



Regional demand-supply matching GIS tool

User manual

Version v1.2



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List of Acronyms and Abbreviations

AGS	Amtlicher Gemeindegchlüssel (Official municipality key)
AURCC	Administrative unit-related coverage class
AURSC	Administrative unit-related supply coverage
%AURSC	Percentage administrative unit-related supply coverage
CLC	Corine Land Cover
NLWKN	Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (Lower Saxony State Agency for Water Management, Coastal Defence and Nature Conservation)
OOWV	Oldenburgisch-Ostfriesischer Wasserverband (Oldenburg-East Frisian Water Association)
RDSMG	Regional demand-supply matching GIS tool

Technical terms

Data	In this manual, the term “ data ” refers to all data sets that contain information required for the tool. This includes csv tables , raster data sets or shape files .
Layer	When this user manual refers to “ layers ”, it always implies shape layers/shape files (*.shp) with corresponding data.
Plug-in	A “ plug-in ” is a software programme that can be accessed by other software applications to extend their functionality. The Regional demand-supply matching GIS tool provides two plug-ins for the open access programme QGIS.
Tool	The Regional demand-supply matching GIS tool provides two plug-ins for QGIS that serves as a tool designed for visualizing and processing open-source information on natural water availability and sectorial consumption

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Data basis:

- © GeoBasis-DE / BKG 2017 (data changed)
- © European Union, Copernicus Land Monitoring Service 2018, European Environment Agency (EEA), with funding by the European Union (data changed)
- 2023 NLWKN
www.nlwkn.niedersachsen.de/opendata (data changed)
- Geofachdaten NLStBV © 2023 (data changed)
- © Statistische Ämter des Bundes und der Länder, Deutschland, 2023. Dieses Werk ist lizenziert unter der Datenlizenz Deutschland - Namensnennung - Version 2.0. | Status: 31.07.2023 / 09:56:40 (data changed)
- Original source: European Environment Agency (EEA), (data changed)
- Data basis: Deutscher Wetterdienst (DWD)

For further information see Table 5.

1 Introduction

Engineers, practitioners, decision makers and different types of stakeholders related to water systems face a diverse set of conditions and challenges. Three of the global water challenges that are related to water security, as highlighted by UNESCO (Makarigakis & Jimenez-Cisneros 2019) are a) water availability, b) water quality and c) water related hazards. As stated in the same source, pressures on water availability can be attributed to population and economic growth, agriculture, water scarcity and/or climate variability and change.

Changes in water resources have significant socio-economic impacts. Low water supply and droughts affect many sectors, such as agriculture, forestry, energy and drinking water provision. Irrigated agriculture, hydropower generation, use of cooling water and other activities related to water use are susceptible to changed flow regimes and reduced annual water availability (European Environment Agency 2008).

To tackle these challenges, the European research project building a water-smart society and economy, short B-WaterSmart, develops and demonstrates smart technologies and circular economy approaches.

In order to implement those solutions more strongly in the practice of the water sector, technical and digital solutions as well as new business models are jointly developed by the project partners. The aim is to accelerate the transformation to water-smart economies and societies in coastal Europe and beyond by reducing the use of freshwater resources, improving the recovery and reuse of resources, and increase water use efficiency.

The regional demand-supply matching GIS tool (RDSMG) was developed as part of the EU project B-WaterSmart (<https://b-watersmart.eu/>).

The RDSMG is a GIS tool designed for visualizing and processing open-source information on natural water availability and sectorial consumption. Information can be used to identify i) possible consumption hotspots and areas of water shortage, ii) alternative water resources or areas with available water sources and iii) water drain from one region to another region. Based on the analysis, the impacts of alternative water availability scenarios on water demand can be displayed and different scales and depths of information can be analysed.

