



018530 - SWITCH

Sustainable Water Management in the City of the Future

Integrated Project
Global Change and Ecosystems

Deliverable D1.4.3 (Replaces D1.4.5 - D1.4.8 and D1.4.16 from original DoW)

The City Water Information System (CWIS) - Training package

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Organisation name and lead contractor for this deliverable: Swiss Federal Institute of
Technology, Lausanne (EPFL)

Revision [final]

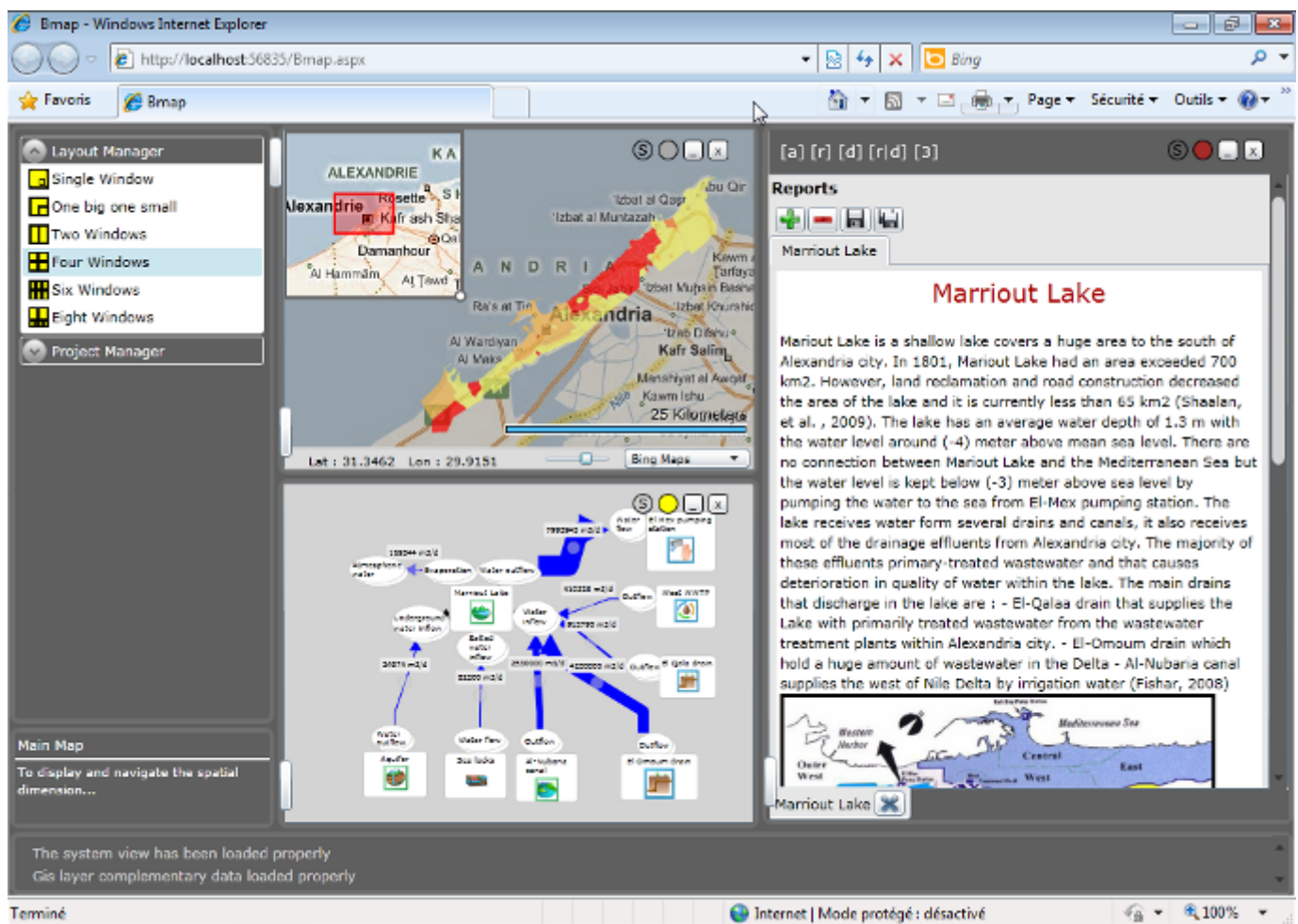
Project co-funded by the European Commission within the Sixth Framework Programme (2006-2011)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

SWITCH Deliverable Briefing Note

SWITCH Document: City Water Information System (CWIS)
Deliverable reference: D1.4.3 (includes D1.4.5, D1.4.5.6, D1.4.7 and D1.4.8 from original DOW)
Author(s) and Institution(s): Colin Schenk, Bastien Roquier, Marc Soutter / EPFL
Publication date: 30 Apr. 2011
Audience Learning alliances, public bodies, researchers, anybody having to deal with complexity, global and integrated approaches to resources management.
Purpose To provide knowledge and information sharing platform to support global and integrated urban planning.
Background Sharing information and knowledge is a very basic first step in the multi-thematic and multi-stakeholder global and integrated approaches that have long been recognized as necessary step towards a more sustainable practice of natural resources management. The City Water suite of tools and, more specifically, the City Water information System, have been designed to address complex strategic planning issues that are a major characteristic of urban water management challenges for the cities of the future.
Potential Impact With its modular structure, including three complementary data viewing tools (reporting, geographic and systemic), its system-based database and its ability to handle scenario/situation data, the City Water Information System offers a unique tool to address complex, multi-thematic and multi-stakeholder issues in a global and integrated framework. Due to its generic layout, based on ontologies, this novel, if not revolutionary, Web-based information system is not restricted to integrated urban water management but has a very broad range of potential fields of application.
Recommendations Try out the online demo version

The City Water Information System (CWIS)

Welcome to CWIS



The City Water Information System (CWIS) is an integrated Web-based software application to explore a same set of information according simultaneously to standard document logics (text/image/hyperlinks), to spatial logics (geographic layout) and to system logics (hierarchies, interrelations).

Its most distinctive features are:

- a modular structure with three independent modules that can be synchronized (i.e. share a same selection of system elements), the **active reporting tool**, the **geographic viewer** and the **system viewer**,
- an underlying generic **system-based database** structure that allows working with **ontologies** (i.e. libraries of system elements describing a given domain, in the present case integrated urban water management). The database is thus able to store any kind of data, with a very high flexibility and adaptability to changes in the objects and attributes that are hosted. Furthermore, potentially any data format can be supported (text, numeric, image, video, geometries, binary, etc.),
- design to support **scenario planning** approaches, the City Water Information System has the ability to manage alternative **situations**, in addition to the temporal dimension of information. The information displayed in the various viewers is thus conditioned by a time context and a situation context: a system element is only displayed if its time tags match the selected time span and if it belongs to the active situation/scenario. System elements belonging to alternative situations may also be displayed but in a dimmed mode.

CWIS and the City Water suite of tools

CITY WATER is a knowledge and information sharing platform to support global and integrated urban planning. With its full set of tools it is meant to help you understand water in your city;

- To understand the different components of the water system in your city, their inter-linkages and aspects of water within a city.
- To understand how water links to other aspects of the city management – for example in education, health, transportation, planning, economic activities.
- To help evaluate the future potential impacts of global trends on the water of your city. Your city might be at risk from climate change, population growth, depopulation or energy cost increases.
- To help evaluate the technical options which need to be considered now so that these impacts can be addressed.

Structure and components of City Water

- The **CWIS** or **City Water Information System**, with its two components
 - The **City Water Database**, i.e. the city specific information organized according to the database structure, to take advantage of the front end tools,
 - The **Web-Server** that provides the data to the client application or front end
 - The **Front End** : some fundamental tools to connect to databases and manage the workspace, plus three different interlinked viewing tools :
 - The **Data viewer/manager**, i.e. the tool aiming at navigation in the database contents,
 - The **Geographic viewer**, i.e. the tool proposed to navigate information on a spatial basis,
 - The **System viewer**, i.e. the tool proposed to navigate information on a systemic basis,
- The various **City Water Simulation models** (simple screening models) :
 - City Water **Balance**, a scoping model to assess the sustainability of a city's water system using indicators. Central to the model is the water balance which is calculated using meteorological data on a daily time-step for an area divided into clusters based on common land use.
 - City Water **Drain**, a model for assessing the interactions between elements of the urban drainage system on a sub-daily time basis:



CITY WATER

A knowledge and information sharing platform to support global and integrated urban water planning

offering

A Combined Information System,

- Generic Database
- Geographic Viewer
- Reporting tool
- Systemic Viewer
- And more...

Linked to a Set of Screening Models

- City Water Balance
- City Water Economics
- City Water Drain
- And more...

catchment runoff, sewers, treatment plants and receiving waters.

- City Water **Economics**, a model to explore the potential economic implications of future strategies on urban water management by analyzing scenarios for cost recovery & economic drivers for change (financing, pricing and subsidies).
- City Water **Risks**, a tool to evaluate the city responses to global change pressures in terms of risks and uncertainties.
- Various **other simulation models** that might also be linked to the CWIS

Data requirements

In order to use the **City Water Information System**, there are no special requirements on data. The more information in the database, the more can be explored and/or shared. It is perfectly possible to start setting up City Water with a very limited set of initial data and feed the system progressively. Much in the same spirit, one does not necessarily have to use the full range of viewing tools : it will be perfectly possible to work, to give an example, with the data manager (reporting tool) alone or the Geographic viewer alone.

In order to use the **City Water Simulation Models**, a limited minimum set of data needs to be stored in the database. What exactly those data are will have to be described in details by the model developers. However, if some of those data would be missing, it simply means that it will not be possible to run the specific model(s) that need those data, but it will still be possible to use **information system** to play around with the information available in the database.

