

Created IT infrastructure for the EU-WATERRES - integrated information and research platform

January 2022

The project No.2018-1-0137 “EU-WATERRES: EU-integrated management system of cross-border groundwater resources and anthropogenic hazards” benefits from a € 2.447.761 grant from Iceland, Liechtenstein and Norway through the EEA and Norway Grants Fund for Regional Cooperation. The aim of the project is to promote coordinated management and integrated protection of transboundary groundwater by creating a geoinformation platform.

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Document summary	
Document contains architecture documentation of IT infrastructure for the EU-WATERRES - integrated information and research platform and description of Map Portal application created as part of the project.	

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Partnerships:



REPUBLIC OF ESTONIA
GEOLOGICAL SURVEY



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HEXAGON



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1. IT infrastructure documentation

1.1. Overview

The purpose of this document is to give a technical insight into the EU-Waterres IT system.

In the “System overview” section we focus on the system’s big picture to make the reader understand the system’s main components and their interactions both from a user and an admin perspective. Next, in the “Hardware” and “Deployment” sections we describe hardware and software infrastructure necessary for the system to operate. In the end, there is a detailed description of the “Map portal” and its development process.

1.2. System overview

In this section we focus on the system’s big picture. We will guide the reader through the components from different user perspectives as it should make it easier to grasp the main components’ structure.

We distinguish three user types:

- Public user – any Internet user
- System user – a user registered in the system
- System admin – a system user with elevated privileges, capable of modifying the system’s configuration

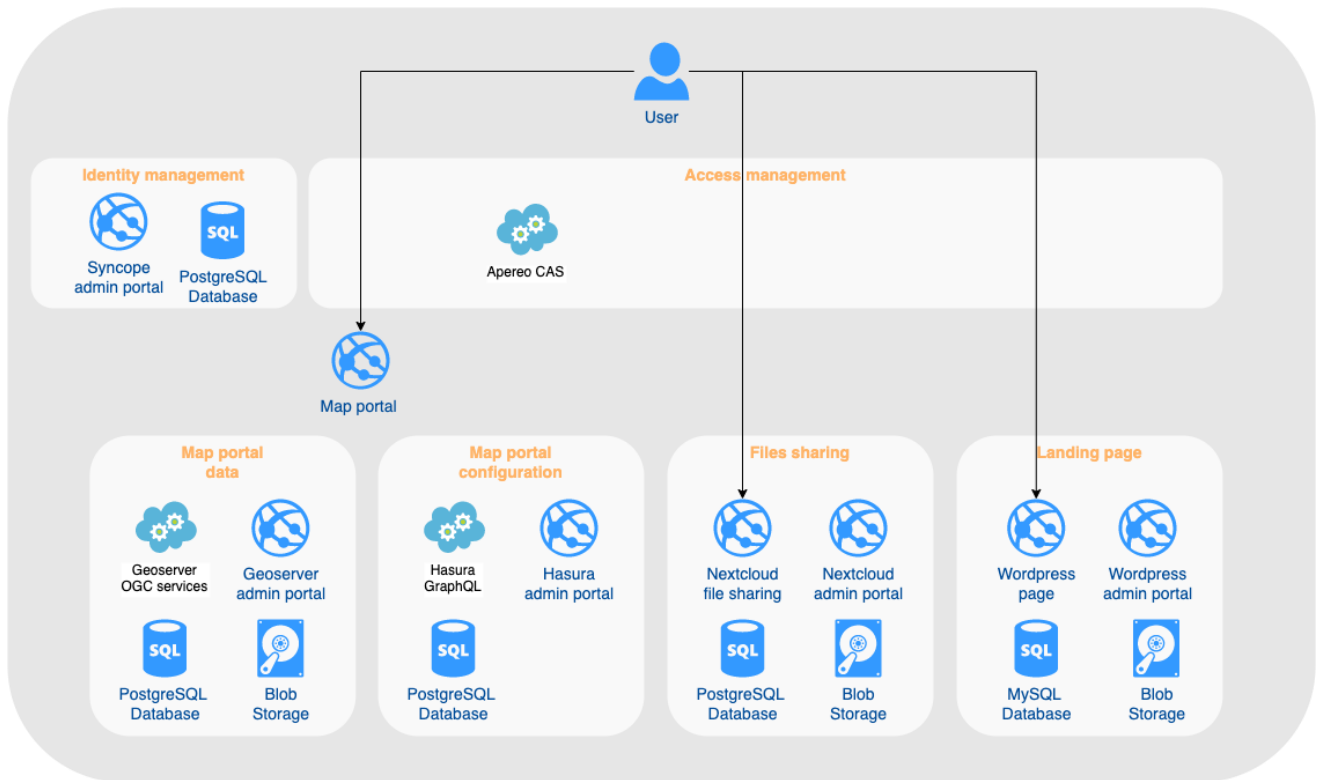


Figure 1. System overview – system user perspective

In the system single sign-on authentication scheme is used. It means that a user may login once in one of the applications and can access other applications without re-entering credentials. Depending on a user type there is a set of system components that the user may access.

From a public user perspective there are two system's components the user may interact with:

- Landing page – Wordpress page
- Map portal

From a system user perspective there are three system's components the user may interact with:

- Landing page – Wordpress page
- File sharing – Nextcloud file sharing
- Map Portal

1.2.1. Landing page

The landing page <http://eu-waterres.eu/> is the main entry point of the system. Its main purpose is to provide information about the EU-WATERRES project to the public, that is:

- Project
- Team
- Activities
- Advisory board
- About the founder

Additionally, the system users should be able to easily login to the system and move to “File sharing” and “Map portal” from the page.

The landing page is setup on WordPress. The configuration is stored in a MySQL database and binary files are stored on a hard drive.

WordPress - <https://wordpress.com/>

WordPress (WP, WordPress.org) is a free and open-source content management system (CMS) written in PHP and paired with a MySQL or MariaDB database. Features include a plugin architecture and a template system, referred to within WordPress as Themes. WordPress was originally created as a blog-publishing system but has evolved to support other web content types including more traditional mailing lists and forums, media galleries, membership sites, learning management systems (LMS) and online stores. One of the most popular content management system solutions in use, WordPress is used by 42.8% of the top 10 million websites as of October 2021

<https://en.wikipedia.org/wiki/WordPress>

MySQL - <https://www.mysql.com/>

MySQL is an open-source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language. A relational database organizes data into one or more data tables in which data types may be related to each other; these relations help structure the data. SQL is a language programmers use to create, modify and extract data from the relational database, as well as control user access to the database. In addition to relational databases and SQL, an RDBMS like MySQL works with an operating system to implement a relational database in a computer's storage system, manages users, allows for network access and facilitates testing database integrity and creation of backups. <https://en.wikipedia.org/wiki/MySQL>

1.2.2. File sharing

The ability to share documents between the system users is essential for smooth cooperation. Nextcloud streamlines the process for both users and administrators. The configuration is stored in a PostgreSQL database and binary files are stored on a hard drive.

Nextcloud - <https://nextcloud.com/>

Nextcloud is a suite of client-server software for creating and using file hosting services. It is enterprise-ready with comprehensive support options. Being free and open-source software, anyone is allowed to install and operate it on their own private server devices.

Nextcloud is functionally similar to Dropbox, Office 365 or Google Drive when used with its integrated office suite solutions Collabora Online or OnlyOffice. It can be hosted in the cloud or on-premises. It is scalable from home office solutions based on the low cost Raspberry Pi all the way through to full sized data centre solutions that support millions of users.

The original ownCloud developer Frank Karlitschek forked ownCloud and created Nextcloud, which continues to be actively developed by Karlitschek and other members of the original ownCloud team.
<https://en.wikipedia.org/wiki/Nextcloud>

1.2.3. Map portal

The map portal is the core component of the system. Its purpose is to visualize the transboundary groundwaters resources geospatial data, so it can facilitate, information access, analysis and cooperation between scientists involved in the project.

The portal was developed from scratch by the Hexagon company. It is based solely on open source. Its functionalities are based on the requirements provided by the scientists, and they are tailored to suit their needs. It is accessible on mobile and desktop platforms.

As it is developed internally there is a separate section in the document describing its technical details.

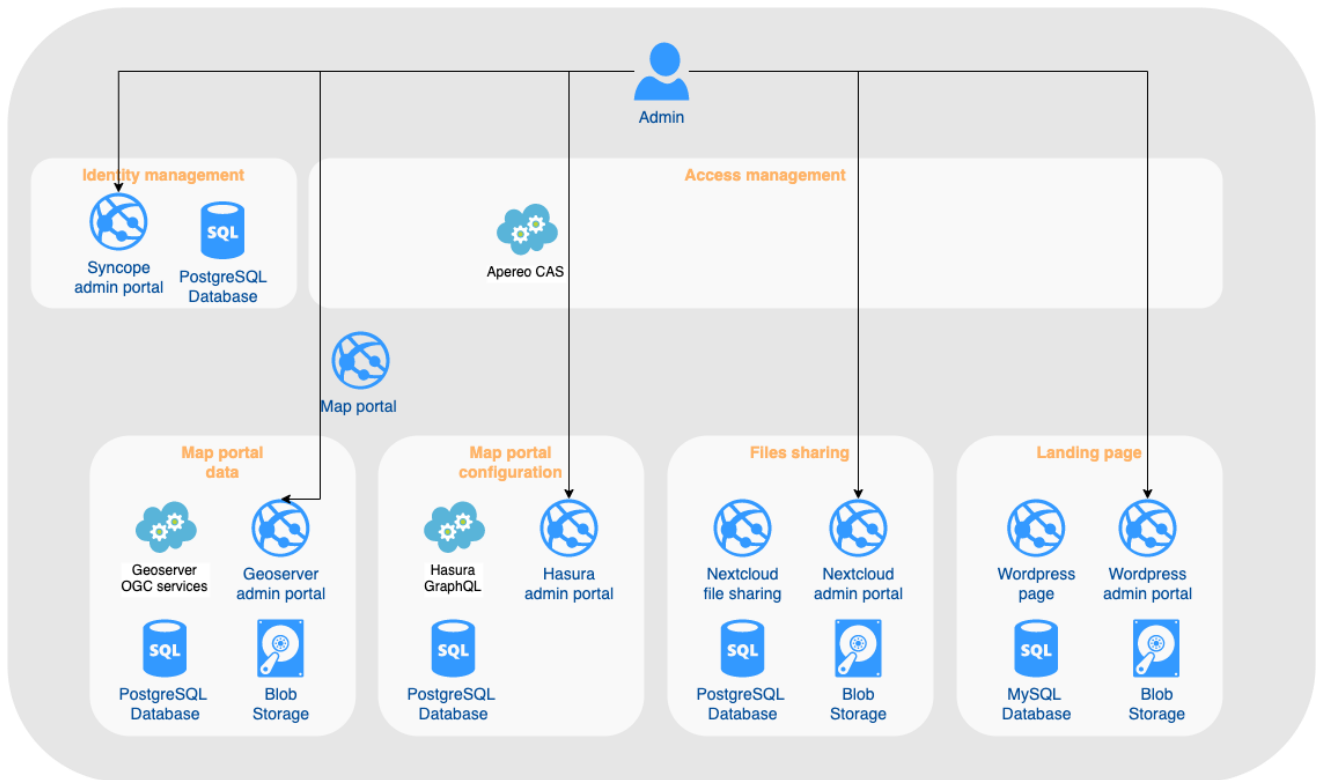


Figure 2. System overview – admin’s perspective

From an admin perspective there are five system’s component he/she may interact with:

- Landing page – Wordpress admin portal
- File sharing – Nextcloud admin portal
- Map Portal configuration – Hasura admin portal
- Map Portal data – Geoserver admin portal
- Identity management – Syncope admin portal

1.2.4. Landing page – admin portal

A Web application that enables system admin to configure the landing page content. It is a part of the WordPress bundle.

1.2.5. File sharing – admin portal

A Web application that enables system admin to configure the file sharing capabilities. It is a part of the Nextcloud bundle.

1.2.6. Map portal – configuration admin portal

The Map portal configuration is served via a GraphQL endpoint from a PostgreSQL database. Hasura is used to expose data residing in the PostgreSQL database via the GraphQL endpoint. The Hasura admin portal is a Web application with a direct access to the data, which enables admin to create, update and delete configuration data.

The Hasura GraphQL Engine is a blazing-fast GraphQL server that gives you instant, realtime GraphQL APIs over Postgres, with webhook triggers on database events, and remote schemas for business logic. Hasura helps you build GraphQL apps backed by Postgres or incrementally move to GraphQL for existing applications using Postgres. The Hasura GraphQL Engine is open-source.

<https://hasura.io/blog/what-is-hasura-ce3b5c6e80e8/>

1.2.7. Map portal – data admin portal

The GIS data for the Map portal is served via OGC Web Services from a PostgreSQL database. GeoServer is a geospatial data server which exposes GIS data via OGC Web Services from a PostgreSQL database. The GeoServer admin portal enables system admin to configure data and services.

GeoServer <http://geoserver.org/>

In computing, GeoServer is an open-source server written in Java that allows users to share, process and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards. GeoServer has evolved to become an easy method of connecting existing information to virtual globes such as Google Earth and NASA World Wind as well as to web-based maps such as OpenLayers, Leaflet, Google Maps and Bing Maps. GeoServer functions as the reference implementation of the Open Geospatial Consortium Web Feature Service standard, and implements the Web Map Service, Web Coverage Service and Web Processing Service specifications.