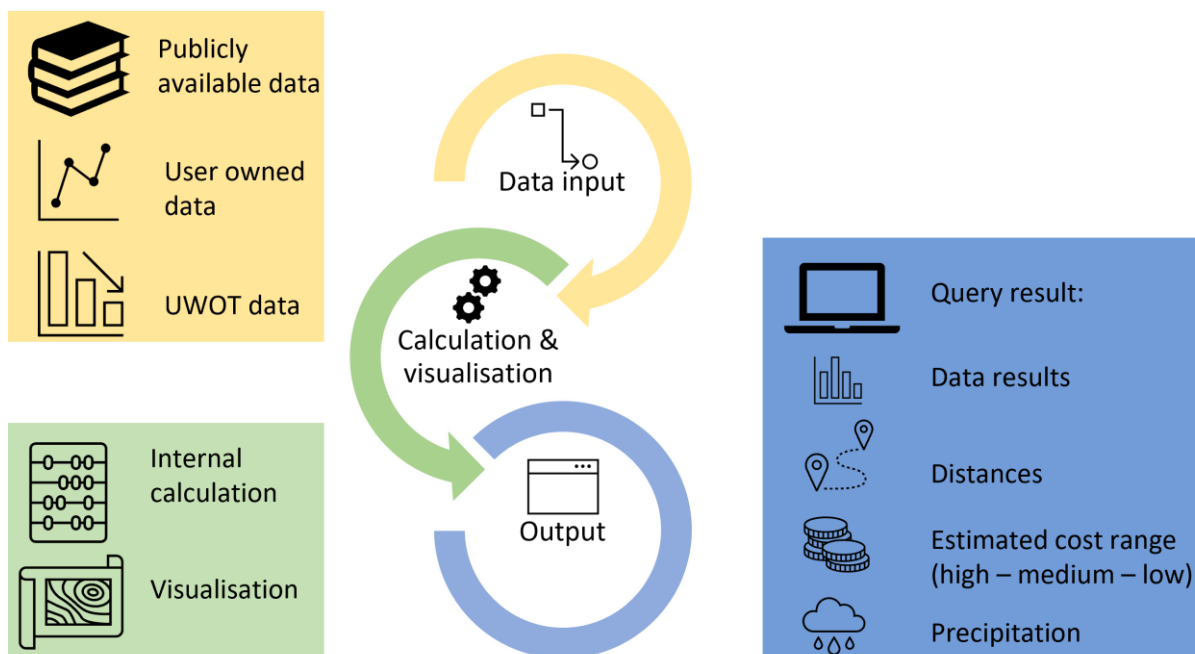


Figure 1: Concept of the regional demand-supply matching GIS tool (RDSMG).

There are five functionalities of the tool that can be used by the end-user:

- 1) Visualization of data in the viewer mode on different scales
 - Data discretization in dependence of scale
 - Water demands / water sources
- 2) Automated identification of water sources and possible water reuse resources in the vicinity of a defined location (depending on distance). Water quality level can be selected.
- 3) Approximate classification of the financial expenditure for the development of the alternative resource (surface water).
- 4) Mean annual precipitation to explore the possibility to use rainwater harvesting as an alternative resource.
- 5) Use of UWOT data for a five-year projection of water demand (depending on availability of UWOT data for the requested point of interest).

The tool is designed to use public and user owned data. For convenience and demonstration purposes, a data package is distributed with the RDSMG. The package is downloadable at the tool's website on the Europe Water Marketplace (<https://mp.uwmh.eu/d/Product/35>).

The tool was first applied to the B-WaterSmart living lab East Frisia, some of the demo data are clipped to the extend of the living lab. For more information on the region of East Frisia please visit the B-WaterSmart (<https://b-watersmart.eu/living-lab/east-frisia-germany/>) and the Europe Water Marketplace site (<https://mp.watereurope.eu/d/CaseStudy/19>) on the East Frisia case study region.

2 Prerequisites

2.1 Required prior knowledge

It is assumed that the user of the RDSMG has a basic knowledge of the QGIS programme. Otherwise, please refer to the QGIS manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html). Furthermore, it is assumed that the user can interpret data on drinking water production and use, as well as quality data of surface and groundwater bodies.