Different kinds of information can be stored in the City databases :

- Numeric values,
- Texts, including URL addresses (link to Web sites)
- Files (pdf files, images, etc.)
- Geometries (spatial objects)
- Lifetimes

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Getting Started

Choose one of the following sections:

[Software architecture](#)

Explains the different parts of the software

[System Requirements](#)

What computer and software are required to setup the database and the server, and run the application

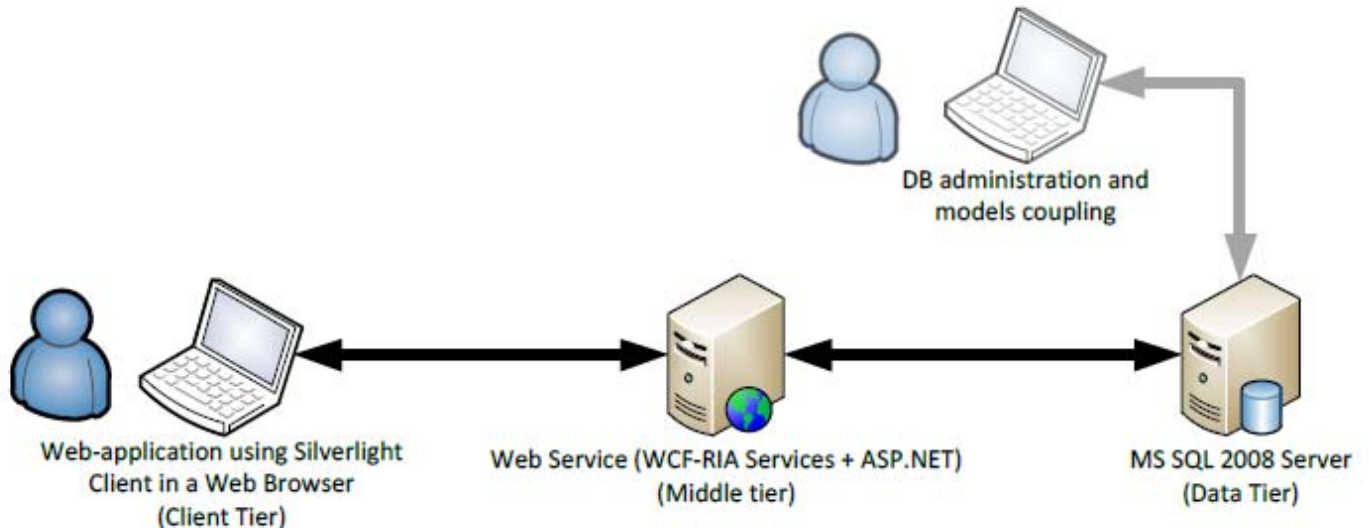
[Getting Help](#)

Provides the different ways to access City Water Information System help resources

Software architecture

The City Water Information System is built as a 3-tier architecture, using the Microsoft Silverlight application framework and ASP.net 4.0 :

- The **data tier** consists of the database server and its database management system (DBMS), where data are stored and from which they are retrieved. In the DBMS (Microsoft SQL server 2008), the data are organised in the form of interconnected tables that follow a predefined database design.
- The **middle tier** is a web server (Internet Information Services IIS) that provides access points to the data and its transfer between the database server and the client(s). The mapping between the relational data stored in a Microsoft SQL Server 2008 and the programmatic objects used by the application is made by the “ADO.NET Entity Framework”.
- The **client tier** is hosted on the computer of the users (either permanently or loaded from a Web site) and mainly contains the [user interface](#) (i.e. the part of the software application that users see and interact with).



System requirements

Data and middle tier

Minimum configuration

- Windows XP, Windows Vista or Windows 7
- 200 MB of free disk space (depending on the database's expected size)
- Microsoft SQL server 2008 R2 (Express)
- Internet Information Services IIS 6.0 or higher

Setting up the database and the Web server is not always straightforward, so that a system administrator should be in charge of that task. More details may be found at <http://www.ipogee.ch/Nexsis>

Client tier

Minimum configuration

- Windows, MacOS (Linux + MoonLight not tested)
- 500MB of RAM (2GB recommended)
- 20MB of free disk space
- 1024x768 screen resolution or higher
- Web Browser with the Silverlight 4.0 plug-in

Getting help

Access to help within the application itself

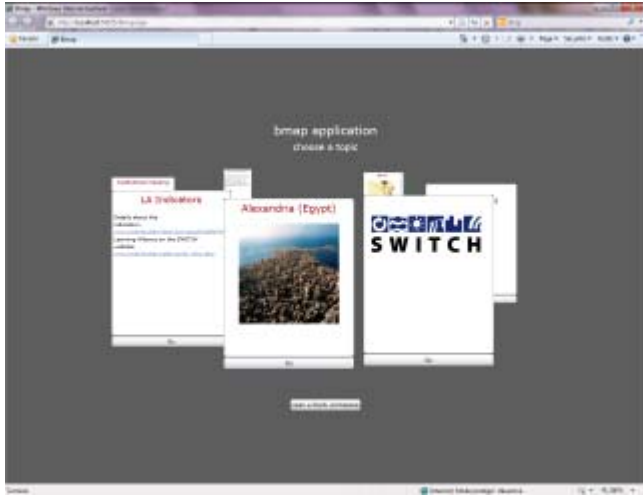
- in the help window,
- in a set of reports, part of a project called Info & docs.

On-line resources

- [download the .chm or .pdf user manual](#),
- [On-line version of the help file](#)

User interface

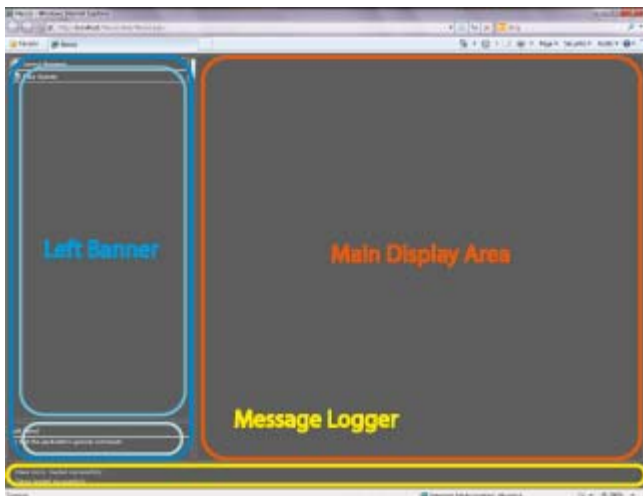
The **City Water Information System** starts with a dashboard where a set of predefined workspaces are proposed as starting points.



The general layout of CWIS' user interface divides the screen into three areas:

- The **main display area**, that will host different viewers (geographic, active report tool, system viewer),
- The **left banner**, that will host the commands,
- The **message logger** used to display messages to the user.

All of these areas may be resized by moving the splitters that separate them



The left banner hosts in its bottom part a small **help window** that displays some information related to the objects the mouse is pointing at.

Furthermore, the left lateral banner may be switched from a permanently visible state to an automatic show/hide behavior by clicking on the bean like button that stays on its top right border. Show/hide is triggered when the bean like button gets focus or when the left banner loses focus.

For more details on the general layout of the City Water Information System, and especially the controls that are provided by its left banner, look at the overall infrastructure section here after.

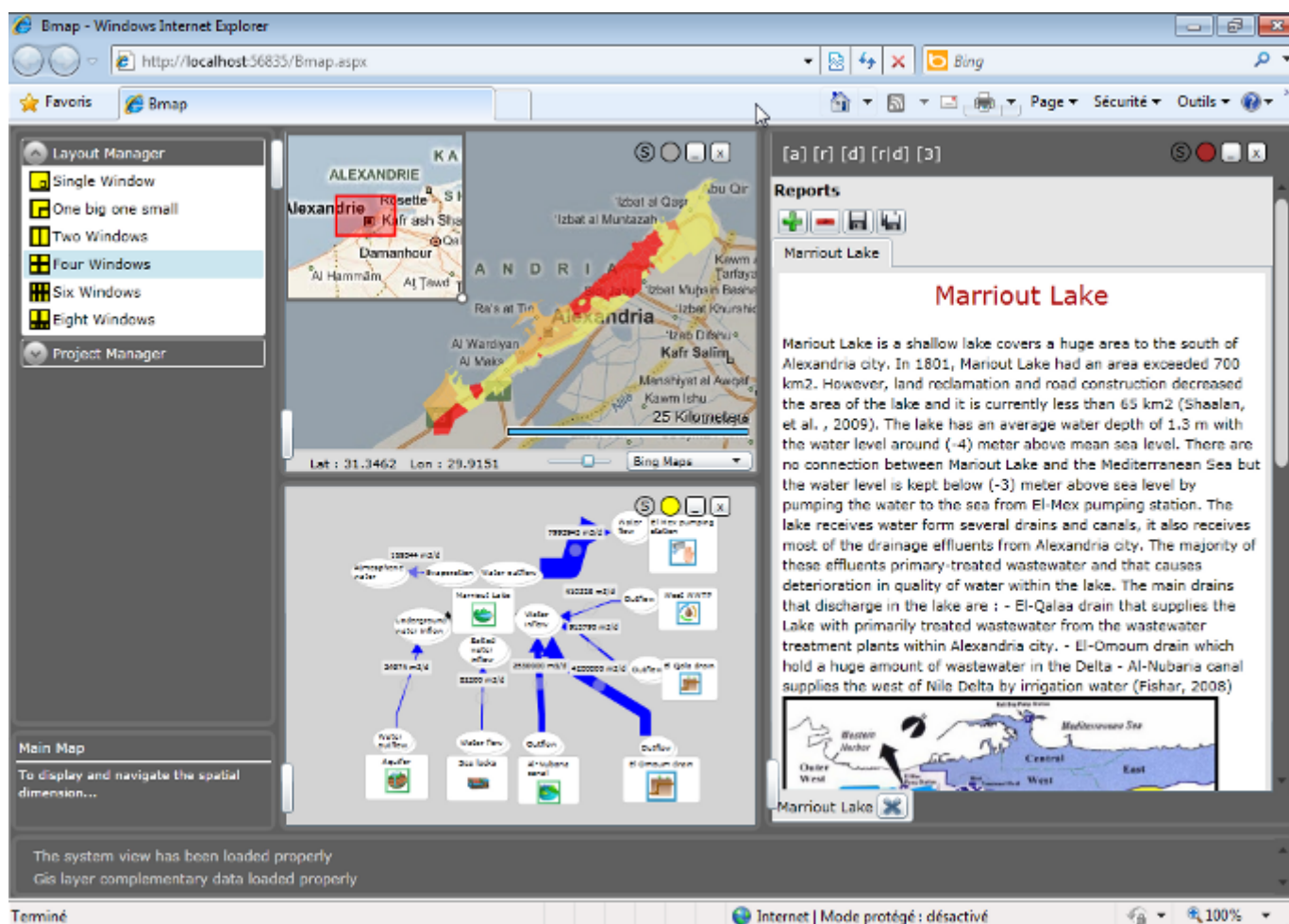
[Overall infrastructure](#)

[Geographic Viewer](#)

[Active Reporting Tool](#)