<https://en.wikipedia.org/wiki/GeoServer>

1.2.8. Identity management – admin portal

In the system single sign-on authentication scheme is used. The authentication and authorization are handled by a combination of two software components that is Apereo CAS and Apache Syncope

The identity management admin portal comes with Apache syncope and it is a Web application that enables the admin to manage users and roles. The user's data is stored in a PostgreSQL database.

Apache Syncope <https://syncope.apache.org/>

Apache Syncope is an Open Source system for managing digital identities in enterprise environments, implemented in Java EE technology and released under Apache 2.0 license.

Apereo CAS <https://apereo.github.io/cas/6.4.x/index.html>

CAS is an enterprise multilingual single sign-on solution for the web and attempts to be a comprehensive platform for your authentication and authorization needs.

CAS is an open and well-documented authentication protocol. The primary implementation of the protocol is an open-source Java server component by the same name hosted here, with support for a plethora of additional authentication protocols and features.

1.3. Hardware

Server ProLiant DL360 Gen10

Processors 2 x

Processor Name Intel(R) Xeon(R) Gold 5218 CPU @ 2.30GHz

Processor Speed 2300 MHz

Execution Technology 16/16 cores; 32 threads

Memory Technology 64-bit Capable

Internal L1 cache 1024 KB

Internal L2 cache 16384 KB

Internal L3 cache 22528 KB

Memory 2 x 64GB 2666MHz RDIMM

Physical drives 4 x 1920 GB SSD

1.4. Deployment

1.4.1. Operating system

Ubuntu Server 20.04.3 LTS

1.4.2. Virtualization setup

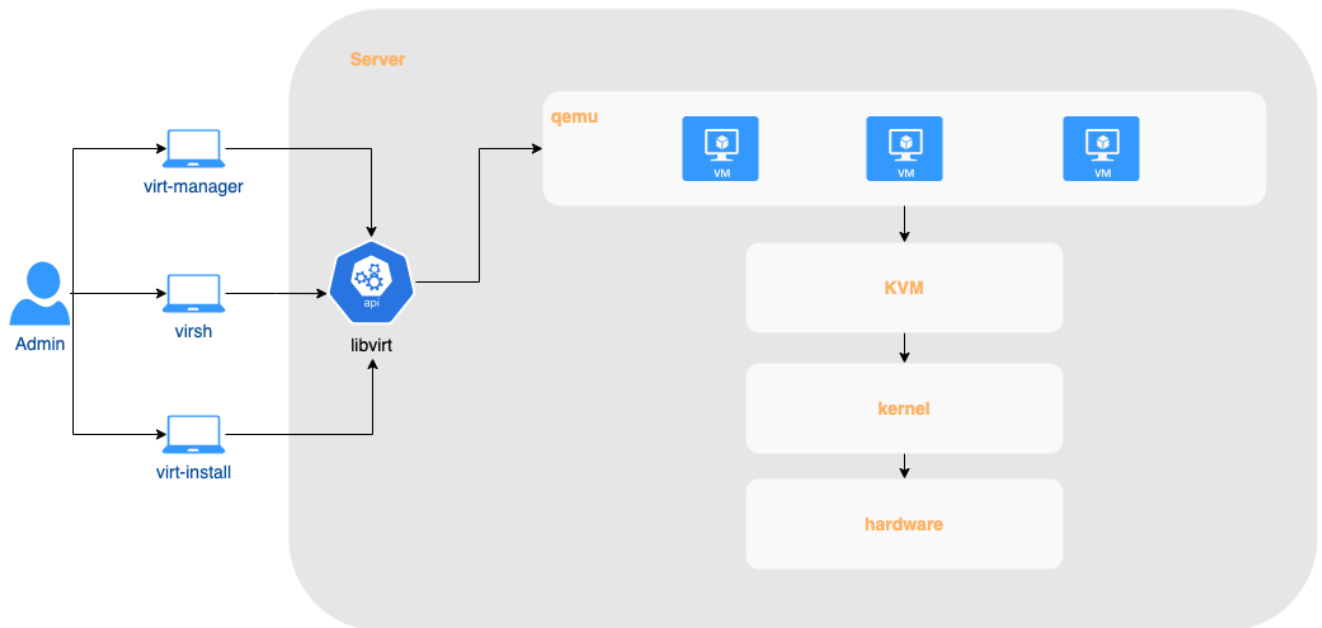


Figure 3. Virtualization setup

Virt-manager

In computing, the Red Hat Virtual Machine Manager, also known as *virt-manager*, is a desktop virtual machine monitor. https://en.wikipedia.org/wiki/Virtual_Machine_Manager

Virsh

You can create, delete, run, stop, and manage your virtual machines from the command line, using a tool called *virsh*. *Virsh* is particularly useful for advanced Linux administrators, interested in script or automating some aspects of managing their virtual machines

<https://help.ubuntu.com/community/KVM/Virsh>

Virt-install

virt-install is a command line tool for creating new KVM, Xen, or Linux container guests using the "libvirt" hypervisor management library. <https://linux.die.net/man/1/virt-install>

Libvirt

libvirt is an open-source API, daemon and management tool for managing platform virtualization. It can be used to manage KVM, Xen, VMware ESXi, QEMU and other virtualization technologies. These APIs are widely used in the orchestration layer of hypervisors in the development of a cloud-based solution. <https://en.wikipedia.org/wiki/Libvirt>

Qemu

QEMU is a free and open-source hypervisor. It emulates the machine's processor through dynamic binary translation and provides a set of different hardware and device models for the machine, enabling it to run a variety of guest operating systems. It can interoperate with Kernel-based Virtual Machine (KVM) to run virtual machines at near-native speed. QEMU can also do emulation for user-level processes, allowing applications compiled for one architecture to run on another. <https://en.wikipedia.org/wiki/QEMU>

KVM

Kernel-based Virtual Machine (KVM) is a virtualization module in the Linux kernel that allows the kernel to function as a hypervisor. https://en.wikipedia.org/wiki/Kernel-based_Virtual_Machine

1.4.3. Kubernetes cluster

The system runs in a deployment environment based on Kubernetes platform. It is realized with microk8s software that enables easy deployment of production-grade Kubernetes clusters. The platform allows for easy deployment of Docker-based application components based on following patterns:

Pod

A pod represents a single containerized application instance. It is based on a Docker application image and deployed on one of the cluster nodes. It is monitored by cluster machinery and restarted if necessary. A pod is an ephemeral object. By itself it does not hold any persistent state.

Deployment

A deployment represents a fleet of pods. It is configured with a pod template and desired number of replicas. When started it creates several pods to match the desired number. If any of them fails the deployment commands creation of new ones to match the target.

StatefulSet

A statefulSet represents a workload that keeps additional state e.g., in a form of persistent disks. It maintains a fleet of pods, but their numbering always follows well-known pattern and allows to properly maintain state information. This workload is used for database engines, state repositories, etc.

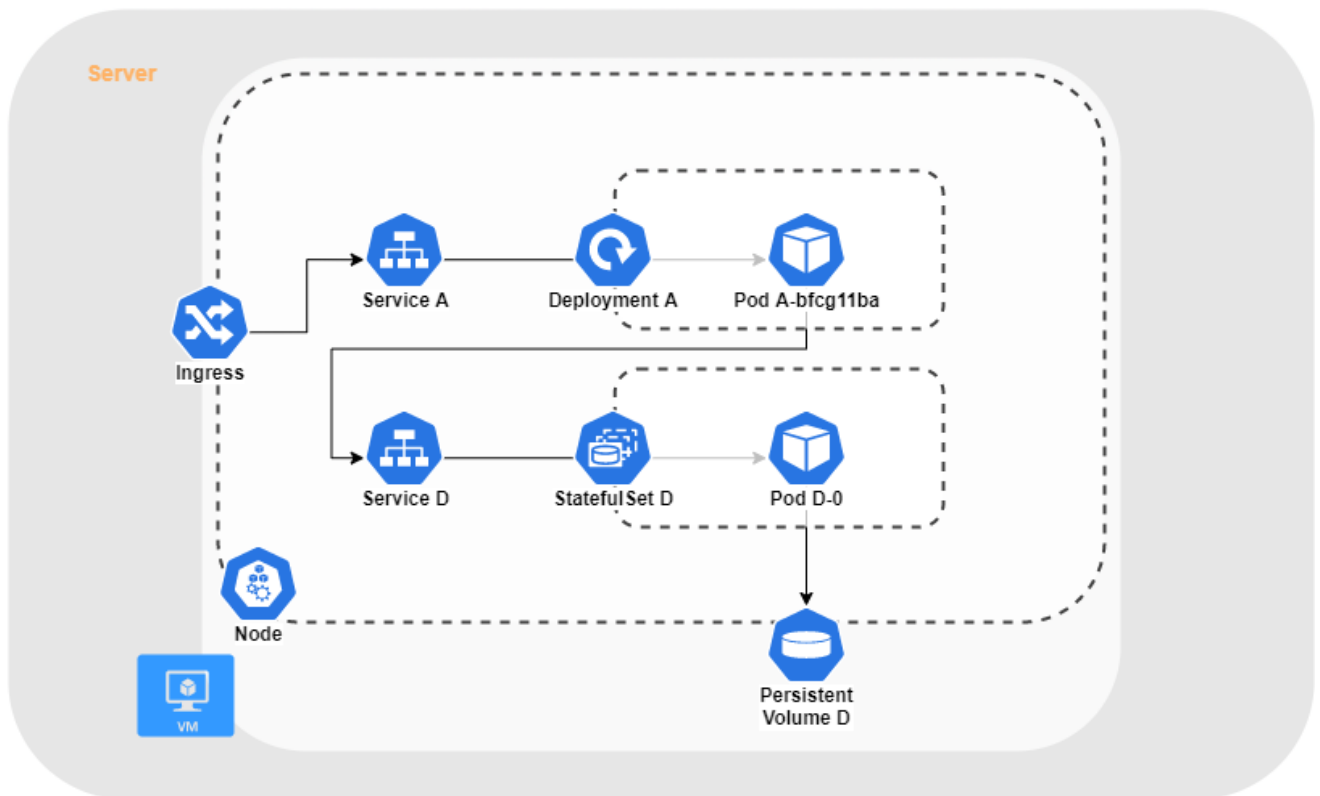


Figure 4. Kubernetes cluster

In addition to workload patterns the following additional concepts are related to Kubernetes platform:

Service

A Service represents common (load balancing) endpoint to allow connecting to one of the pods running specified application. It is aware of pod's availability, creation, and destruction. Each Service has an internal DNS name that is used by client-components connecting to it.

Ingress

Ingress represents traffic coming to the cluster from external networks and systems. It is filtered and routed to services defined internally. This component also serves as a reverse proxy for internal components allowing e.g. mapping path components of externally visible URL addresses.

Persistent Volumes

Some applications require to keep data on persistent storage (e.g. DB engines on disk). It is achieved by attaching dedicated types of volumes to pods. These volumes are stored on physical storage of underlying virtual machine and are not recycled after restarting (or even recreating) pods.

1.5. Map portal

1.5.1. Overview

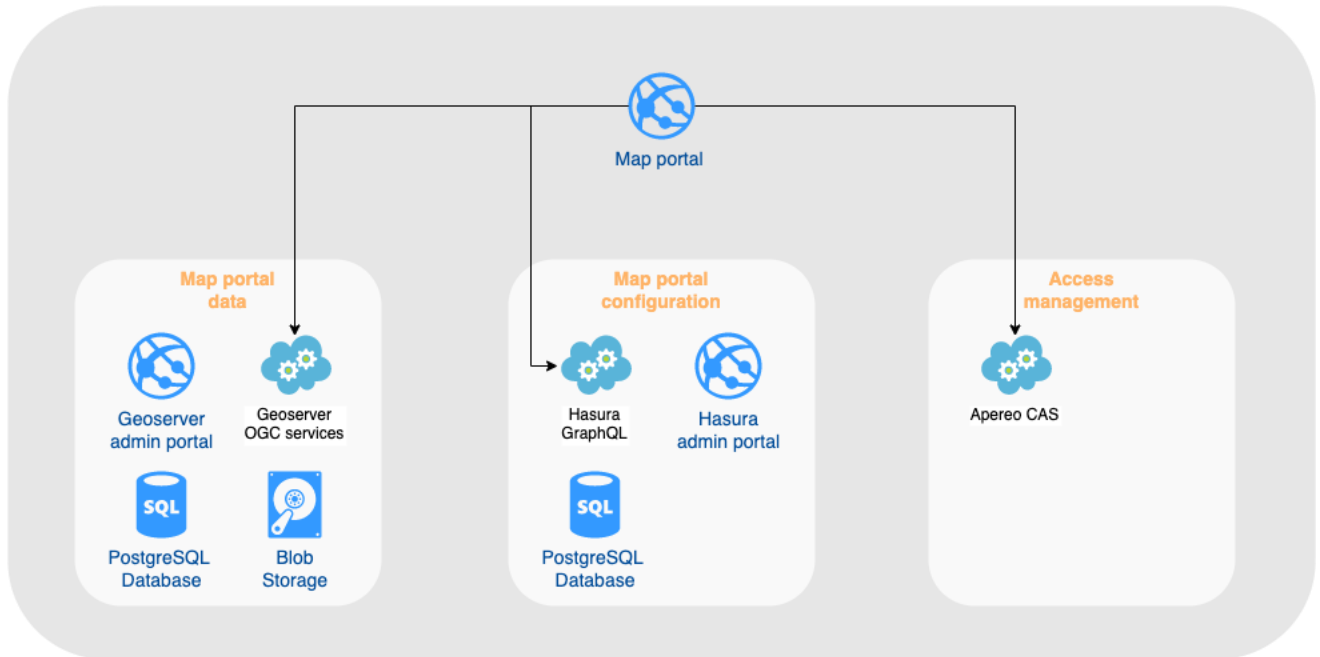


Figure 5. Map portal architecture

Map portal architecture is based on two concepts microservices and single page application (SPA).