2.2 Obtaining necessary Information

To obtain the necessary information, you can use the following sources, for example:

- For more information on the regional demand-supply matching GIS tool, please consider visiting the *Water Europe Marketplace* product page (<https://mp.uwmh.eu/d/Product/35>).
- For background information on QGIS and its application, please refer to the official QGIS website (<https://www.qgis.org/en/site/index.html>) or the QGIS manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html).
- For background information on the B-WaterSmart project, the case study regions and other water smart solutions developed in the B-WaterSmart framework, please visit <https://b-watersmart.eu/>.
- This user manual contains all the necessary information for operating the RDSMG.
- For background information on the data used, please visit the websites of the original data bases linked in Table 5.

2.3 Legal Notice

This user manual and the two plug-ins that were created as part of the regional demand-supply matching GIS tool (RDSMG – From point on map, RDSMG – From point layer) are available to you free for non-commercial use.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), the rights to use, copy, modify, merge, publish, distribute copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions: The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

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By using the RDSMG, you as a user agree to abide by the applicable terms of use of the original data providers and of the *Water Europe Marketplace*. We distance ourselves from any consequences of non-compliance with the terms of use. We distance ourselves from all content that

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We cannot guarantee that the provided data are necessarily comprehensive, complete, accurate or up to date.

We reserve the right to change this user manual and the regional demand-supply matching GIS tool at any time without prior notice and/or to discontinue their operation. We are not obliged to update the content provided on the *Water Europe Marketplace*.

3 Description of the RDSMG

3.1 Technical requirements

This plug-in has been developed and tested with QGIS version 3.28.5 Firenze. It is recommended to use the following program versions for the execution of the plug-in, otherwise the functionality may be limited:

- QGIS version: 3.28.5 Firenze
- QGIS code version: 50adba36f2
- Qt version: 5.15.3
- Python version: 3.9.5
- GDAL version: 3.6.3
- GEOS-Version: 3.11.2-CAPI-1.17.2
- PROJ version: Rel. 9.2.0, March 1st, 2023
- PDAL version: 2.5.2 (git version: 57c4e7)

3.2 Required data

In Table 1 you will find a list of the data provided on the *Water Europe Marketplace* product page (<https://mp.uwmh.eu/d/Product/35>). The column names required for the tool are marked in bold. They can also be found in Table 2 and Table 3. The data provided are all to be used according to the respective conditions of use of the original providers (to be found in Table 5).

Table 1: Data for the RDSMG provided on the *Water Europe Marketplace* product page

Name	Purpose	Year of publication	Attributes	Explanation
LowerSaxony	Outline of Lower Saxony, to identify in which federal state the query takes place	2017	Fed_State	Federal State
			area_m2	Area in m ²
LowerSaxony_County	Counties of Lower Saxony, to identify in which county the query takes place	2017	County	Name of county
			AGS	Official municipality key
			area_m2	Area in m ²
LowerSaxony_Community	Communities of Lower Saxony, to identify in which community the query takes place	2017	name	Name of community
			administra	Type of community
			AGS01	Official municipality key
			area_m2	Area in m ²
OOWV		2017	area name	Name of area