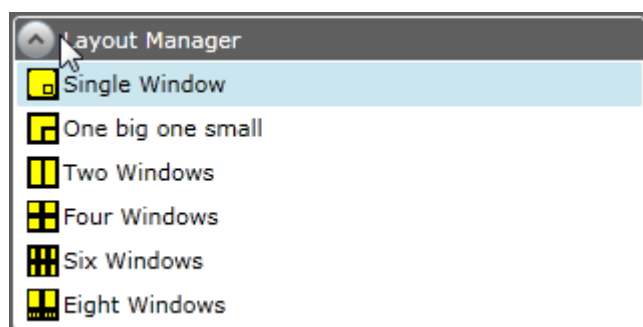
[System Viewer](#)

Overall infrastructure



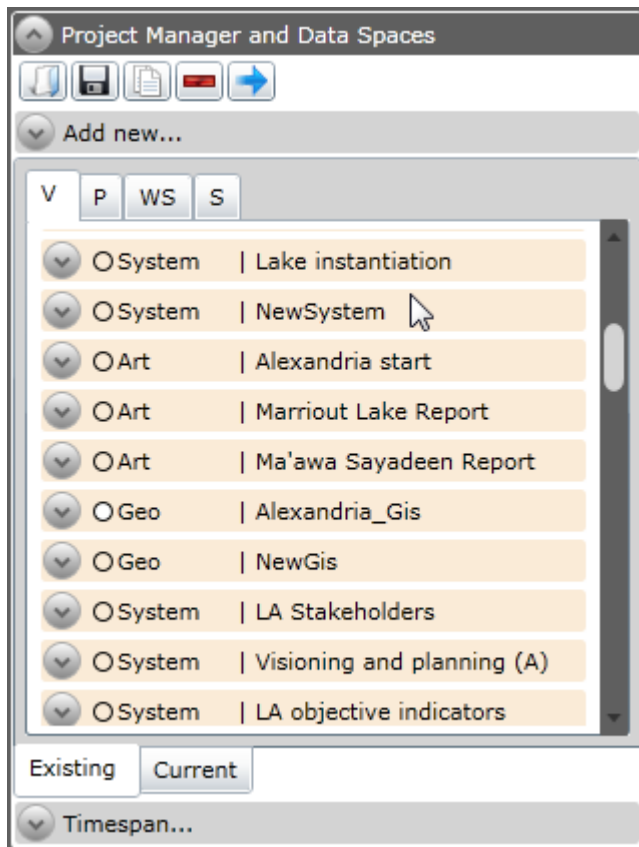
The general tools that are common to the whole application are located in the general lateral banner, with exception of the three buttons located on the upper right part of each View (see at the bottom of this section). This left banner may be set as visible or hidden (by a click on the bean-like button located on its upper right edge). If hidden, hovering the mouse over the bean-like button will automatically unhide the banner and hide it again when loosing focus.

- The **Layout Manager** allows to split the main display area into regions that will host the various views. Selecting one of the listed layouts will split the display area accordingly. Unlike other software, **CWIS** does not use overlapping tiled windows. The various subregions may be resized by clicking and moving the splitters that separate them.



- The **Project Manager and Data Spaces** control hosts four items:
 - (i) a tool bar with a bunch of buttons,
 - (ii) the **Add New...** expander,

- (iii) a set of tabbed lists, and
- (iv) the **Timespan...** expander.



These items are described here below, starting with the tabbed lists:

- These lists expose the **Views** (V tab), **Projects** (P tab), **Workspaces** (WS tab) and **Situations** (S tab) stored in the database.

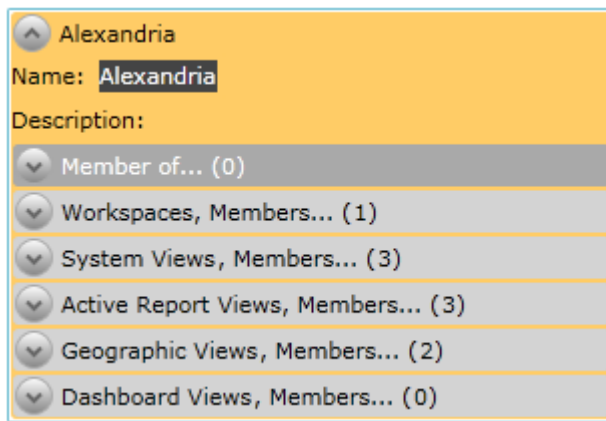
Views (V) are the elementary tools used to access and display data, either according to document logics (active reporting tool), to spatial logics (geographic viewer) or to system logics (system viewer). Dashboard views is a special case of views designed to be used in the dashboard that shows up at the startup of the application.

Workspaces (WS) may be seen as snapshots of the user interface: they store the main area's layout along with the views that are displayed in its various regions. Saving a workspace is a convenient way to store and retrieve the view configuration from a work session to the next, or to predefine a set of viewers for a group of inexperienced users.

Projects (P) may be considered as containers in which to host various views and workspaces that belong to a same concern/study/topic. Views as well as Workspaces may belong to several Projects.

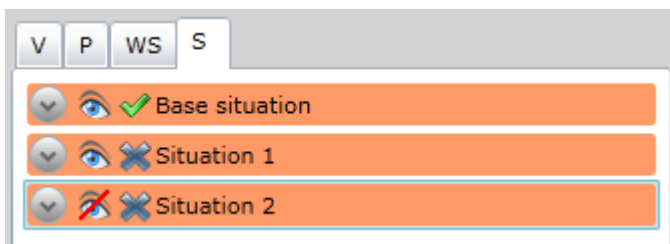
Situations (S) are actually subgroups of system elements (the system elements being the various items stored in the database, such as watersheds, wells, stakeholders, energy flux, and whatsoever, see the system view section for more details). The currently existing elements belong to a so-called base situation but may or may not belong to alternatives situations. Situations may thus be used to "filter" data and only display the data belonging to the situation(s) that have been marked as being visible.

As illustrated by the Alexandria Project Each of these items may be expanded and then renamed. In expanded form, the display some of their characteristics, such as the projects they belong to (Views, Workspaces and Scenarios) and the items they contain (Projects).



This group of four tabbed lists (V, P, WS, S) describe the overall **Existing** set of Views, Workspaces, Projects and Situations. One may define a subset of the **Current** Views and Situations that are used during a work session. When adding a view to the display, it will be automatically added to the current list of views. Views may also be added and removed from the current list by using the blue arrow buttons (see below).

Finally the **Situations** list is used to manage the visibility status of system elements according to the situations they belong to (an element may belong to several situations): elements belonging to the active situation (green V sign) have full visibility. Elements that do not belong to the active situation but do belong to another visible situation (eye enabled) are visible but dimmed. Elements that only belong to non visible situations are hidden. Situation related visibility status of elements may be set at the overall level or specified for each view independently (see specific views sections). Situations memberships of elements may be set and changed through contextual menus (see specific views sections).



- The **toolbar** exposes the following tools :



The **Open** button may be used to open and display a **View** or a **Workspace**. In the case of a View, the latter is opened and displayed in the first empty display area. If none of them is available, the view is simply loaded and added to the subset of **Current** Views. With **Views**, one can use the Drag and Drop operation, with the Ctrl-Key pressed, to replace the View in a display area by the one that is being dropped.



The **Save** button saves the selected item (View, Project, Workspace, Situation).



The **Copy** button adds a copy of the selected item at the bottom of the list (View)

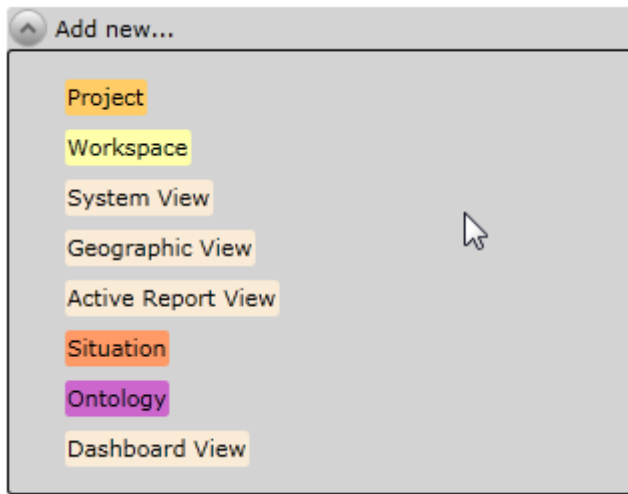


The **Delete** button deletes the selected item (View, Project, Workspace, Situation).



The **Transfer** buttons transfer the selected item (View, Situation) from the Existing to the Current set of items, and back.

- The **Add New...** sub section of the Data Spaces section provides the tools necessary to add new items (View, Project, Workspace, Situation) using the Drag-Drop operation, with the Ctrl-Key pressed. These items can either be added to a region of the display area (Views) or in the item tabs below (V, P, WS, S).



- The **Time Span** section is meant to filter displayed data according to a defined "time window" (not implemented yet).