1.5.2. Services

Microservices is an architectural style that structures an application as a collection of loosely coupled services that have well defined responsibilities. In the system there are:

- OGC services. Web services responsible for serving geospatial data.
 - Web Feature Service (WFS) – it serves vector features that need to be interactive, e.g., their style can be modified on the client side, without re-fetching of the data. It is used to serve monitoring points and cross sections data.
 - Web Map Service (WMS) – it serves raster data that can be adjusted per each request. It offers better data retrieval performance, but the downside is the limited interactivity. It is used to serve the layers with feature info capability.
 - Web Map Tile Service (WMTS) – it serves raster data from a raster tile cache. It offers top performance, but there is no interactivity. It is used to serve base layers data.

The geospatial data is stored in a PostgreSQL database. The services are configured on an open-source server for sharing geospatial data – GeoServer.

- Configuration service (Preference service) is responsible for serving the map portal application configuration. Administrator may adjust the application content presented to a user via the configuration.

The configuration is stored in a PostgreSQL database, the data is exposed via a GraphQL endpoint and is consumed by the map portal application

- Central Authentication service (CAS) is a single sign-on protocol for the web. Its purpose is to permit a user to access multiple applications while providing their credentials (such as user ID and password) only once. It also allows web applications to authenticate users without gaining access to a user's security credentials, such as a password. Access to some of the map portal's application functionalities is restricted and controlled by CAS.

1.5.3. Application

Map portal application is a single-page application (SPA). SPA is a web application or website that interacts with the user by dynamically rewriting the current web page with new data from the web server, instead of the default method of a web browser loading entire new pages. The goal is faster transitions that make the website feel more like a native app. https://en.wikipedia.org/wiki/Single-page_application

1.5.3.1. Technology stack

The application is based on open-source libraries.

The programming language is TypeScript.

The file version control system is Git.

Main libraries:

- React JS
- MUI
- Apollo client
- OpenLayers

1.5.3.2. Development process

The development process is managed using the SCRUM methodology. The development team works in two weeks sprints. Each sprint starts with a sprint planning, when list of tasks for the sprint is presented, discussed and assessed. During the sprint developers pick a task from the list and implement necessary functionality. In most of the cases the implemented functionality is a UI control

with an underlying business logic. The implementation is complete when the following checklist is fulfilled:

- Component presents itself well on mobile devices
- Component is compliant with the Web Content Accessibility Guidelines (WCAG)
- Component presents itself well in high contrast colour schemes
- Component presents itself well in all predefined font sizes
- Component presents itself well in all app sizes
- Component can be controlled with a keyboard
- Component's text literals (labels, aria labels etc.) are translated. (En and Pl translations are provided)
- Unit tests coverage is satisfactory

After the implementation is complete, developer creates a pull request, so it can be reviewed by other developers. After the change is accepted by all the developers, it is merged with the main code branch. From the main code branch container images are built and deployed to the Kubernetes cluster where they can be tested by a Q&A

1.6. Authentication and authorization

The system is designed to maintain secured access to applications and data stored in it. It contains its own user database and authentication mechanisms. These purposes are handled by following components:

User Data Storage – Apache Syncope + PostgreSQL

All users are defined in Auth DB (PostgreSQL) that is consumed and exposed by Apache Syncope. It provides REST API for user management and delivery.

User Data Administration Console

User facing component for administering users is Apache Syncope Admin Console (Admin UI). It allows administrative access to users database and allows for creating, editing and removing users from the system.

Authentication – OAuth2 via Apereo CAS

To allow Single-Sign-On experience there is an OAuth2 service included in the system based on Apereo CAS server. It is highly regarded production ready software that allows multiple different

authentication scenarios. In the system we are using OAuth 2.0 workflows to enable the web applications authenticate against the central users database.

2. Description of Map Portal application

1.7. General description of application

Parts of the application:

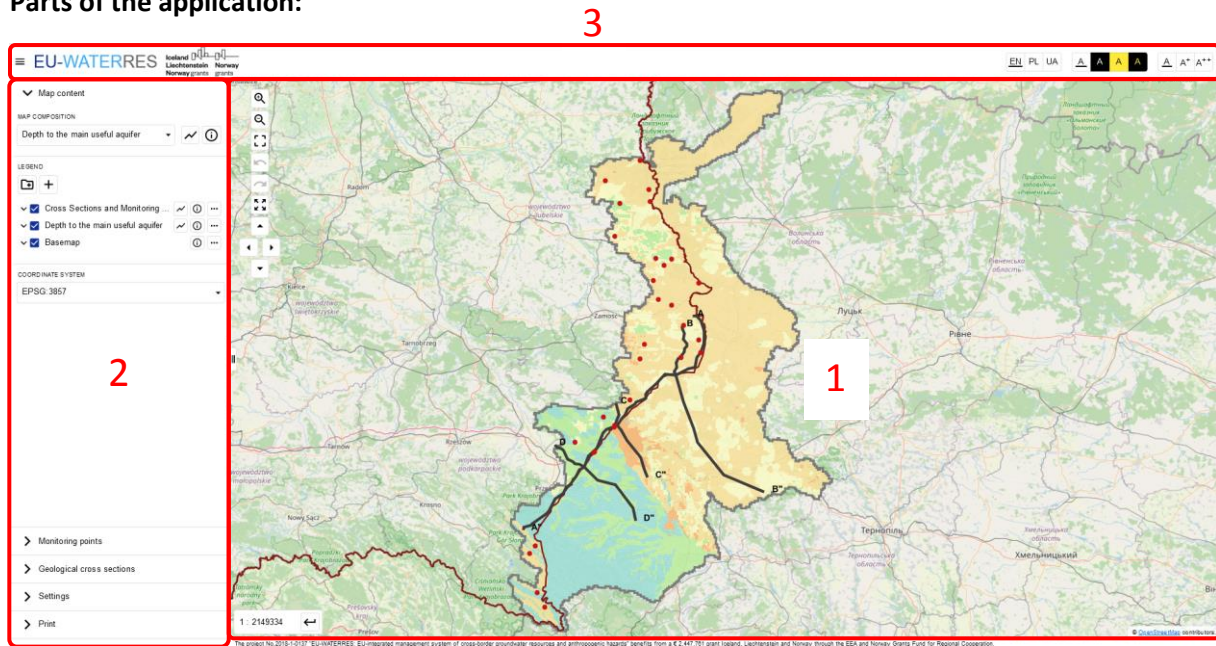


Figure 6. Map Portal application view

1. Map window

Map window is the main part of the application. Map compositions selected by the user are displayed in the map window. Each map composition can have several map layers (OGC WMS, WMTS and WFS). Map window contains also:

- Navigation tools,
- Map scale field.

2. Sidebar

Sidebar contains several tabs with functions.

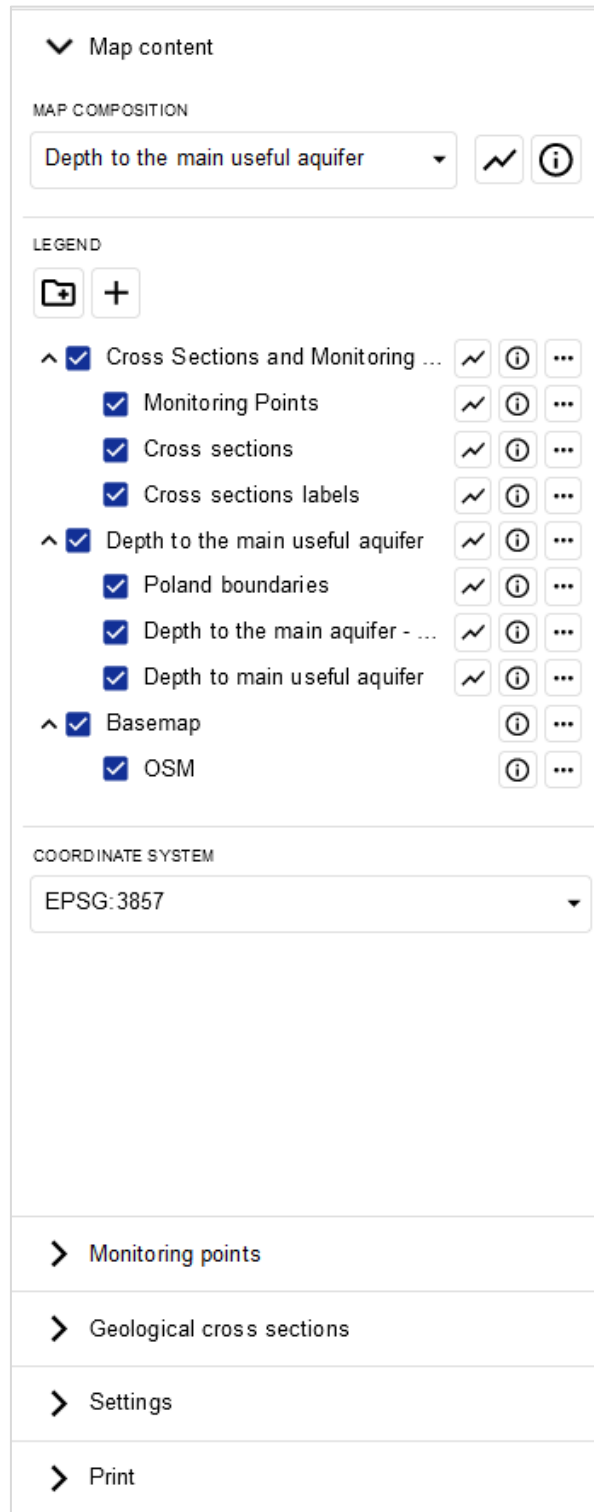


Figure 7. Sidebar

Available tabs:

- Map content – contain functions connected with information about map content and map content control:
 - Map selection,
 - Map legend,
 - Map description and layer description,
 - Map content modification (map legend functions),
 - Changing coordinate reference system.
- Monitoring points – contain list of monitoring points and functions connected with list (zoom to selected point, display information about point).
- Geological cross sections – contain list of geological cross sections and functions connected with list (zoom to selected section, display section).
- Print – tab with printing map function.
- Settings – tab with application settings e.g. screen diagonal size.

The sidebar can be hidden and expanded with the button, and stretched to the appropriate size.

3. Banner

Banner contains:

- EU-WATERRES logo. The logotype redirects user to eu-waterres.eu website.
- Grants Fund logo.
- Ikons for changing the language of the application to:
 - English (default),
 - Polish,
 - Ukrainian.
- Ikons for changing the contrast of the application. The assumption is in line with WCAG. Contrast options available:
 - Default color scheme,
 - Black background and white font,
 - Yellow background and black font,
 - Black background and yellow font.
- Ikons for changing the text size. The assumption is in line with WCAG. Text size available:
 - Medium font size (default),
 - Large font size,
 - Extra large font size.

1.8. Detailed description of application functions

1.8.1. General

1.8.1.1. Compliance with WCAG

Map Portal application is compliant with the Web Content Accessibility Guidelines (WCAG). The extent of compliance is shown below.

1.8.1.1.1. Switching application to high contrast

User can select one of the three high contrast color schemes pressing button in top right corner of the application, allowing users with sight impairments for easier application use.



Figure 8. High contrast color schemes buttons

High contrast color schemes available:

- Black background and white fonts
- Yellow background and black fonts
- Black background and yellow fonts

1.8.1.1.2. Switching the font size

Users can select one of three predefined font sizes pressing button in top right corner of the application.

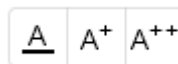


Figure 9. Font size buttons

Three font size available:

- Medium (default)
- Large
- Extra large

Selecting large or extra large font size allows users with sight impairments for easier application use.

1.8.1.1.3. Application zooming in / out using the mouse

Users can change the size of the Map Portal application by pressing Ctrl key and scrolling the mouse wheel it can be use instead of switching the font size by three buttons in top right corner of the application.

1.8.1.1.4. Accessibility through keyboard

User can access all of the application functions without a mouse, using keyboard only (by pressing Tab and Enter keys) accordingly to Web Content Accessibility Guidelines (WCAG). It allows users who cannot use the mouse full capability in using application.

1.8.1.2. Changing the language

Users can use the Map Portal application in three available languages: English, Polish and Ukrainian. English is default language. Changing the language also affects names and descriptions of layers, layer groups (categories) and map compositions in “Map content” menu. Users can change language by click on button in top right corner of the application.



Figure 10. Language selection buttons

▼ Вміст карти

КОМПОЗИЦІЯ КАРТИ

Глибина до основного корисног...