	Association area of water supplier OOWV (for living lap East Frisia), to identify in whether the query takes place in OOWV area or not		area_m2	Area in m ²
LandUse	Corine Land Cover 2018; Land use, to state wick land use type(s) exist around the query	2018	OBJECTID	ID number of objects
			Code_18	Corine Land Cover (2018) Code
			CLC_Lable 1	General lable of Corine Land Cover classes
			CLC_Lable2	Lable of Corine Land Cover sub classes
			CLC_Lable3	Detailed lable of Corine Land Cover classes
			area_m2	Area in m ²
NatureReserves	Nature Reserves in 2022 (Lower Saxony and Bremen), to identify in whether the query takes place in a nature reserve	2022	NRS_ID	Nature reserve_Unique identification number
			name	Name of nature reserve
			category	Category of the area
			enforcemen	Enforcement region
			area_m2	Area in m ²
			NRS_URL	Link to nature reserve
DrinkingWater ProtectionArea	Drinking water Protection areas in Lower Saxony, to identify in whether the query takes place in a water protection area or a water protection area lies in between query and clostest surface water body	2022 , latest version 2023	WPA_name	Name of water protection area
			Function	Function of water protection area
			Status	Status of water protectiona rea
			ProtZone	Protection zone
			Number	Number ID of area
			SubAreaNo	Number ID of sub area
			Authority	Corresponding authority
			EntryDate	Date of data collention
			Basis	Base of data collection
			Legal	Legal background
			From_date	Date since when the area has been a water protection area
Roads	Roads of Lower Saxony, to identify whether the direct path of the query point to the nearest surface water crosses roads and, if so, how many	2010	SectionID	Road section identification
			RoadID	Road identification
			ID_short	Short road identification name
			Class	Class of road: A = Autobahn (motorway), B = Bundesstraße (federal road), L = Landstraße (Country road), K = Kreisstraße (County road)
			InternID	Intern road ID
			Date	Date of data update

			Length	Length of road or road section in m
ProductionConsumtion	Data collection of drinking water consumption, production, to identify potential water suppliers and water recipients and to calculate percentage usage of total drinking water consumption	2016	name	Name of county
			administra	Type of county
			area_m2	Area in m ²
			AGS	Official municipality key
			tot_Consum3	Total water consumption in m ³ /a
			Dem_house	Water demand of households and small businesses in m ³ /a
			PerCapCons	Per capita consumption; in L/(P*d)
GroundWaterBodies	Ground water bodies in Lower Saxony and their quantitative and chemical status, to identify good chemical status in groundwater bodies	2016	OBJECTID	Object ID
			EU_CD_GB	EU groundwater body code
			name	Name of groundwater body
			QuanStat	Quantitative status
			chemStat	Chemical status
			Nitrate	Status regarding nitrate
			Pesticide	Status regarding pesticides
			Other	Status regarding other substances
			Exceedances	Exceedances
			RiverBasin	River Basin
			FedState	Federal State
class	Subdivision into different quality groups; 1= drinking water quality, 2= good chemical status (surface and groundwater bodies), 3= poor chemical status (surface and groundwater bodies), 4 = quality not specified			
SurfaceWaterBodies	Rivers in Lower Saxony and their ecological and chemical status, to identify good chemical status in surface water bodies and to calculate the distance from the query point to the nearest surface water body.	2015, revised 2016	OBJECTID	Object ID
			WB_name	Name of the water body
			WB_no	Number of the water body
			WB_type	Category/type of the water body
			modific	Type of modification of the water body if not natural water body
			reason	Reason for modification
			eco_Stat	Ecological status
			Macrozoobe	Condition regarding macrozoobe
			Phyto	Condition regarding phytoplankton
fish	Condition regarding fish			

			chem_Stat	Chemical status
			HeavyMet	Condition regarding heavy metals
			Pesticides	Condition regarding pesticides
			Industry	Condition regarding industrial substances
			OtherSub	Condition regarding other substances
			class	Subdivision into different quality groups; 1= drinking water quality, 2= good chemical status (surface and groundwater bodies), 3= poor chemical status (surface and groundwater bodies), 4 = quality not specified
WWTP	Urban Waste Water Treatment Plants in Lower Saxony, to measure the distance from query point to next WWTP in order to propose a possible alternative water use	2022	fid	Field ID
			OBJECTID	Object ID
			name	Name of urban waste water treatment plant
			UWW	Urban waste water
Precipitation	Raster of multi-year mean precipitation levels for Germany from 1981 to 2010, to provide information for rainwater harvesting (1 km x 1 km resolution)	1981-2010	Band 1	Precipitation (Germany) in mm=L/m ²

Table 2 lists the mandatory data for the use of this plug-in. Table 3 contains a list of all optional data that can be used for the tool.