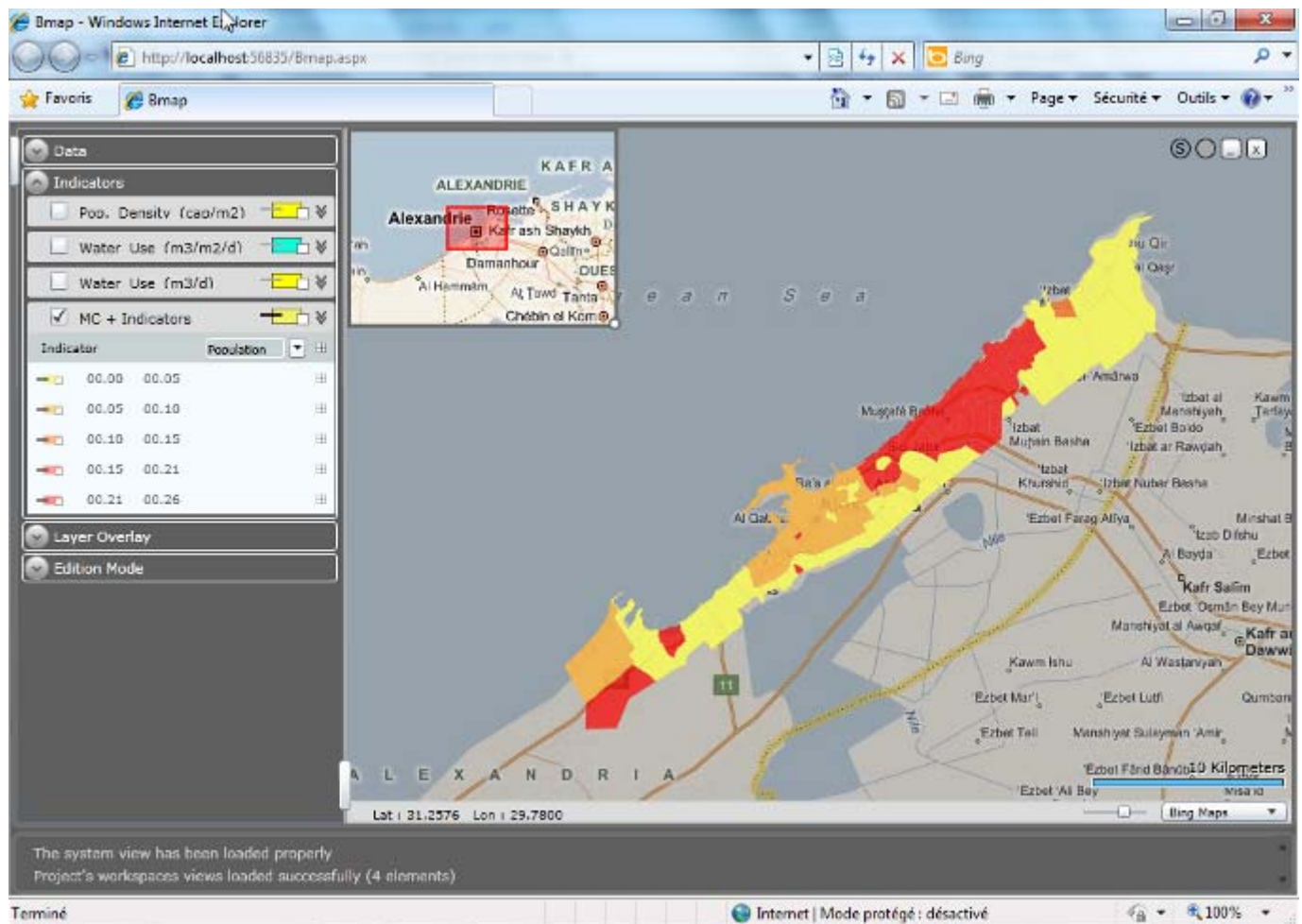
Each View in the display has a set of three small buttons in their upper right corner. Dragging the left one (depicted with an S), again with the Ctrl-Key pressed, from a View and dropping it onto another View will synchronize the current selections of those two Views. A Right-Click on this same button will deactivate the synchronization.

The middle button is used, with the Ctrl-Key pressed, to drag a view from one region and drop it into another one. The color tag is reflected in the View list.

The right button will remove the View from the display.

Geographic viewer

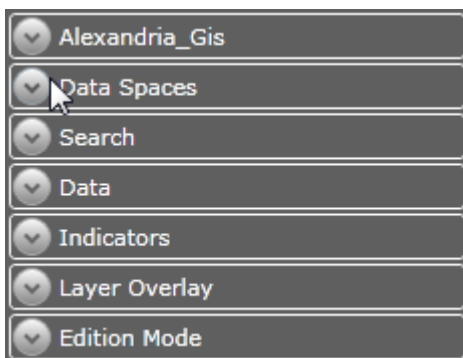
To browse information on a spatial basis...



- **Pan and Zoom.** So far panning and zooming are implemented in a very simple and straightforward way: panning is achieved by moving the mouse around with the left button pressed, whereas zooming is achieved with the mouse's scroll button.
- **Background Layer.** The map's background layer may be changed using the bottom right Combo Box whereas the background layer's opacity may be set with the nearby slider



- **Mini-map.** The Mini-map shows the area covered by the main map at a (usually) larger scale in the form of a red square. The Mini-map can be resized by dragging the small button located at its bottom-right corner. A Double-Click on this button will hide the Mini-map or, if hidden, display it again. Panning and zooming work in the same way as for the main map, except that panning on the red square will move the square, thus changing the visible area of the main map accordingly. The background layer of the Mini-map may be changed through the related contextual menu (Right-Click on the Mini-map).
- **Lateral banner.** The left banner may be set as visible or hidden (by a click on the bean-like button located on its bottom right edge). If hidden, hovering the mouse over the bean-like button will automatically unhide the banner and hide it again when loosing focus. The left banner of the Geographic View hosts a set of seven elements, of which the first three are common to all type of views (Geographic, System and Reporting tool):



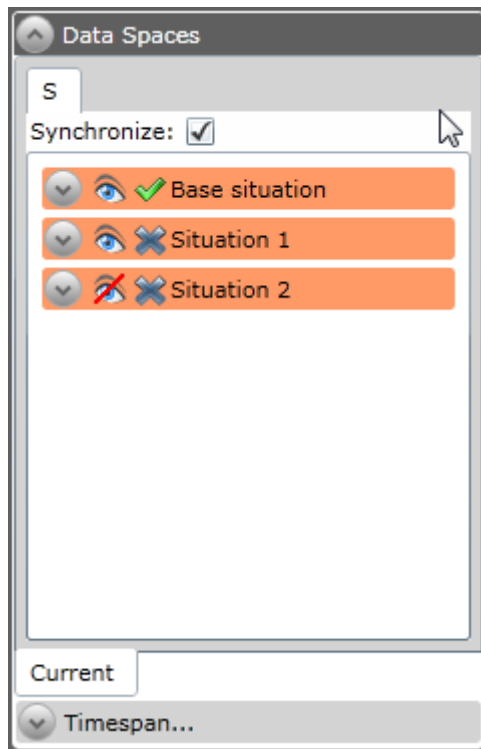
Common items :

- **Metadata.** A small control that simply reminds (and may edit) the name and description of the View



- **Data Spaces.** This control replicates the **Situation** manager located in the **Project Manager and Data Spaces** control of the main left banner (see [Overall infrastructure](#)). With the **Synchronize** option checked, the higher level project wide settings are used, whereas if not checked the local settings will be used. These settings define the visibility status of system elements according to the situations they belong to: the elements, i.e. the shapes displayed on the map in this case, belonging to the active situation (green V sign) have full visibility. Elements that do not belong to the active situation but do belong to another visible situation (eye enabled) are visible but dimmed. Elements that only belong to non visible situations are

hidden. Situations memberships of elements may be set and changed through contextual menus.



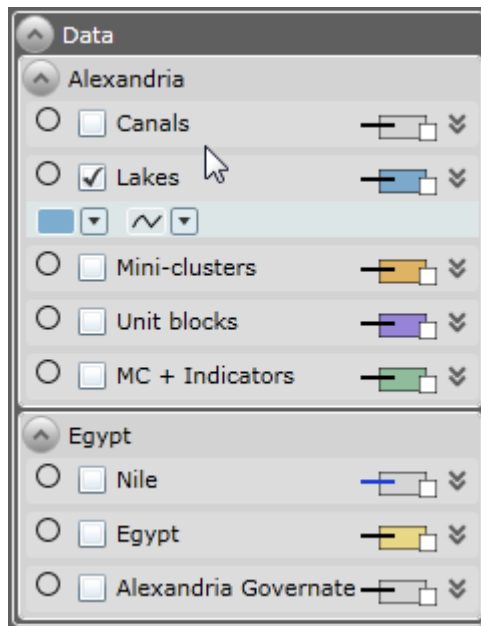
- **Search tool.** This tool allows to search for system elements, either on a By Name basis or a By Id basis. Not implemented yet for the Geographical viewer, see the other viewers for more details.



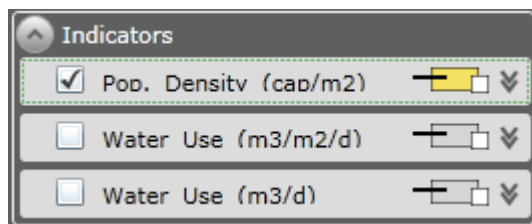
Specific items :

- **Data.** This expander lists the geographical data layers that may be displayed on the map or used to build indicator maps. The data layers are grouped in a hierarchical structure with up to three levels. Each layer item shows (i) a rounded button used to grab it (with the Ctrl-Key pressed), drag and drop it in the indicator section, to create a new indicator map, (ii) a square check box to show and hide the layer on the map, (iii)

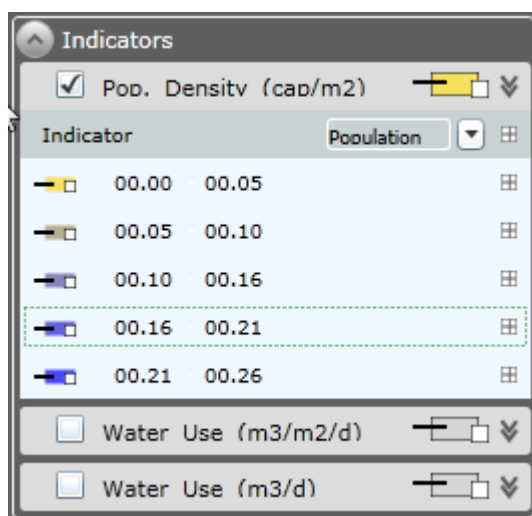
the layers name, (iv) a pictogram showing its color features and (v) an expand button. Expanding a data layer gives access to the tools to configure the layer items' fill color and opacity, and stroke color, opacity and thickness.



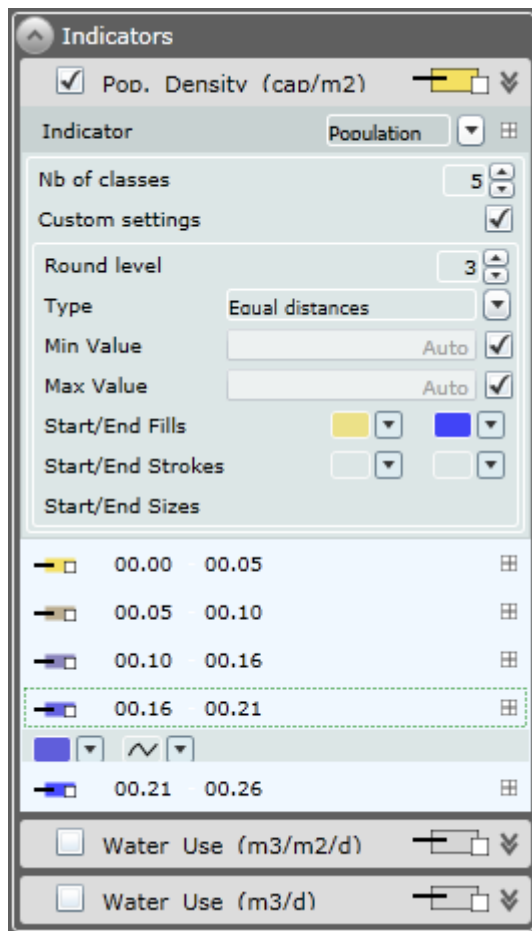
- **Indicators.** Indicator maps are based on data layers, with an associate parameter used to draw the layer's shapes according to a color or size ramp. The indicator layers are grouped in a hierarchical structure with up to three levels. To create a new indicator, one has to grab the rounded button located on the left side of a data layer in the **Data** expander, and then to Ctrl-Drag and Drop it either on top of the **Indicators** expander (in the title header) or in one of the predefined groups of indicators.