ЛЕГЕНДА

- ^ Геологічні розрізи та пункти мо...

 - Пункти моніторингу
 - Геологічні розрізи
 - Геологічні розрізи - мітки
- ^ Глибина до основного корисно...

 - Польща - державні кордони
 - Глибина до основного вод...
 - Глибина до основного кори...
- ▼ Basemap

СИСТЕМА КООРДИНАТ

EPSG: 3857 (Pseudo-Mercator)

> Пункти моніторингу

> Геологічні розрізи

> Налаштування

> Роздруківки

Figure 11. Sidebar in Ukrainian language

1.8.1.3. Using on mobile devices

Map Portal application can be used on mobile devices. The application is fully responsive, it contains a full functionality structure on all mobile devices. It is adapted to smoothly navigate through the functionalities.

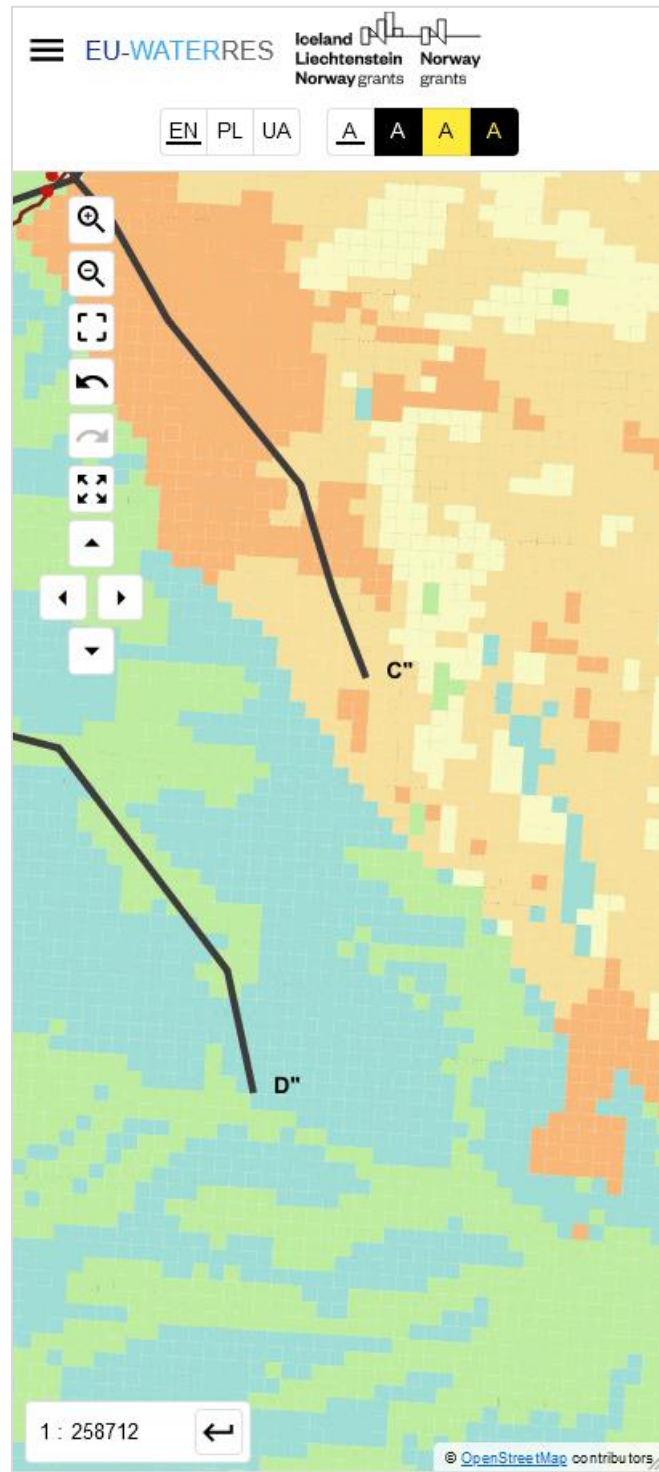


Figure 12. Map portal on mobile devices

1.8.2. Map window functions

1.8.2.1. Map navigation

Map navigation buttons are located in top left corner of map window.



Figure 13. Map navigation buttons

1.8.2.1.1. Zoom in / zoom out

Users can zoom in / zoom out the map using “Zoom in” and “Zoom out” buttons. User can also zoom in and zoom out the map using mouse scroll wheel.



Figure 14. Zoom in / zoom out buttons

1.8.2.1.2. Zoom to box

Users can draw a rectangle on the map and the map fits to the drawn shape. When user clicks on “Zoom to box” button, black dot appears in the middle of rectangle meaning that option is currently turned on and every time user will click on the map with mouse it will begin to draw a rectangle to zoom to. Rectangle is drawn by click and draw method which means that user needs to hold left mouse button pressed and then draw, when button is released map is zoomed to drawn rectangle.



Figure 15. Zoom to box button turned off and on

1.8.2.1.3. Previous / next view

Users can return to the previous map view or go to the next map view using “Undo” and “Redo” buttons.



Figure 16. Undo / redo map view buttons

1.8.2.1.4. Reset zoom

Users can reset the zoom to the predefined map composition range using “Reset zoom” button.



Figure 17. Reset zoom button

1.8.2.1.5. Move the map

Users can move the map in four directions (N, E, S, W) using four buttons or pan using the mouse by left click and drag. When panning Zoom by rectangle option must be turned off.



Figure 18. Move the map buttons

1.8.2.2. Map scale field

Map scale field is located in bottom left corner of map window.

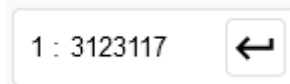


Figure 19. Map scale field

1.8.2.2.1. Showing the map scale

Map scale field shows the current scale of the map displayed on the screen. The scale is calculated based on the screen diagonal size set in the Settings menu.

1.8.2.2.2. Setting the map scale

Users can set the map scale by typing a value for the map scale denominator in the map scale field. After confirming the value, the map is zoomed in or out to the set scale.

1.8.2.3. Showing object properties

Users can obtain information about the attributes of the object selected on the map. After clicking on the selected object on the map, the form with the object's attributes will be displayed.

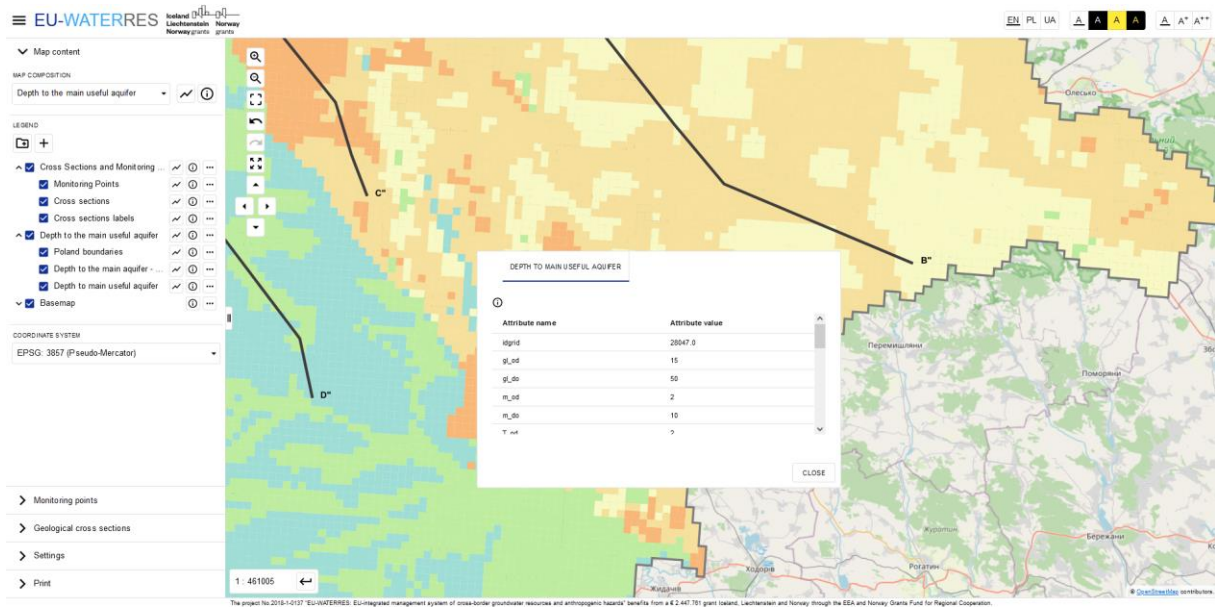


Figure 20. Information about object selected on the map

1.8.3. Map content functions

1.8.3.1. Map composition selection

Users can select one of several predefined map compositions for display in the map window. Map compositions can be made with WMS, WMTS and WFS services. Each map composition includes information about the source web services, the position and properties of the map layers in the map legend, the name and description of the layers in different languages, the default coordinate reference system, lists of monitoring points and geological cross sections, etc. The Map composition configuration is saved in the System database.

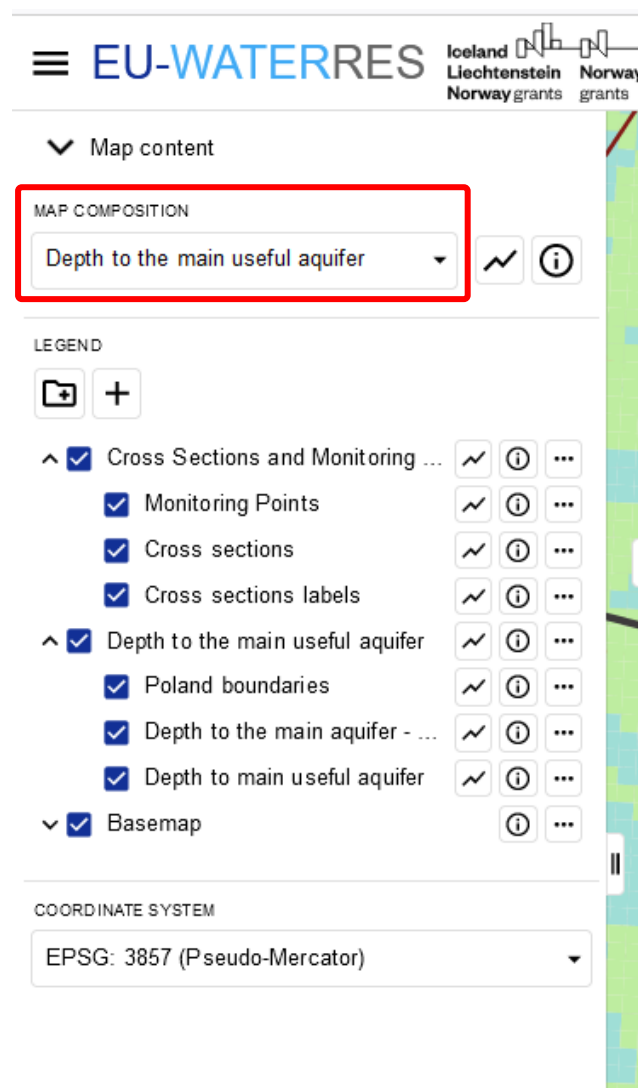


Figure 21. Map composition selection

1.8.3.2. Map legend

In map legend section user can see map composition layers grouped in layer groups (categories). Many functions are available for layers and layer groups.

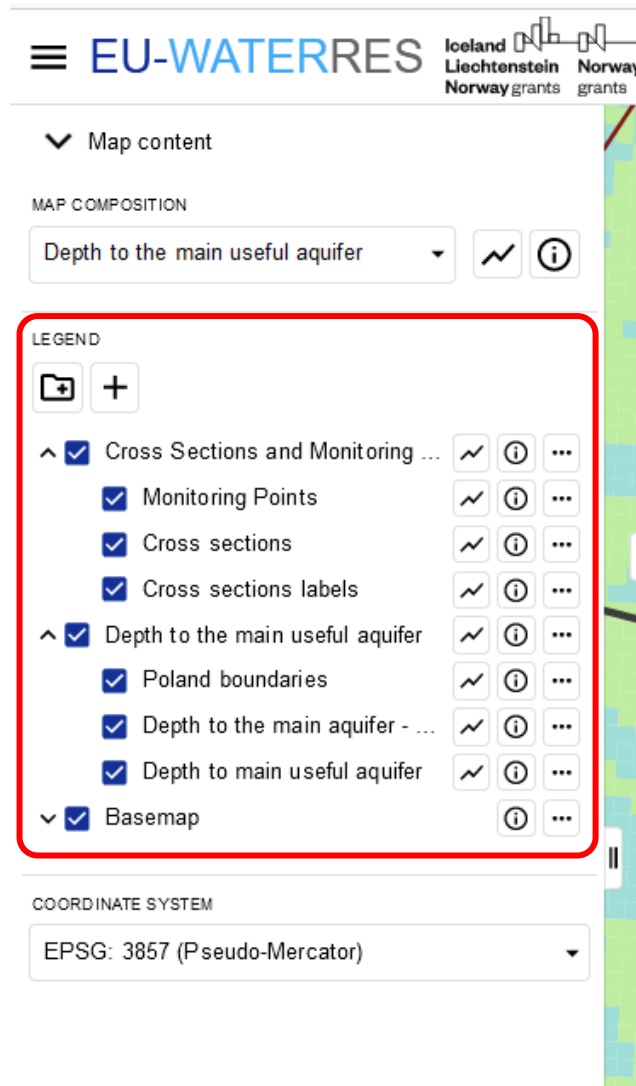


Figure 22. Map legend

1.8.3.2.1. Turning on / off layer visibility

Users can turn on/off visibility of the map layer with checkbox located next to chosen layer. Same applies to layer group. Layers with visibility turned off isn't displayed on the map. All changes are updated "on the fly".