The provided data in Table 1 can be replaced at any time with your own data that meet the requirements in Table 2 and Table 3. If you want to use your own data, prepare it according to the specifications in Table 2 and Table 3, so that the required attributes are present (column “Required attributes”) and have the name defined in column “Required names“. It is particularly important that the units and column names correspond to the specifications in Table 2 and Table 3.

You can also use your own data in multiple datasets, e.g. separate datasets for total drinking water consumption and water demand per capita (unlike the “ProductionConsumption” shape layer, which

contains multiple information). You must specify these data sets as input in the tool accordingly (see chapter 5.5)

For a higher informational value, it is recommended to use data from the same year. Please check that all data used (and your “points of interest”-layer) are in the same coordinate reference system, otherwise errors and inaccuracies may occur in the internal calculations and queries of the plug-in. The data provided on the *Water Europe Marketplace* product page are in the EPSG:3035 - ETRS89-extended / LAEA Europe coordinate reference system (unit: metre).

You need data for all areas in which you want to query points, otherwise you will get the blank value *NULL* in the output. It is not necessary to clip data sets to your query area if there is more data than you need. No results are shown for regions that are not queried.

Table 2: Mandatory Data for the RDSMG

Data description	Data form	Required attributes	Required names
Map of the federal states	Shapefile (polygons)	Name of federal State	Fed_State
Map of Counties	Shapefile (polygons)	Name of counties	County
Data for total drinking water consumption related to counties	Shapefile (polygons) or table that can be assigned to the shapefile of the counties, e.g. via municipality keys.	Total drinking water consumption in m ³ /a	tot_ConsM3
Data for total drinking water production related to counties	Shapefile (polygons) or table that can be assigned to the shapefile of the counties, e.g. via municipality keys. drinking water consumption related to counties	Total drinking water production in m ³ /a	tot_ProdM3
Data of Groundwater bodies	Shapefile (polygons)	Subdivision into different quality groups; 1= drinking water quality, 2= good chemical status (surface and groundwater bodies), 3= poor chemical status (surface and groundwater bodies), 4 = quality not specified	class
Data of surface water bodies	Shapefile (lines)	1) Name of the water body 2) Subdivision into different quality groups; 1= drinking water quality, 2= good chemical status (surface and groundwater bodies), 3= poor chemical status (surface and groundwater bodies), 4 = quality not specified 3) Optional : Condition regarding heavy metals 4) Optional : Condition regarding pesticides 5) Optional :	WB_name class HeavyMet Pesticides Industry OtherSub

		Condition regarding industrial chemicals 6) Optional : Condition regarding other substances	
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Table 3: Optional data for the RDSMG

Data description	Data form	Required attributes	Required names
Map of Countries of the world	Shapefile (polygons)	Name of countries in English	/ (column selectable)
Map of Communities	Shapefile (polygons)	Name of community	name
Water supplier association area	Shapefile (polygons)	Name of area/water supplier	area name
Map of Land use (Corine Land Cover)	Shapefile (polygons)	Lable of Corine Land Cover sub classes, Corine Land Cover Code (for urban fabric (ostacles))	CLC_Lable2 Code_18
Map of nature reserves	Shapefile (polygons)	None, only a query is made as to whether there are polygons present or not.	/
Map of drinking water protection areas	Shapefile (polygons)	None, only a query is made as to whether there are polygons present or not.	/
Map of Roads	Shapefile (lines)	None, only a query is made as to whether there are lines present or not.	/
Data for Water consumption per capita	Shapefile (polygons) or table that can be assigned to the shapefile of the counties, e.g. via municipality keys.	Per capita consumption; in L/(P*d)	PerCapCons
Data for Water consumption per sector	Shapefile (polygons) or table that can be assigned to the shapefile of the counties, e.g. via municipality keys.	Water demand of households and small businesses in m ³ /a	Dem_house
Data for groundwater yield	Shapefile (polygons) or table that can be assigned to the shapefile of the counties, e.g. via municipality keys.	1) Yeald of groundwater body in classes 2) Withdrawal via wells 3) Withdrawal via waterworks (plants)	/ (column selectable)
Map of waste water treatment plants	Shapefile (points)	Name of urban waste water treatment plant	name
Data for precipitation	Rasta data (one band)	Precipitation in mm=L/m ²	/