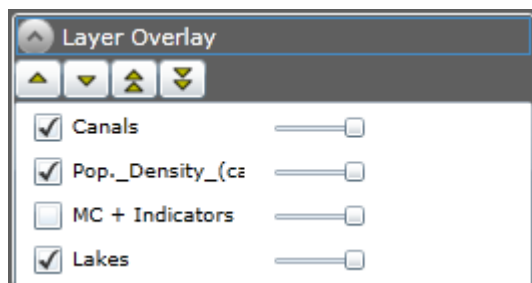
Expanding an indicator layer gives access to the indicator parameter selection and to the scale used to draw the indicator map.



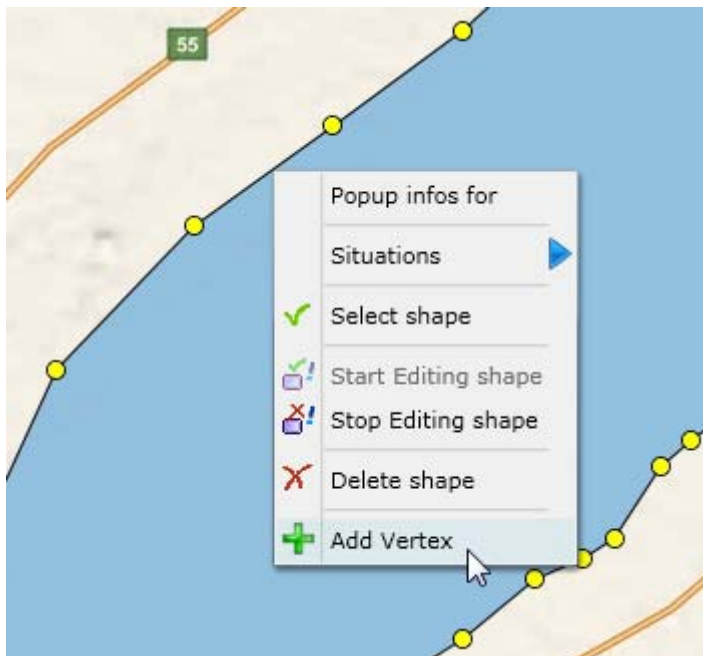
Expanding the indicator definition area gives access to the indicator map settings: (i) the number of classes, (ii) the custom settings option, that allows one, if checked, to define manually the lower and upper limits and the fill and stroke properties of each thematic class. If unchecked, the theme classes will be defined automatically, according to (iii) the level of rounding, (iv) the type of distribution, (v) automatic or custom lower and upper boundaries and (vi) the limits of the fill, stroke and size scale to be used.



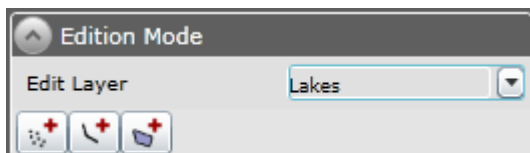
- **Layer Overlay.** Each layer added to the map is added on top of all others. The overlay structure of map layers is managed in the layer overlay section, as well as their overall opacity and visibility. The overlay manager actually shows all layers that have been loaded during the current working session and not only the visible layers.



- **Edition Mode.** Selecting and/or editing the shapes of a map layer is achieved through contextual menus (accessed by a Right-Click on the targeted shape). A selected shape will be drawn in red with an orange border, while editing a shape will draw its vertices, vertices that may then be move around or deleted (contextual menu). To add a new vertex on a shape, Right-Click on the edge of the shape at the location where you would like to have the new vertex added.

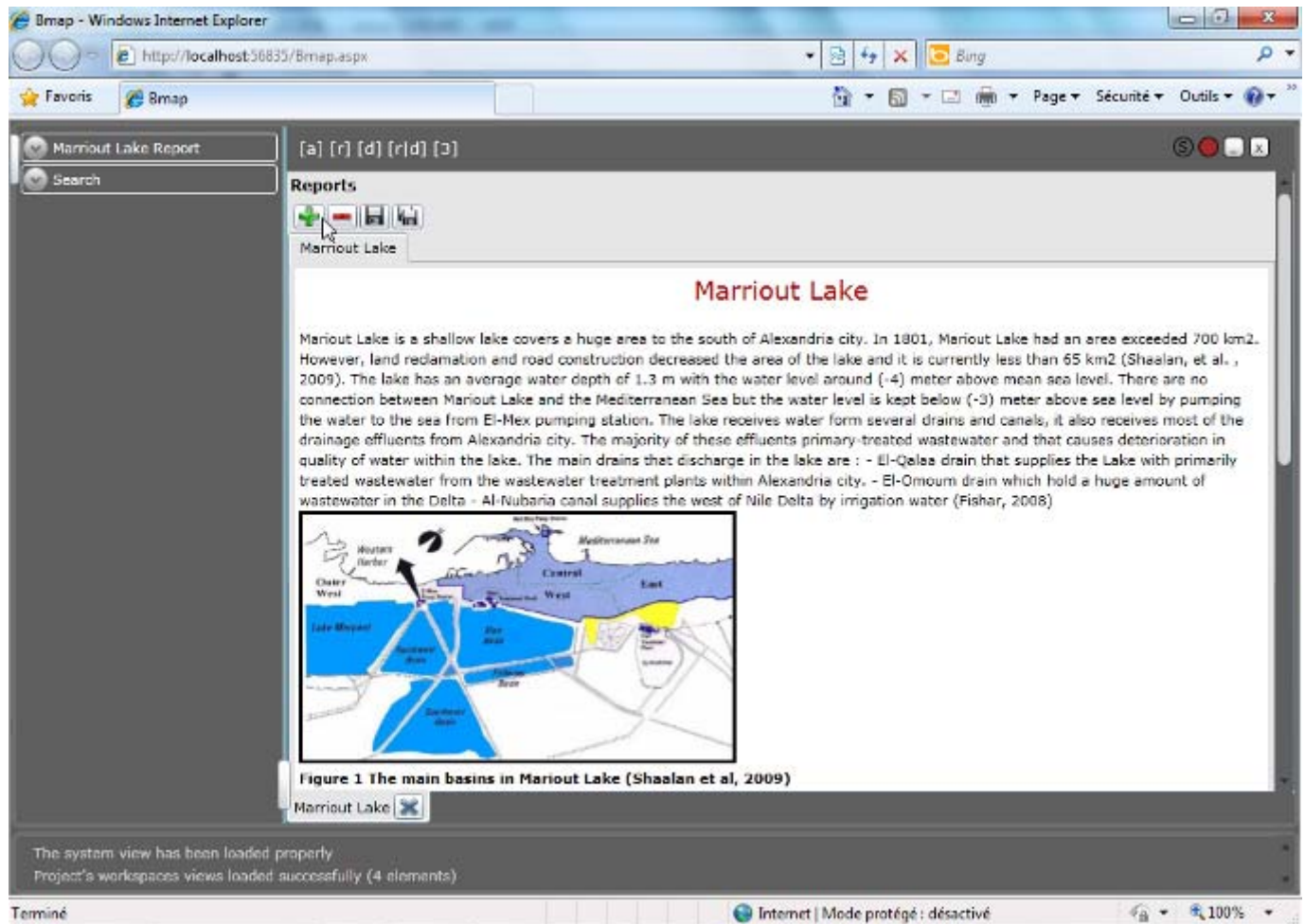


- To add new shapes, open the Edition Mode control, select the layer in which the new shapes are to be added, press the toggle button to choose between point, lines and polygons and then start drawing: in Add Point mode, each click on the map will add a new point, in Add Line or Add Polygon mode, each click on the map will add a new vertex to the shape. Double-click on the last created vertex to quit the Add mode.

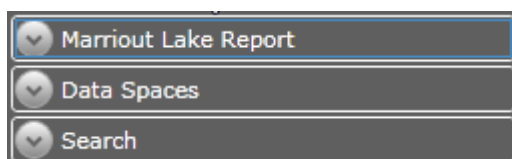


Active Reporting Tool

To view and edit the related reports, data, tables and charts...

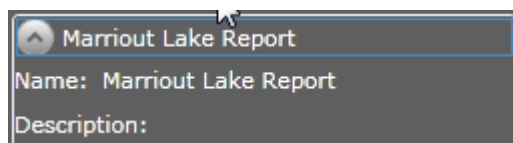


- **Lateral banner.** The left banner may be set as visible or hidden (by a click on the bean-like button located on its bottom right edge). If hidden, hovering the mouse over the bean-like button will automatically unhide the banner and hide it again when loosing focus. The left banner of the Active Reporting Tool hosts the set of three elements that are common to all type of views (Geographic, System and Reporting tool):

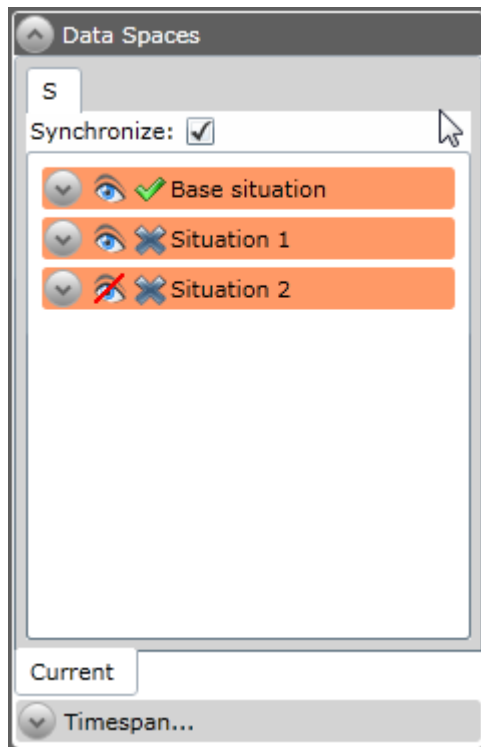


Common items :