1.8.3.2.2. Changing layers order

Users can change map layers and layer groups order by the drag and drop method or by “Move up”/“Move down” buttons located in context menu of the layer and layer group. Order of the layers in the legend corresponds to the order of the layers displayed on the map. Changing layer or layer group order in legend affects map display in the map window. All of the information is updated “on the fly”.

1.8.3.2.3. Changing layer transparency

Users can set map layer’s transparency by using slider in context menu of the selected layer.

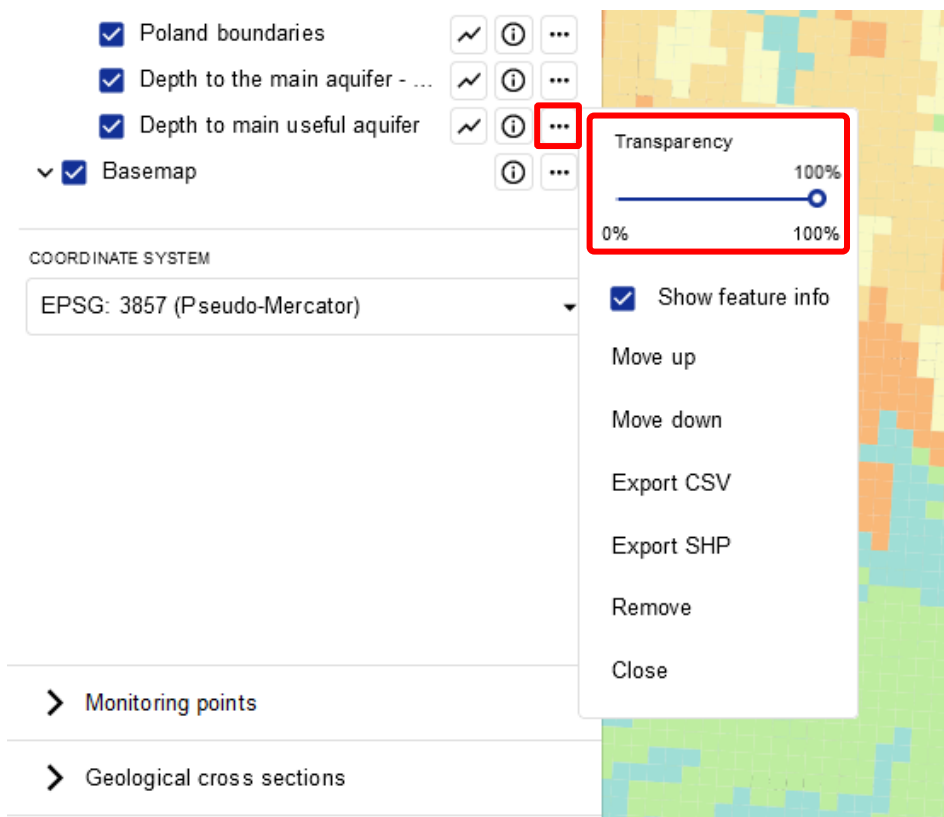


Figure 23. Changing layer transparency

1.8.3.2.4. Turning on / off layer locatability

The layer locatability on the map can be turned on/off by the user with checkbox “Show feature info” in context menu of the selected layer. If the checkbox is turned on, user can obtain information about attributes of the layer object selected on the map.

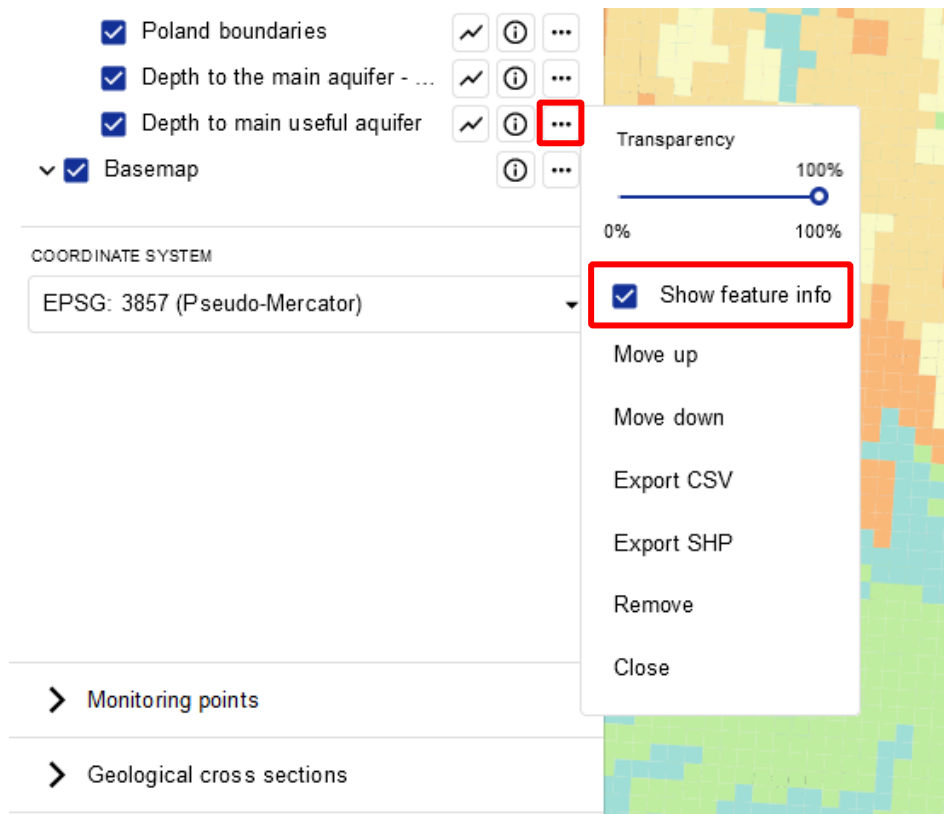


Figure 24. Show feature info

1.8.3.2.5. Layer, group and map graphic legend display

Users can display graphic legend for the layer, layer group and map composition. Graphic legend for the layer containing graphical representation of the layer objects on the map. Graphical representations of layers are displayed accordingly to graphical options that are set by WMS/WMTS owner or predefined in application configuration.

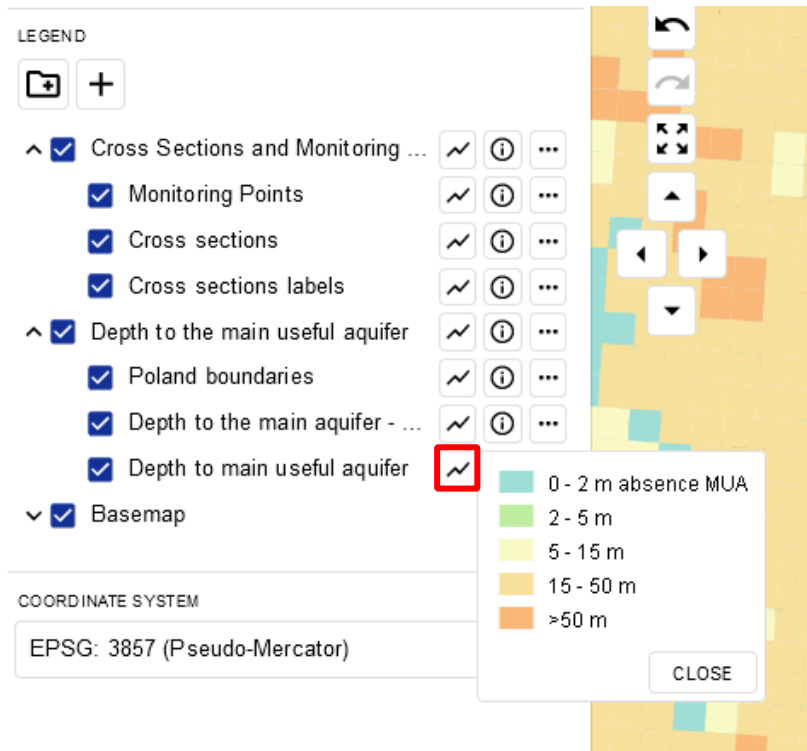


Figure 25. Layer graphic legend

Layer group graphic legend consists of the graphic legends of all the layers in the group.



Figure 26. Layer group graphic legend

Map composition graphic legend consists of the graphic legends of all the layers in the map composition.

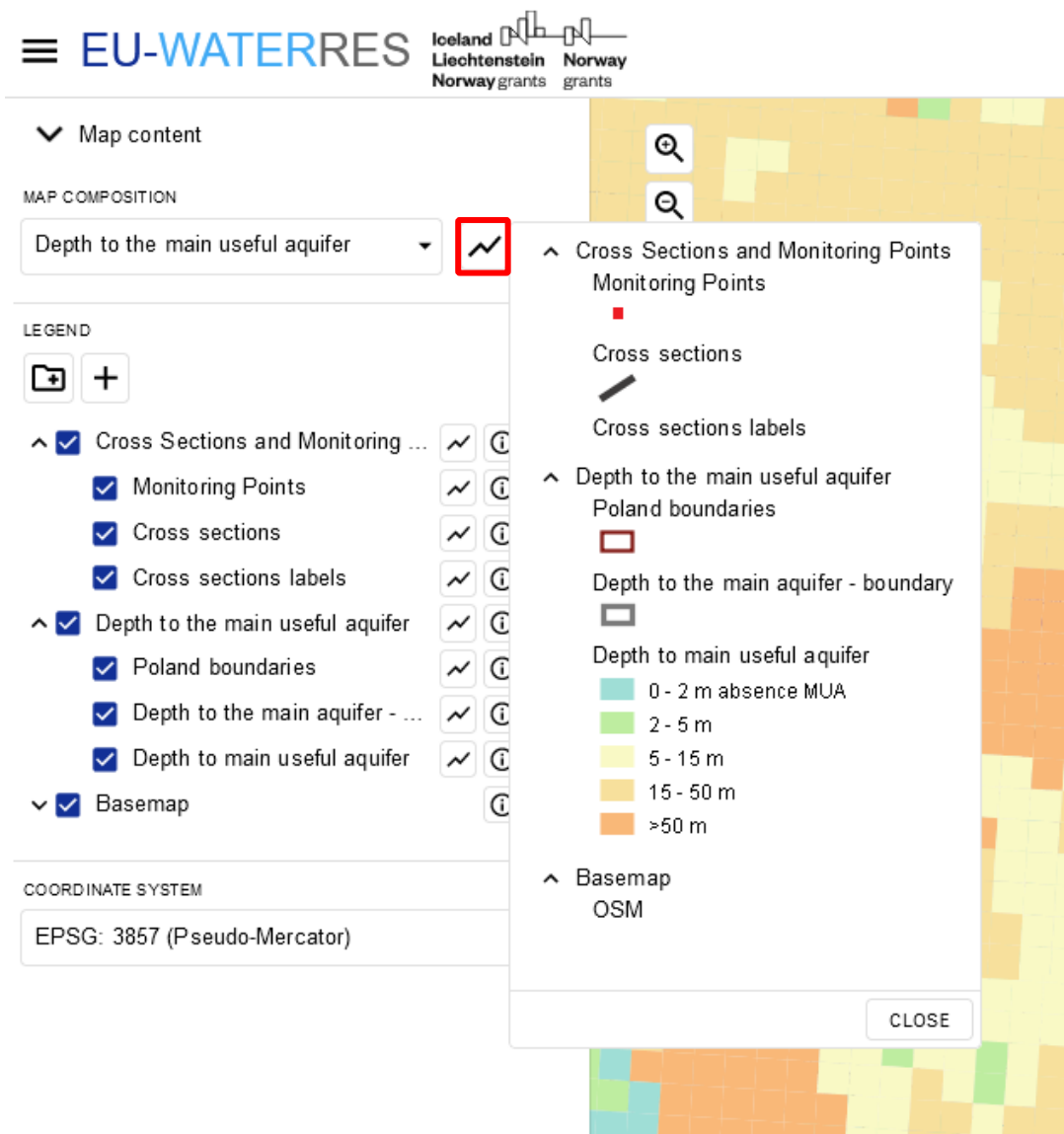


Figure 27. Map graphic legend

1.8.3.2.6. Layer, group and map description display

Users can display description of the layer, layer group or map composition by pressing “Show info about ...” button next to name of layer, layer group or map composition. Buttons “Show info about ...” are available only for layers and layer groups for which descriptions have been defined in map composition. Descriptions are translated when user changes currently selected language.