UWOT output data	.csv file	The UWOT data must be geographically located and preferably presented at county level, as annual values. This function is still limited to the county of Ammerland. You can select a date and the RDSMG will generate the corresponding output.	/(column selectable)
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For legal reasons, not all optional data can be made available for download via the *Water Europe Marketplace* product page. Please download the following data sets yourself if you intend to use them with the RDSMG (See Table 4).

Table 4: Data sets to download yourself

	Download suggestion	Important information	Required names
Data	Map of countries of the world	Name of countries in English	/(column selectable)
Download suggestion	https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/countries		
Data	Data for groundwater yield: e.g.: "Ergiebigkeit der Grundwasservorkommen von Deutschland 1:1.000.000 (ERGW1000)"	1) Yield of groundwater body in classes 2) Withdrawal via wells 3) Withdrawal via waterworks (plants)	/(column selectable)
Download suggestion	https://www.bgr.bund.de/DE/Themen/Wasser/Produkte/produkte_node.html;jsessionid=8D2CB757FB63D4E62BB4133FB9199D65.internet011		

3.2.1 Data reference and legal notice of provided data

The data provided are all to be used according to the respective conditions of use of the original providers (to be found in Table 5). This user manual contains links to external websites of third parties over whose content we have no influence. Therefore, we cannot assume any liability for these external contents. The respective provider or operator of the pages is solely responsible for the content of the linked pages. We distance ourselves from all content that may be relevant under criminal or liability law or offend common decency.

We cannot guarantee that the linked and provided data sets are necessarily comprehensive, complete, accurate or up-to-date. We accept no responsibility for any problems arising from the use of these data sets or linked external websites.

Table 5 lists the data made available on the *Water Europe Marketplace* product page for the RDSMG with their original sources. It also specifies the changes made. In Table 5 you can also find a link to the applicable legal notice that applies to the respective dataset.

Table 5: Reference and legal notice of provided data

Data name		Copyright	Date/Year of download	Changes made to original data
LowerSaxony LowerSaxony_County LowerSaxony_Community OOVV		© GeoBasis-DE / BKG 2017 (data changed)	2022 and 2023	<ul style="list-style-type: none"> Attributes have been translated into English Some non-essential attributes for the RDSMG have been removed. The "0" in front of the AGS has been removed so that the data can be linked to other data sets. For layers "LowerSaxony" and "OOVV", the corresponding data was selected and dissolved using QGIS' Geoprocessing Tool "Dissolve" to generate an outline. The area in m² was calculated with QGIS itself.
	Download link	https://opendata-esri-de.opendata.arcgis.com/datasets/esri-de-content::kreisgrenzen-2017/explore		
	Legal notice	https://www.govdata.de/dl-de/by-2-0		
LandUse		© European Union, Copernicus Land Monitoring Service 2018, European Environment Agency (EEA), with funding by the European Union (data changed)	2022	<ul style="list-style-type: none"> Data were clipped to Lower Saxony using QGIS' Geoprocessing Tool "Clip" Explanations for Corine 2018 land use classes were added. The area in m² was calculated with QGIS itself.
	Download link	https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=download		
	Legal notice	https://land.copernicus.eu/terms-of-use		
NatureReserves		2023 NLWKN www.nlwkn.niedersachsen.de/opendata (data changed)	2023	<ul style="list-style-type: none"> Attributes have been translated into English Some non-essential attributes for the RDSMG have been removed. The area in m² was calculated with QGIS itself.