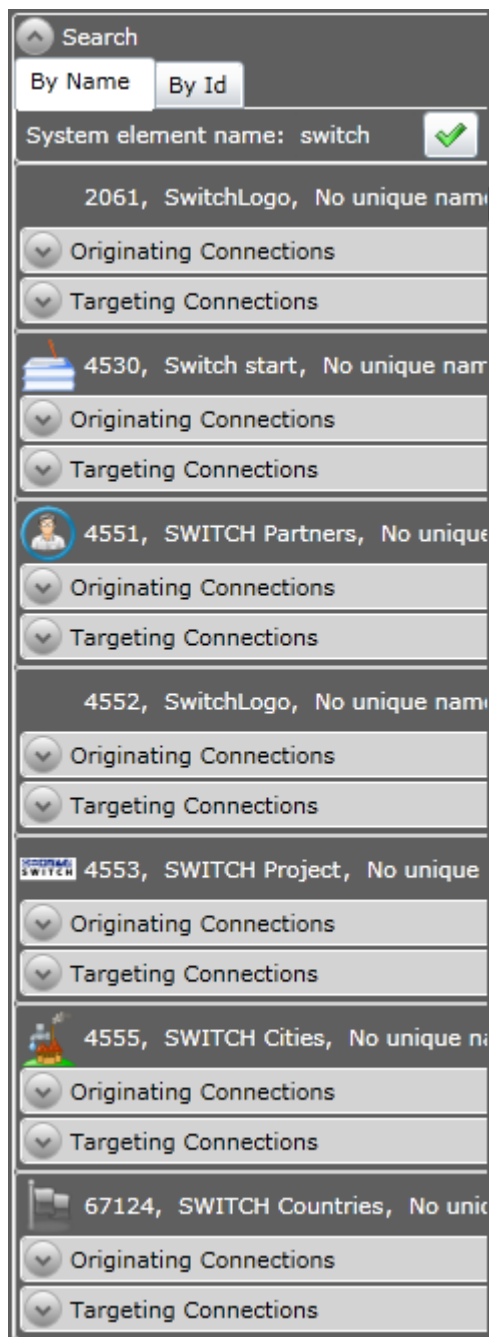
- **Metadata.** A small control that simply reminds (and may edit) the name and description of the View



- **Data Spaces.** This control replicates the **Situation** manager located in the **Project Manager and Data Spaces** control of the main left banner (see [Overall infrastructure](#)). With the **Synchronize** option checked, the higher level project wide settings are used, whereas if not checked the local settings will be used. These settings define the visibility status of system elements according to the situations they belong to.

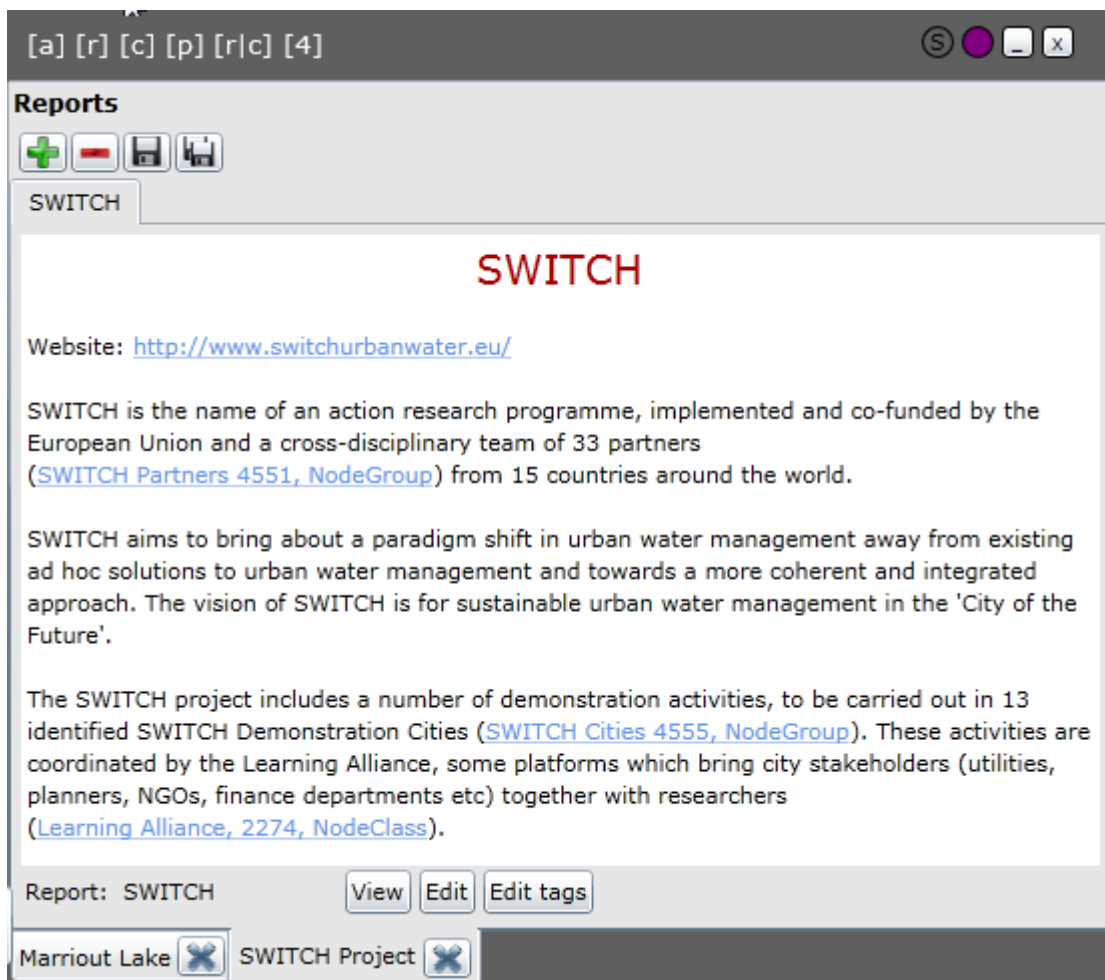


- **Search tool.** This tool allows to search for system elements, either on a By Name basis or a By Id basis. The results of a search will be displayed as a list of items, with for each found item some basic information along with the lists of originating and targetting connections (see System Viewer). A Ctrl-Drag of one list item and subsequent Drop in the display area of the reporting tool will load and display this element's data.

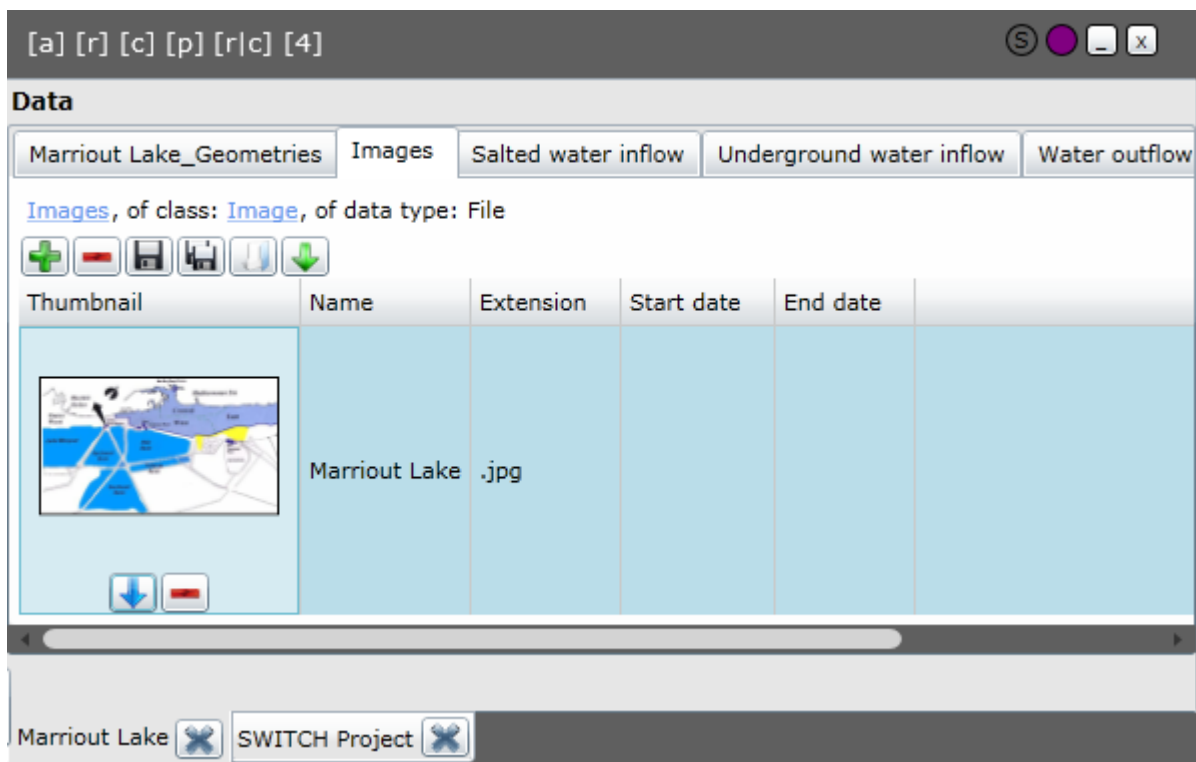


- **Structure of the view.** The Active Reporting Tool view area consists in a tabbed view with one tab for each item or system element that is displayed by the view. Each of these tabs contains the item's data, structures in four sections :
 - **Attributes.** The Attributes section displays some of the major features of a system element and may be seen as a kind of summary.
 - **Reports.** The Reports section hosts, again in a tabbed structure, the various reports that may be linked to the item.
 - **Data Catalog.** The Data Catalog section provides access to view and edit the different "raw" data associated to a system element.
 - **Data Panel.** The Data Panel section provides an alternative to the Data Catalog, to display and edit data associated to a system element in tabular and chart views.