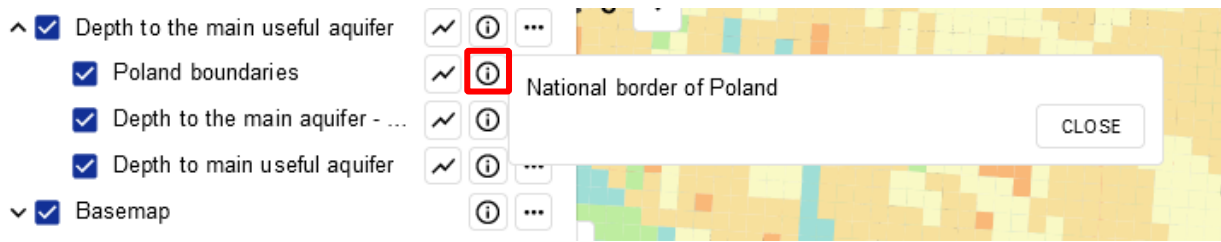


Figure 28. Layer description

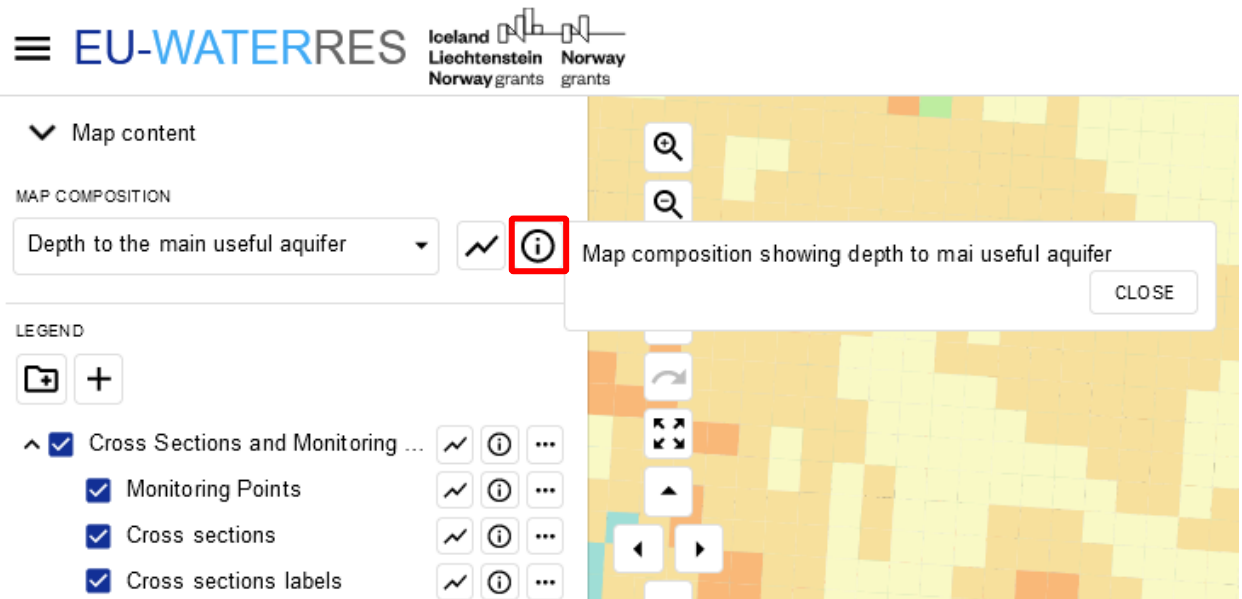


Figure 29. Map description

1.8.3.3. Adding a new layer

Users can add a new layer from WMS or WMTS to the map. Layer is added to the map only in current session of application.



Figure 30. Add layer button

The image shows a web form titled "Add layer" with two tabs: "BASIC OPTIONS" (active) and "ADVANCED OPTIONS".

Service type:
 WMS WMTS

Source:

Layer options:
 Swap axes

Group options:
 Create new group Add to existing group

At the bottom right, there are two buttons: "CANCEL" and "ADD".

Figure 31. "Add layer" form

Basic options tab

Service type - by selecting "WMS" or "WMTS" Service type option user defines what type of service is to be added.

Source – user defines source service address. After pressing "Get Layers" button, list of layers from the selected service appears. User has to chose one layer from the list.

Layer options

Swap axes checkbox – user can swap axes X and Y for the layer if it is necessary.

Layer name – user can change default layer name.

Group options

New layer has to be attached to existing or new layer group. User has to chose one of two radio buttons:

- "Create new group" – requires a new group name to be defined.
- "Add to existing group" – user has to select one of group existing in map composition

Add layer

BASIC OPTIONS ADVANCED OPTIONS

Service type:

WMS WMTS

Source:

URL *

Layers:

- Granice Obrębów Ewidencyjnych
- Granice Jednostek Ewidencyjnych
- Granice Gmin**
- Granice Miast
- Granice Powiatów
- Granice województw

Layer options:

Swap axes

Layer name *

Group options:

Create new group Add to existing group

Group name *

Figure 32. Completed "Add layer" form

Advanced options tab

In Advanced options tab user can provides additional info about new layer.

Add layer

BASIC OPTIONS **ADVANCED OPTIONS**

Translations:

Layer description (EN)
Podstawowa jednostka podziału terytorialnego w Polsce.Typy gmin:1 - gmina miejska,

Layer name (PL)

Layer description (PL)

Layer name (UA)

Layer description (UA)

Feature info settings:

Show feature info

Available feature info formats:

text HTML

CANCEL ADD

Figure 33. "Add layer" form – Advanced options tab

Translations

Layer description (EN) – description to be displayed when user uses English version of application.

Layer name (PL) – name of the layer displayed in Polish version of application.

Layer description (PL) – description to be displayed when user uses Polish version of application.

Layer name (UA) – name of the layer displayed in Ukrainian version of application.

Layer description (UA) – description to be displayed when user uses Ukrainian version of application.

Feature info settings – user can turn off / on new layer locatability with checkbox “Show feature info”. If the checkbox is turned on, user can obtain information about attributes of the layer object selected on the map.

Available feature info formats – user can chose format of received data in feature info function for some layers (text HTML or GML).

After pressing “ADD” button on completed “Add layer” form the layer is added to the current map composition.

1.8.3.4. Adding a new group

User can add a new layer group (category) to the legend. Layer group is added to the legend only in current session of application.



Figure 34. Add group button

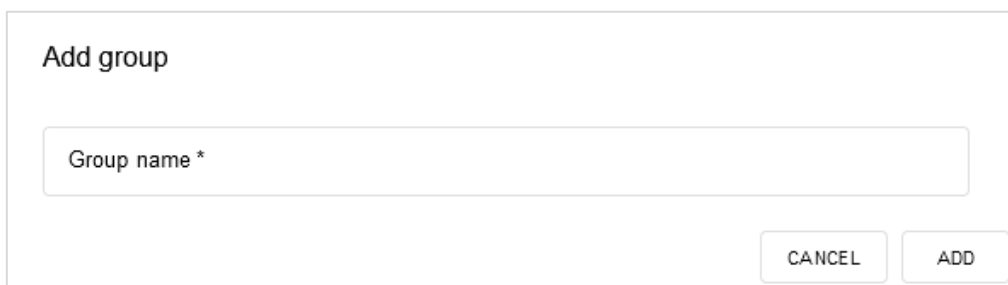
The image shows a screenshot of the 'Add group' form. The form has a title 'Add group' and a text input field labeled 'Group name *'. At the bottom right of the form, there are two buttons: 'CANCEL' and 'ADD'.

Figure 35. “Add group” form

In “Add group” form user is able to add new layer group to the legend by filling “Group name” input field and then pressing “ADD” button.

1.8.3.5. Removing the layer and the layer group

Users can remove the layer and the layer group (category) from the legend of the map composition by pressing “Remove” command in layer or group context menu. Layers and layer groups are removed only in current session of application which means that after reloading application all layers and layer groups are again available in legend part of map content menu.

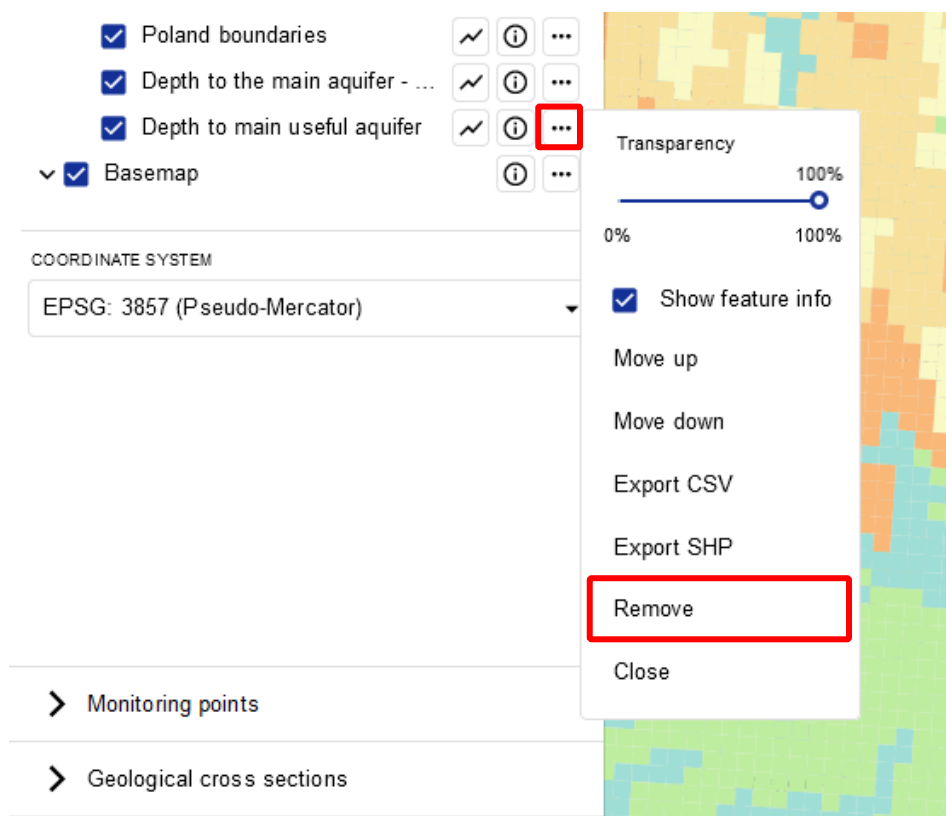


Figure 36. Remove layer command

1.8.3.6. Changing coordinate reference system

Users can choose to display the map in predefined coordinate reference systems (CRS) chosen from list in Map content section of the sidebar. It alters map display by changing reference system, if any of the layers is not compatible with currently selected coordinate reference system layer has its name written in grey and in layer description information is displayed that this layer does not support currently selected CRS.

EU-WATERRES Iceland
Liechtenstein
Norway grants

Map content

MAP COMPOSITION

Depth to the main useful aquifer

LEGEND

- Cross Sections and Monitoring ...
 - Monitoring Points
 - Cross sections
 - Cross sections labels
- Depth to the main useful aquifer
 - Poland boundaries
 - Depth to the main aquifer - ...
 - Depth to main useful aquifer
- Basemap

COORDINATE SYSTEM

EPSG: 3857 (Pseudo-Mercator)

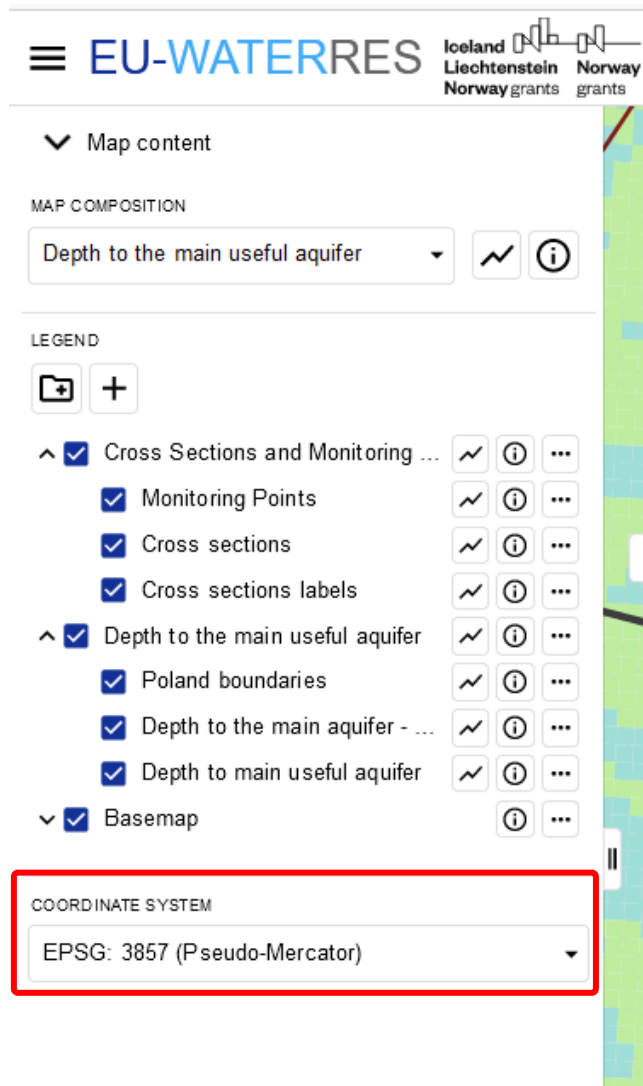


Figure 37. Coordinate reference system selection

1.8.3.7. Data export

1.8.3.7.1. Export to SHP

Users can export the selected map layer to SHP format by pressing “Export SHP” command in layer context menu. SHP files are downloaded by browser. Export is available only for layers published as part of the integrated information and research platform.