	Download link	https://www.umwelt.niedersachsen.de/startseite/service/umweltkarten/natur_amp_landschaft/besonders_geschuetzte_teile_von_natur_und_landschaft/naturschutzrechtlich-besonders-geschuetzte-teile-von-natur-und-landschaft-9065.html		
	Legal notice	https://www.govdata.de/dl-de/by-2-0		
DrinkingWaterProtectionArea		2023 NLWKN www.nlwkn.niedersachsen.de/opendata (data changed)	2023	<ul style="list-style-type: none"> Attributes have been translated into English Some non-essential attributes for the RDSMG have been removed.
	Download link	https://www.nlwkn.niedersachsen.de/startseite/wasserwirtschaft/daten_karten/wasserbuch/downloadseite_wsg/downloadseite-schutz-und-gewinnungsgebiete-fuer-trink-und-grundwasser-sggw-46101.html		
	Legal notice	https://www.govdata.de/dl-de/by-2-0		
Roads		Geofachdaten NLStBV © 2023 (data changed)	2023	<ul style="list-style-type: none"> Data have been merged to one Layer and transferred to coordinate reference system EPSG:3035. Attributes have been translated into English. Some non-essential attributes for the RDSMG have been removed.
	Download link	https://www.strassenbau.niedersachsen.de/startseite/service/geofachdaten_und_wms_kartendienste/geofachdaten-und-wms-kartendienste-133771.html Download: https://map.strassenbau.niedersachsen.de/zip/DE-NI-SBV_Downloadservice_Strassennetz.zip		
	Legal notice	Download: https://www.strassenbau.niedersachsen.de/download/97091		
ProductionConsumtion		© Statistische Ämter des Bundes und der Länder, Deutschland, 2023. Dieses Werk ist lizenziert unter der Datenlizenz Deutschland - Namensnennung - Version 2.0. Stand: 31.07.2023 / 09:56:40 (data changed)	31 st July 2023	<ul style="list-style-type: none"> GENESIS table 32211-02-02-4-B was downloaded and the values for “Wasserabgabe an Letztverbraucher” (Water delivery to end users) were taken and transferred to a csv-table as “total drinking water consumption (tot_ConsM3)”. The values were converted into m³/a The values for “Wasserabgabe je Einwohner und Tag (in Liter)” (Water delivery per inhabitant and day (in litres)) were taken and transferred to

				<p>the csv-table as “Per capita consumption (PerCapCons)”.</p> <ul style="list-style-type: none"> • The values for “Haushalte und Kleingewerbe” (Households and small businesses) were taken and transferred to the csv-table as “demand for households and small businesses (Dem_house)”. The values were converted into m³/a • GENESIS table 32211-01-01-4-B was downloaded and the values for “Wassergewinnung Insgesamt” (Total water extraction) were taken and transferred to a csv-table as “total drinking water production (tot_ProdM3)”. The values were converted into m³/a. • The .csv files were merged and linked to a shape layer of the counties in Lower Saxony. • The area in m² was calculated with QGIS itself.
	Download link	https://www.regionalstatistik.de/genesis/online		
	Legal notice	https://www.govdata.de/dl-de/by-2-0		
GroundWaterBodies		2022 NLWKN www.nlwkn.niedersachsen.de/opendata (data changed)	2022	<ul style="list-style-type: none"> • Attributes have been translated into English • Some non-essential attributes for the RDSMG have been removed. • The geometries were repaired by using an inverted buffer of 0.001 m • Data were clipped to Lower Saxony using QGIS' Geoprocessing Tool "Clip"
	Download link	Download: http://www.umweltkarten-niedersachsen.de/Download_OE/WRRL/WFD_GWBODY_LOCAL.zip		
	Legal notice	https://www.govdata.de/dl-de/by-2-0		
SurfaceWaterBodies		2022 NLWKN www.nlwkn.niedersachsen.de/opendata (data changed)	2023	<ul style="list-style-type: none"> • Attributes have been translated into English