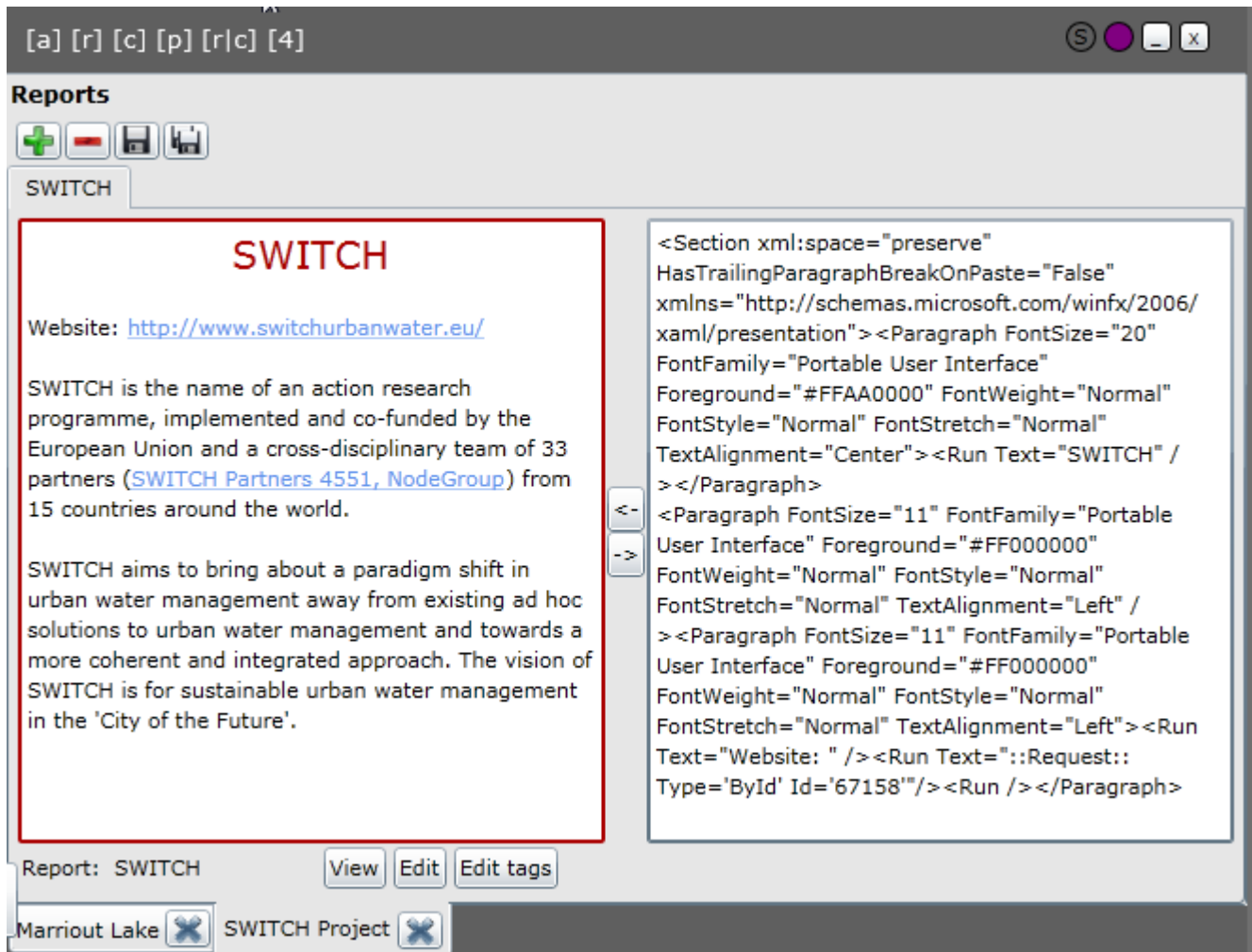
A set of controls, located on the top left of the display area, allow to control which sections of the display will be visible: **[a]**, **[r]**, **[c]** and **[p]** to limit the display to the attributes, reports, data catalog and data panel sections respectively, **[r|c]** to display both the report and data catalog sections, and **[4]** to display all of them.



- Editing data in the Data Catalog.** The Data Catalog Section of the view exposes the various data associated to the selected system element: these data are presented in a tabbed layout (to be soon complemented/replaced with tabular/chart layouts), each line relating to an element of information in the information group (see System view). Clicking into the fields allows to edit them and change their value (or upload an alternative image as in the example below).



- Editing Reports.** The buttons in the toolbar on top of the Report section allow (i) to create a new report, (ii) to delete an existing report, (iii) to save the changes in the active report, and (iv) to save changes made in all reports in the view. The report itself can be switch to Edition mode by clicking on the **Edit** button, which will draw a red frame on the report's edge and allow direct writing into the report area. In Edition mode, the [r|d] display allows to Ctrl-Drag and drop data items from the data section into a report. The report's layout is controlled by a Xaml Markup language, similar to html (see [here](#) for some details). Pressing the **Edit tags** button will split the view in two, with the report on the left and the tags on the right. The two arrow buttons located between those two windows allow to update the tags from the text, and vice-versa.



- Using the Data Panel.** Data Panels are available provided an item "Group of Data Panels" has been added as a property (see [System Viewer](#)) to the system element under consideration (the Switch Project in the example above). If so, the four buttons on top of the Data Panel display area allow to add, delete and save Data Panels. Data Panels are actually a set of three tabbed items: a parameter **selection** tab, a **table** display tab and a **chart** display tab. When adding a new Data Panel, the parameter selection tab is first displayed. It allows to choose the information that will be displayed in the table and chart displays. The important point to keep in mind is the fact that there are up to **four** dimensions that need to be set: (i) a system element might have several indicators/attributes that can be displayed, (ii) these indicators may take different values in time and (iii) according to the different situations/scenarios. (iv) The fourth dimension appears when it comes to analyze groups of system elements, i.e. Node groups (see System Viewer), such as for example the group of elements belonging to a geographic layer: the Table/Graph may for instance display the indicators/attributes values in columns for the various members of the group in rows, for a fixed time span and a fixed situation/scenario. Changes in the selection will be reflected instantly in the table and chart displays.

[a] [r] [c] [p] [r|c] [4]

Data panels

Group of Data Panel

+ -

New data panel

Chart type: Columns Name: New data panel Description:

Select the table columns

Indicators

AL2. Participation 62388, InformationGroup
AL1. Social inclusion 62389, InformationGroup
O4. Process documentation 62390, InformationGroup
O3. Demonstration activities 62391, InformationGroup
O2. Regular innovative events 62392, InformationGroup
O1. Communication between stakeholders 62394, InformationGroup
Monitoring Indicators 62436, InformationGroup

Select the table rows

Times

+ -

Start: <dd.MM.yyyy> 15
End: <dd.MM.yyyy> 15

Fix the last parameter

Situations

Base situation
Situation 1
Situation 2

Selection Table Chart

Alexandria Learning Alliance

[a] [r] [c] [p] [r|c] [4]

Data panels

Group of Data Panel

+ -

New data panel

	AL2. Participation 62388, InformationGroup	AL1. Social inclusion 62389, InformationGroup	
03.08.2010 - infinite	100	60	
01.08.2008 - infinite	75	60	
01.12.2007 - infinite	70	45	

Selection Table Chart

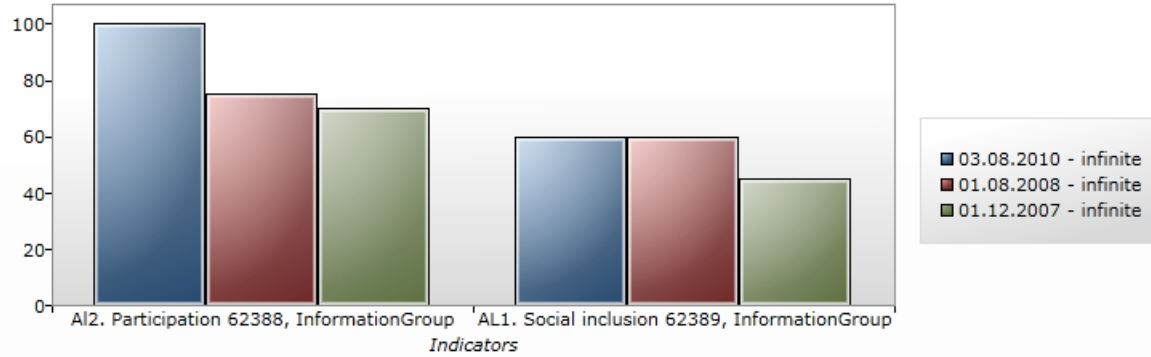
Alexandria Learning Alliance

Data panels

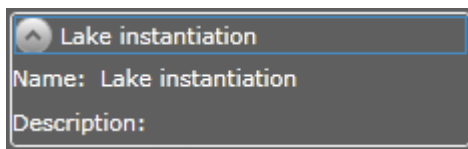
Group of Data Panel



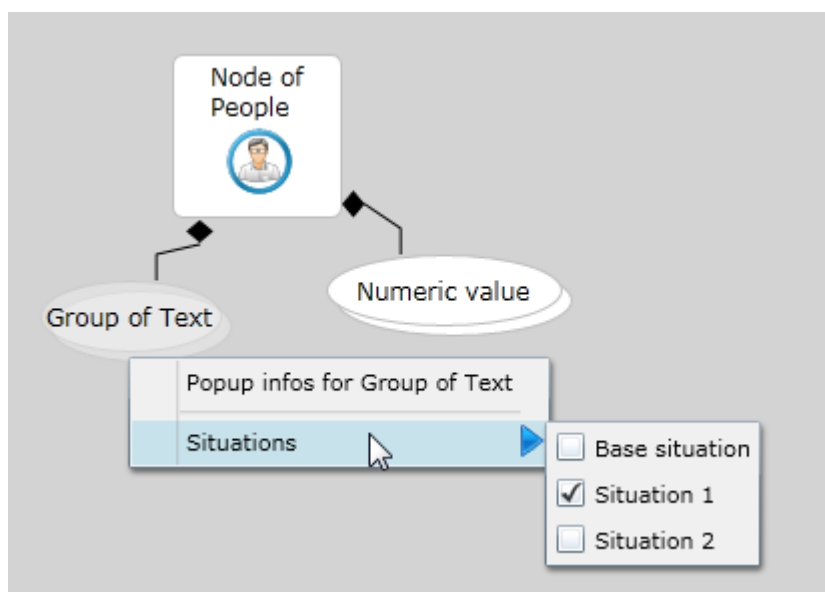
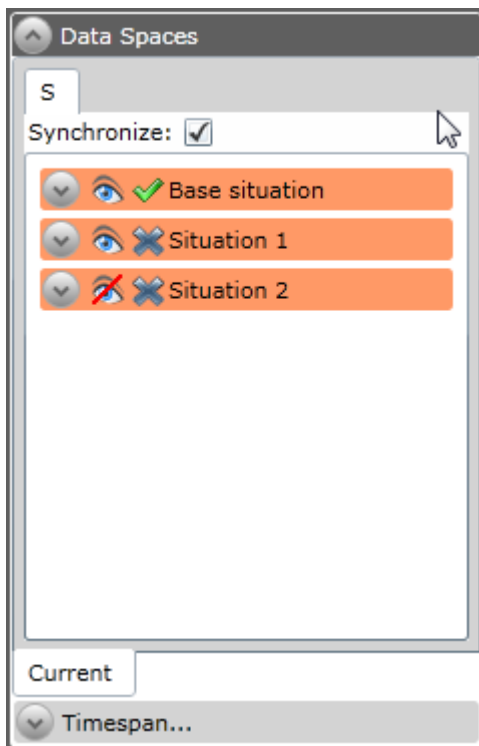
New data panel



