Tributary	Int	ID for upstream WB w/smallest accumulated area; 0 if source
	Basin	Int	ID for smallest basin where this WB is entirely within
	Code	Text	Pfafstetter code
	River	Int	ID in a river name lookup table
	Type	Int	1=river, 2=lake, 3=transitional, 3=groundwater, 4=coastal
	Length	Float	WB length
	Acc Length	Float	Accumulated length to mouth
	Min elevation	Float	Meter above sea level
	Max elevation	Float	Meter above sea level
	Modified	Int	Lookup: 1=Natural, 2=Artificial, 3=Heavily modified
<b>WWTPs</b> Layer: • WWTPs	<b>ID</b>	Int	Wastewater treatment plant ID
	Municipality	ID	Lookup: Admin Units
	Name	Text	
	Status	Int	Lookup: Operational, Suspended, etc.

	Start year	Int	
	Efficiency	Float	%
	Method	Int	Lookup: 1=Primary, 2=Secondary, 3=Tertiary treatment
	Design capacity	Float	
	Operational capacity	Float	
<b>Stations</b> Layers: <ul style="list-style-type: none"> <li>• River water quality sampling sites</li> <li>• Lake water quality sampling sites</li> <li>• Gauging stations</li> <li>• Weather stations</li> <li>• Wells</li> </ul>	<b>ID</b>	Int	Monitoring stations
	Type	Int	Lookup: 1=river water quality, 2=lake wq., 3=gauging station, 4-weather station, 5=groundwater borehole
	Subtype	Int	Lookup examples: Active, Suspended, Terminated, Unknown
	Compliance	Float	Shown as %. See WM 11.
	Name	Text	Multilingual
	Code	Text	
	X	Float	X-coordinate if UTM, longitude if lat/long
	Y	Float	Y-coordinate if UTM, latitude if lat/long
	WB	Int	ID for nearest waterbody
	AU	Int	ID for smallest admin unit to which this belongs
	Start year	Int	
	End year	Int	
	Photo	Link	
	Sol	Text	Source of Information including links to labs, etc.
<b>Parameters</b>	<b>ID</b>	Int	
	Type	Int	Same as Type in Stations table
	Name	Text	E.g.: BOD
	Symbol	Text	E.g.: Biochemical Oxygen Demand
	Unit	Text/Int	Unit of measurement; could be lookup. E.g.: mg/l
	Code	Text	Laboratory code
	Std Lim Lo	Float	Lower standard limit (if any)
	Std Lim Hi	Float	Upper standard limit (if any)
	LoD	Float	Limit of detection (if applicable)
	CAS	Int	Lookup: Chemical Abstract Sservices or similar identifier
	Method	Int	Lookup: Analytical method, WMO practice etc.
	Min	Float	Absolute smallest value for this parameter (to catch typos)
	Max	Float	Absolute largest value for this parameter (to catch typos)
	Rule	Text	Inequality to catch inter-parametric errors, e.g. >BOD for COD
	Fraction	Int	Lookup: 1=total, 2=dissolved, 3=suspended particulate matter
Format	Int	Lookup for how numbers are presented (decimals, % etc.)	
	Formula	Text	Used to calculate derived parameters like DO% and ammonia
<b>Samples</b>	<b>Station</b>	Int	ID for station
	<b>Parameter</b>	Int	ID for parameter
	<b>Sampling Time</b>	Date	
	Value	Float	From lab or in situ
	Flag	Int	Lookup: used for outliers, rule violators etc.
<b>Profiles</b>	<b>Station</b>	Int	ID for station
	<b>Parameter</b>	Int	ID for parameter
	<b>Sampling Time</b>	Date	
	<b>Depth</b>	Float	Meters below surface
	Value	Float	From lab or in situ
	Flag	Int	Lookup: used for outliers, rule violators etc.
<b>Enterprises</b> Layer:	<b>ID</b>	Int	
	Name	Text	

<ul style="list-style-type: none"> <li>Industries</li> </ul>	Link	Link	Homepage for the enterprise
	WB	Int	ID for nearest waterbody
	AU	Int	ID for smallest admin unit to which this belongs
	Type	Int	Lookup: <a href="#">ISIC</a> (UN)
	IPPC	Bool	See also WM 11
	Water abstraction	Float	m <sup>3</sup> /year
	Emissions	Text	
	Number of employees	Int	
	Production rate	Text	
<b>Hotspots</b> Layer: <ul style="list-style-type: none"> <li>Hotspots</li> </ul>	<b>ID</b>	Int	
	WB	Int	ID for nearest waterbody
	AU	Int	ID for smallest admin unit to which this belongs
	Description	Text	
<b>Layer Tree</b>	<b>ID</b>	Int	
	Parent	Int	ID for parent node or 0 if root
	Label	Text	Multilingual text on the branch of the tree
	Tooltip	Text	Multilingual tooltip when hovering over on the branch
	Shapefile	Text	Some kind of link between end-node and map layer
<b>Users</b>	<b>ID</b>	Text	Unique user-ID
	Password	Text	Encrypted password (e.g. <a href="#">SHA-2</a> )
	Authorization	Bits	Bitmask with credentials for this user
	Email	Text	
	Phone	Text	

Annex 3

<b>SECTION 1 - EXPERTISE OF FIRM/ ORGANISATION</b>						
<i>Track Record and Experiences: Provide the following information regarding corporate experience within the last ten (10) years which are related or relevant to those required for this Contract.</i>						
<i>Name of project</i>	<i>Client</i>	<i>Contract Value</i>	<i>Period of activity</i>	<i>Types of activities undertaken</i>	<i>Status or Date Completed</i>	<i>References Contact Details (Name, Phone, Email)</i>