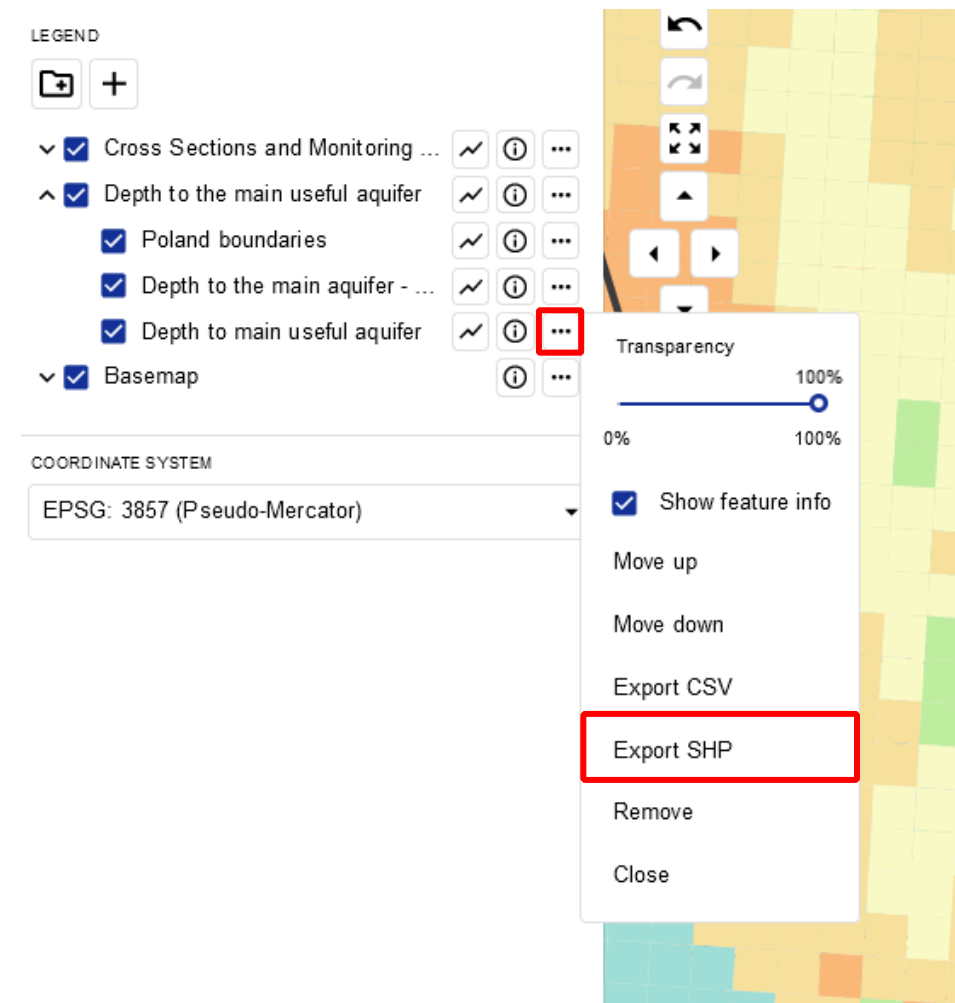


Figure 38. Export to SHP

1.8.3.7.2. Export to CSV

Users can export the selected map layer to CSV format by pressing “Export CSV” command in layer context menu. CSV files are downloaded by browser. CSV files do not contain information about the geometry of the objects. Export is available only for layers published as part of the integrated information and research platform.

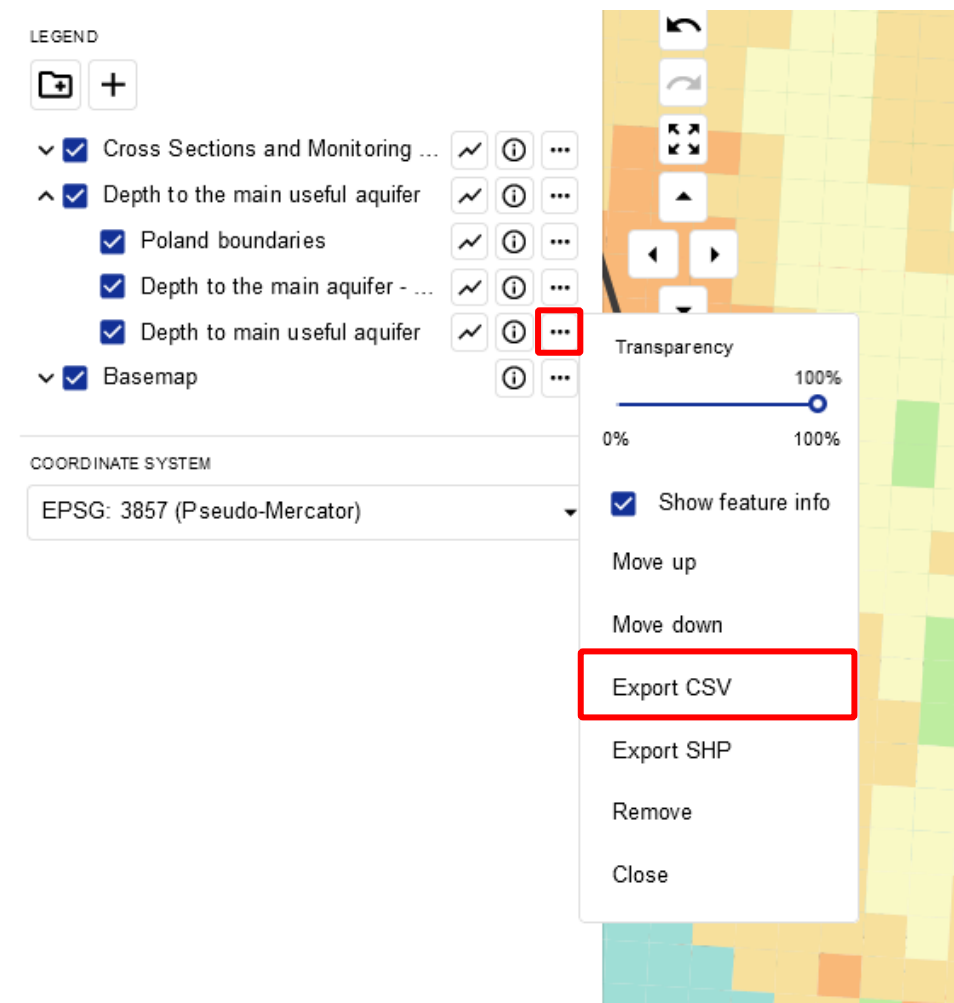


Figure 39. Export to CSV

1.8.4. Monitoring points list

User can quickly display list of monitoring points by selecting “Monitoring points” menu on the sidebar. List of monitoring points is defined in the selected map composition it means that different map compositions can have different monitoring points lists.

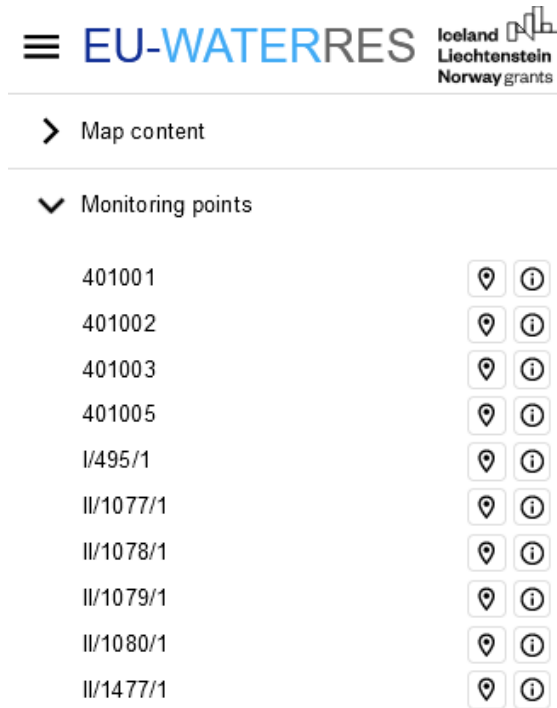


Figure 40. “Monitoring points” menu

Functions available on the list are described below.

1.8.4.1. Display attributes of feature

User can obtain information about attributes of the object selected from the list by pressing “Display attributes of feature” button.

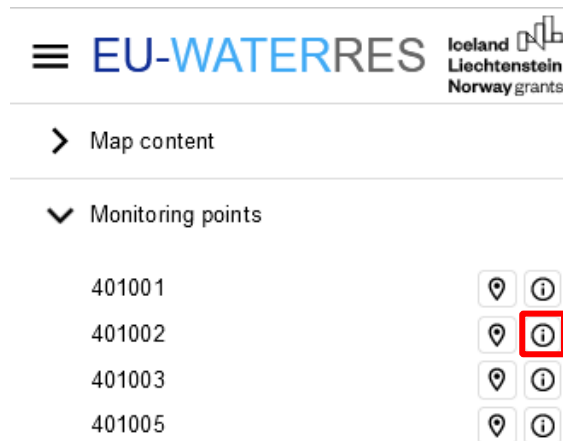
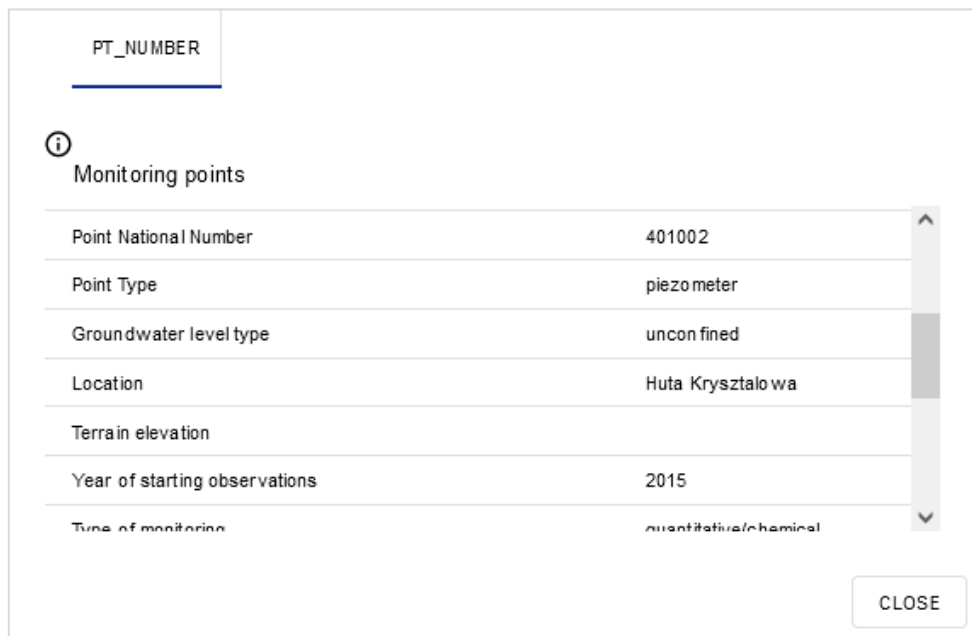


Figure 41. Display attributes of feature button

After pressing button, the form with the object's attributes will be displayed.



The screenshot shows a form titled "PT_NUMBER" with an information icon. Below the title is a section for "Monitoring points" containing a table of attributes. A "CLOSE" button is located at the bottom right of the form.

PT_NUMBER	
Monitoring points	
Point National Number	401002
Point Type	piezo meter
Groundwater level type	uncon fined
Location	Huta Kryształowa
Terrain elevation	
Year of starting observations	2015
Type of monitoring	quantitative/chemical

Figure 42. Information about object form

1.8.4.1.1. Object attachments display

Objects can have file attachments (raster file or PDF) which can be opened by the user from the information about object form by pressing thumbnail of attachment.

1.8.4.2. Locate feature

Map range can be fitted to the geometry of the object selected in the list by pressing "Locate feature" button. It results in zooming map to selected feature which is displayed. User can remove displayed object from the map by pressing "CLEAR" button below the list.

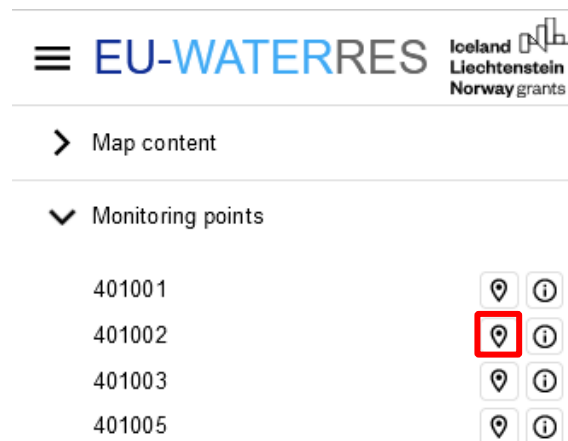


Figure 43. Locate feature button

1.8.5. Geological cross sections list

User can quickly display list of geological cross sections by selecting “Geological cross sections” menu on the sidebar. List is defined in the selected map composition it means that different map compositions can have different geological cross sections lists.