Selection Table Chart

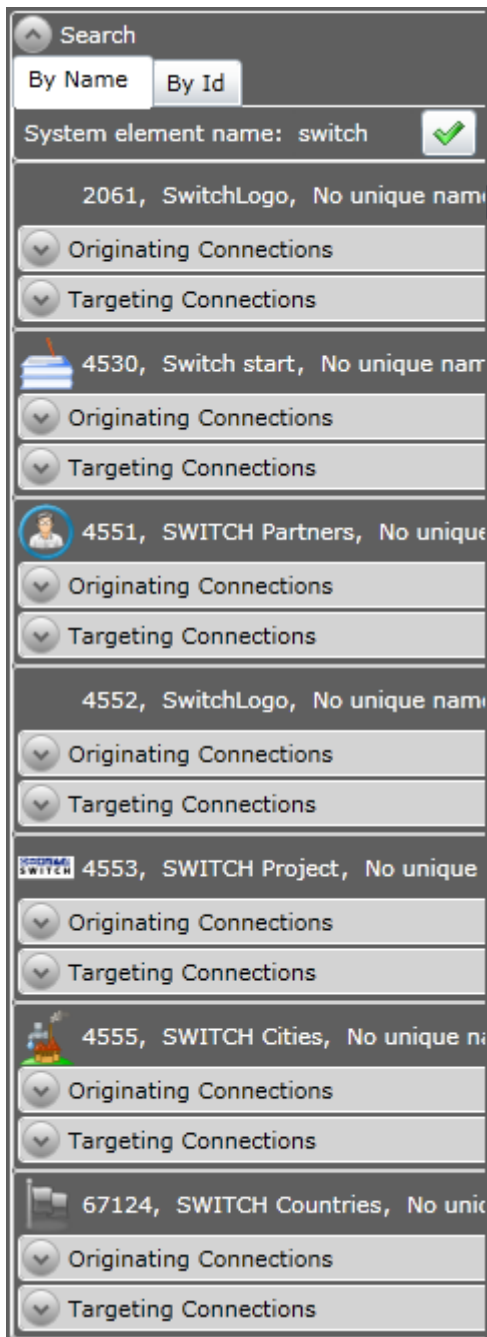


- **Data Spaces.** This control replicates the **Situation** manager located in the **Project Manager and Data Spaces** control of the main left banner (see [Overall infrastructure](#)). With the **Synchronize** option checked, the higher level project wide settings are used, whereas if not checked the local settings will be used. These settings define the visibility status of system elements according to the situations they belong to: the system elements displayed in the display area that belong to the active situation (green V sign) have full visibility. Elements that do not belong to the active situation but do belong to another visible situation (eye enabled) are visible but dimmed. Elements that only belong to non visible situations are hidden. Situations memberships of elements may be set and changed through contextual menus (Right-Click on the system element).



- **Search tool.** This tool allows to search for system elements, either on a By Name basis or a By Id basis. The results of a search will be displayed as a list of items, with for each found item some basic information

along with the lists of originating and targeting connections (see System Viewer). A Ctrl-Drag of one list item and subsequent Drop in the display area of the reporting tool will load and display this element's data.

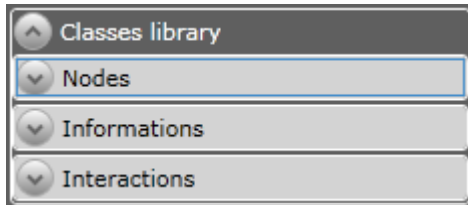


Specific items :

- **Classes library.** The classes library is a set of system elements that have been defined so far to describe urban water management (see below for some conceptual details) and may be used to draw System Views.

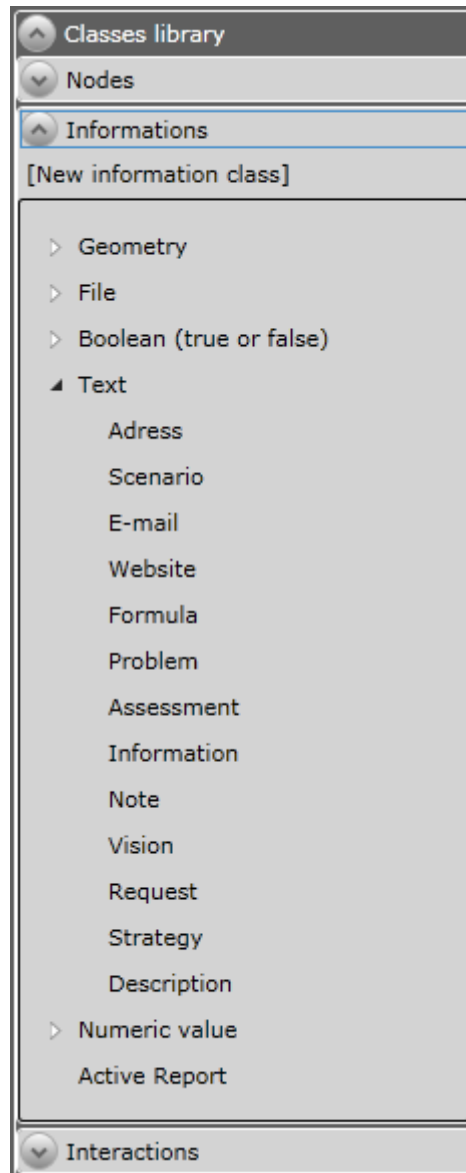
*System elements are defined along two axes: the type and the level. The possible types are **node**, **interaction** and **information**. A node is a system element, such as a lake, a person or a policy. An interaction is a flux or an influence between two groups. Finally, an information is an actual value whose format can be a numeric value, a text, a geometry, a file, or a lifetime. The possible levels are “class”, “instance” or “property”. A class is an abstract template allowing the creation of instances based on its definition. For example, a given, real-world lake is an instance of the “lake” class defining what a lake is. Properties of an element are classes used within the context of an element. For example, a car may have the properties number of wheels, a color, etc. The latter are instances of the wheel and color classes, within the context of a car. As the cars have more than one wheel, and maybe different colors, these properties are also called “groups”. Interactions are also properties, but cannot be considered as a group or an instance (it can be a class, though). Overall, the combination of the two axes (type and level) produces eight different constructs (interaction being not represented as an instance).*

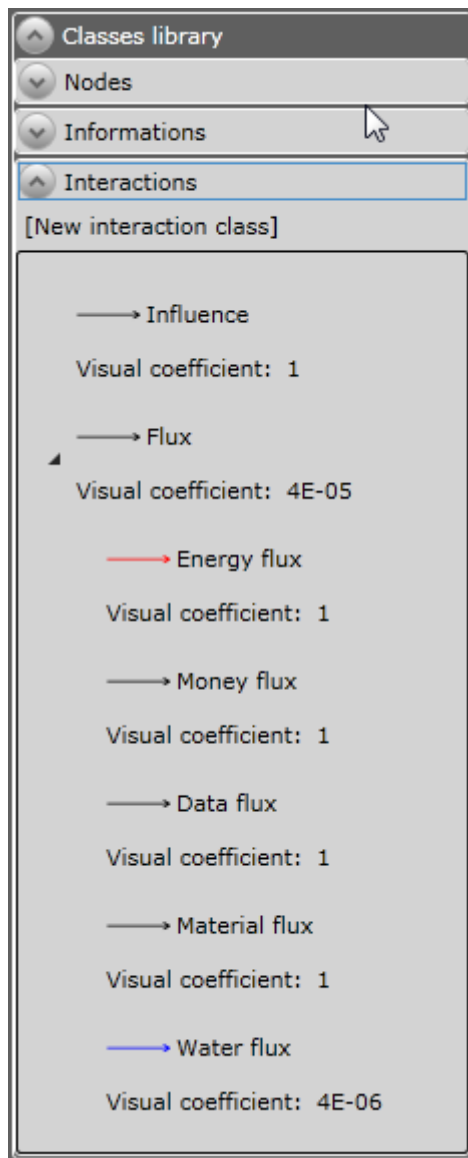
In summary, the Classes library hosts three groups of elements: nodes, information and interactions



As depicted by the figure below, these groups contain a quite large inventory of system element "types" that form the basic bricks that are used to described the system structure of data.

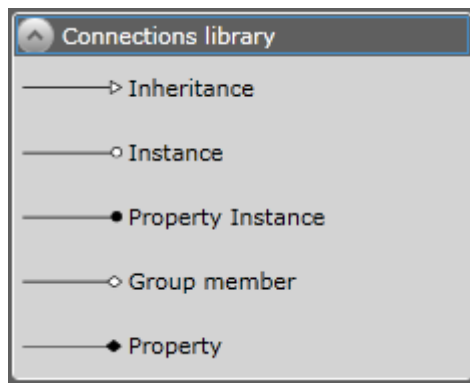
System elements can be Ctrl-dragged and dropped onto the graphic area to be added to the System View. The standard behaviour is to add a group. On drop, keep pressing the Ctrl-Key and press in addition the Shift-Key to add an instance. Similarly, keep pressing the Ctrl-Key and press in addition the Alt-Key to add the class itself.





System elements can be Ctrl-dragged and dropped onto the graphic area to be added to the System View. The standard behaviour is to add a single element (instance). To add a group, keep pressing the Ctrl-Key and press in addition the Shift-Key when dropping the item. Similarly, keep pressing the Ctrl-Key and press in addition the Alt-Key to add the class itself.

- **Classes library.** The connections library provides the five types of structural connections that may be needed to describe the system logics of system elements' interconnections :
 - (i) Inheritance, the connection between a parent class et one of its children class or subclass.
 - (ii) Instance, the connection between an instance and its parent class.
 - (iii) Property Instance, the connection between a property and its parent class.
 - (iv) Member, the connection between an element and the group it belongs to.
 - (v) Property, the connection between a property and the element it describes.



- **Navigation.** The navigation area simply allows to activate the exploration mode. In exploration mode, the system elements that are currently displayed in the view are dimmed and when selecting an item all its connected elements are displayed. To add one of these elements to the current display, Right-Click on it: it will be duplicated and the duplicate will remain visible when the exploration mode is deactivated.