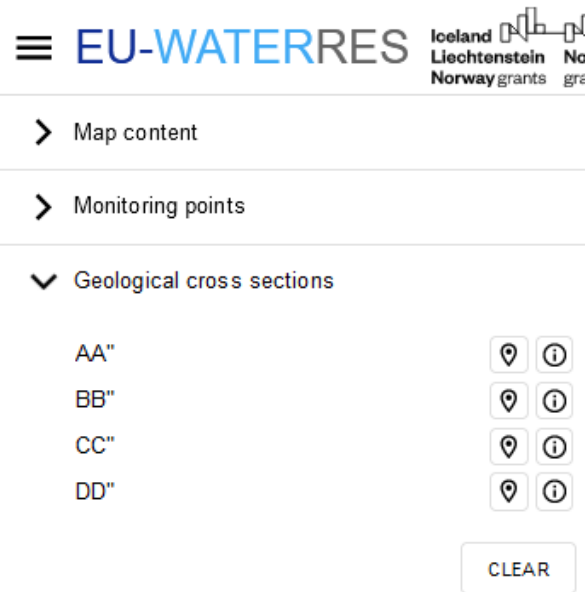


Figure 44. “Geological cross sections” menu

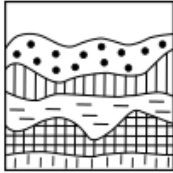
Functions available on the list are the same as functions available on the monitoring points list and are described below.

1.8.5.1. Display attributes of feature

After pressing “Display attributes of feature” button, the “Information about object” form with thumbnail of the attachment will be displayed.

NAME

i Cross sections

Attribute name	Attribute value
Image	
Length	189.03
Cross section name	AA"

CLOSE

Figure 45. Information about object form with thumbnail

1.8.5.1.1. Object attachments display

After pressing thumbnail of attachment on "Information about object" form, file with cross section will be displayed in a new browser tab.

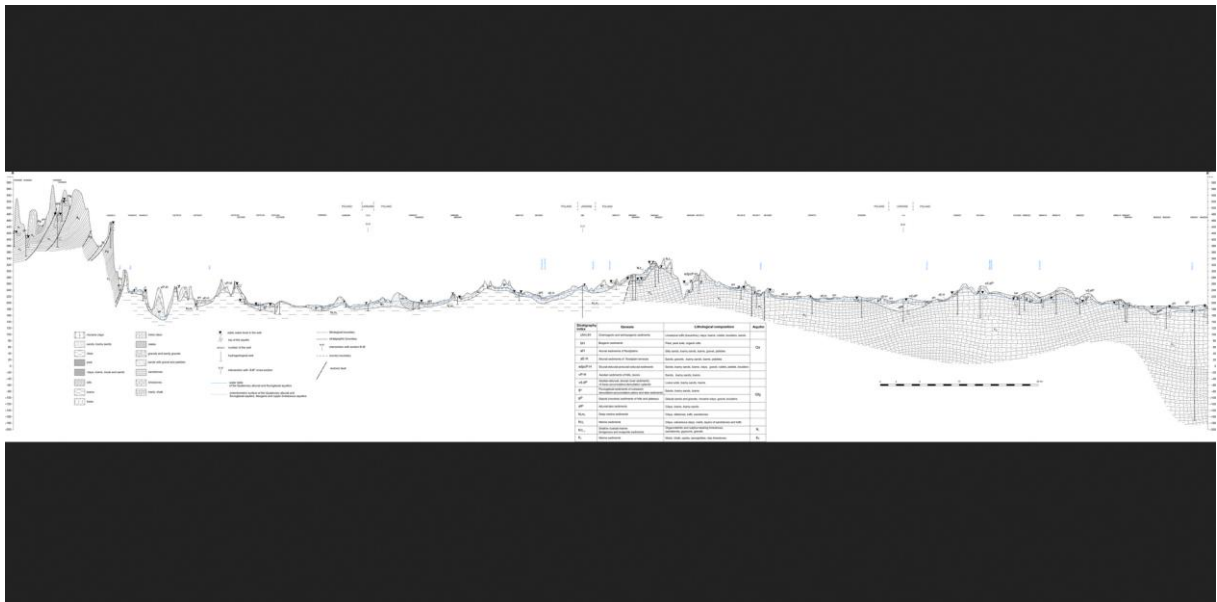


Figure 46. Displayed attachment

1.8.5.2. Locate feature

Map range can be fitted to the geometry of the object selected in the list by pressing “Locate feature” button. It results in zooming map to selected feature witch is displayed. User can remove displayed object from the map by pressing “CLEAR” button below the list.

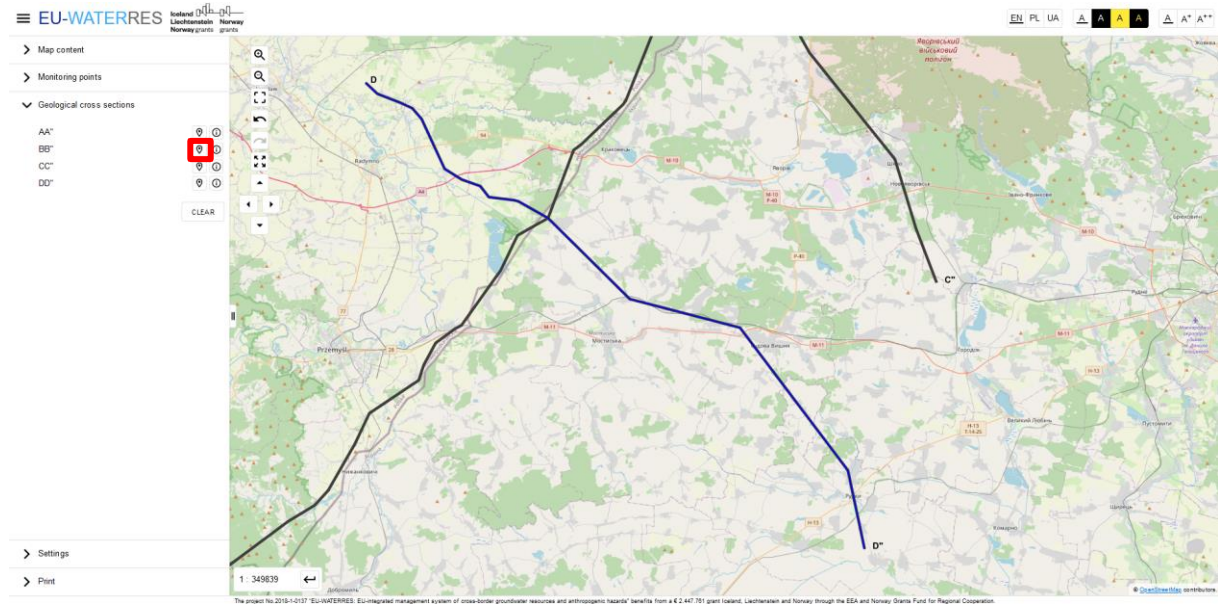


Figure 47. Locate feature function

1.8.6. Printing map

User can generate printout of selected part of the map displayed in the map window. Print properties can be defined by user in “Print” menu on the sidebar.

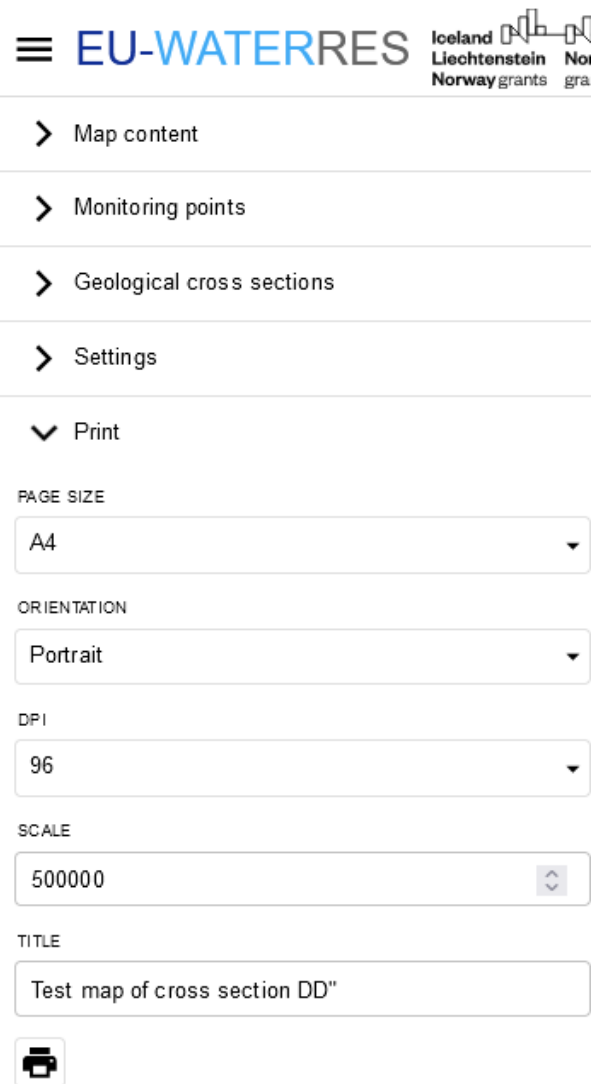


Figure 48. “Print” menu

When user selects “Print” menu the print area appears on the map. User can change location of the print area by dragging the rectangle on the map with mouse. The size of the print area can be changed by user by changing **scale** or **page size** in “Print” menu. User can also define other print parameters: page **orientation**, **DPI** resolution and **title**.

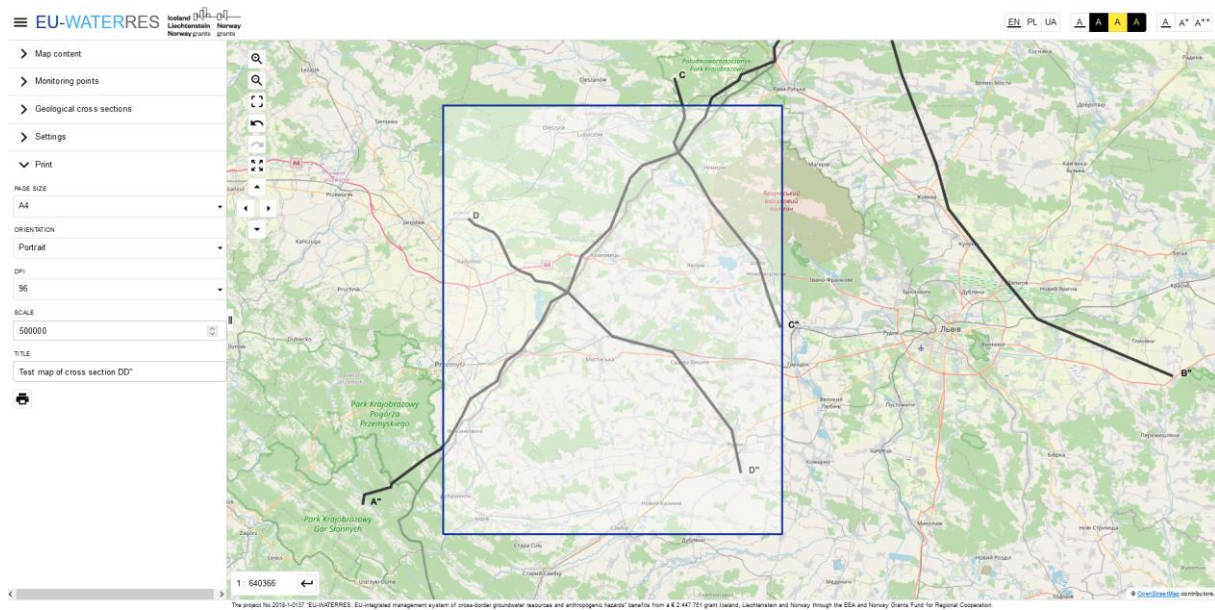


Figure 49. Print area in the map window

Final step in generating printout is pressing “Print” button (button with printer), then file in PDF format is generated and downloaded by browser. Generated map printout is shown below.

1.8.7. Settings

In “Settings” menu, user can define different screen diagonal size than default one. Screen diagonal size affects calculation of map scale showing in the map scale field.

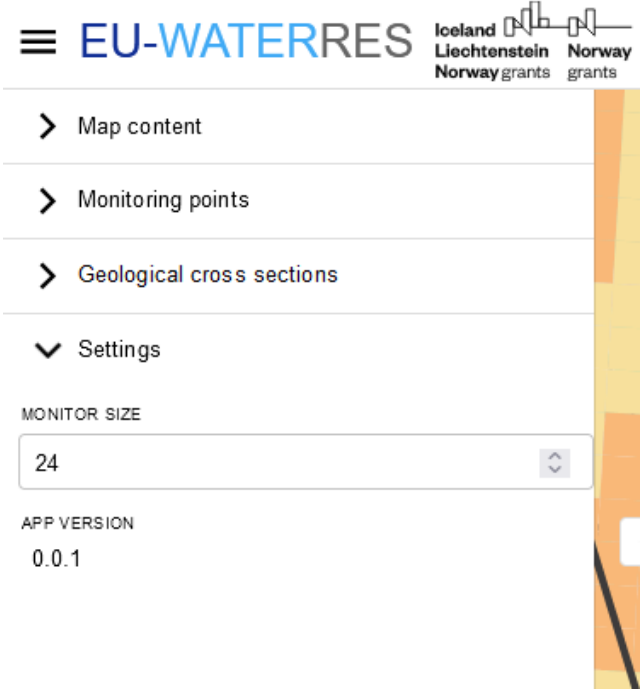


Figure 51. “Settings” menu