				<ul style="list-style-type: none"> Some non-essential attributes for the RDSMG have been removed.
	Download link	Download: www.umweltkarten-niedersachsen.de/Download_OE/WRRL/WFD_RWSEG_LOCAL.zip		
	Legal notice	https://www.govdata.de/dl-de/by-2-0		
WWTP		Original source: European Environment Agency (EEA), (data changed)	May 2023	<ul style="list-style-type: none"> Some non-essential attributes for the RDSMG have been removed. Remaining attributes have been renamed
	Download link	https://www.eea.europa.eu/en/datahub/datahubitem-view/6244937d-1c2c-47f5-bdf1-33ca01ff1715 Download: https://sdi.eea.europa.eu/data/3a69dbaf-15d8-443d-a0ff-fa2c4bb8ab0d?path=%2FGPKG		
	Legal notice	https://www.eea.europa.eu/en/legal-notice		
Precipitation		Data basis: Deutscher Wetterdienst (DWD)	May 2023	/
	Download link	https://opendata.dwd.de/climate_environment/CDC/grids_germany/multi_annual/precipitation/grids_germany_multi_annual_precipitation_1981-2010_17.asc (multi-year means of the entire year)		
	Legal notice	https://opendata.dwd.de/climate_environment/CDC/Nutzungsbedingungen_German.pdf English version: https://opendata.dwd.de/climate_environment/CDC/Terms_of_use.pdf		

3.3 Internal calculation

The regional demand-supply matching GIS tool calculates some attributes of the query point based on your input data. These internal calculations are explained below.

The estimation of the x- and y-coordinate is done by QGIS itself. If the query points are provided as a point layer, the coordinates are given in the coordinate reference system of the point layer. If the query point is set manually, then the coordinate is given in the project coordinate reference system.

3.3.1 Distances

Figure 2 visualizes which distances can be queried by the RSDMT.

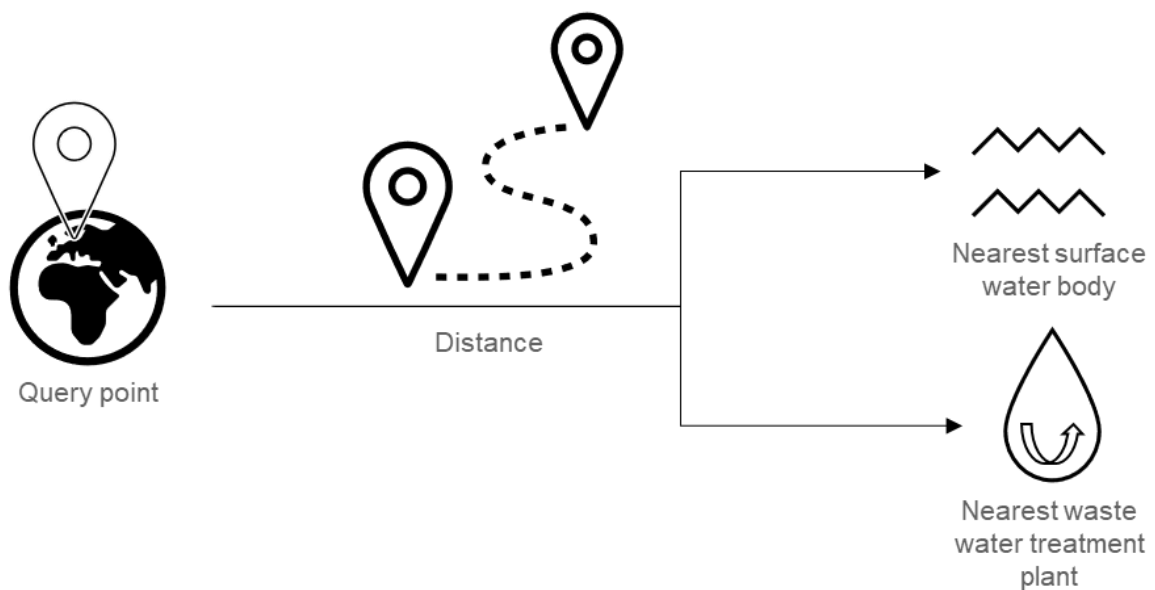


Figure 2: Visualisation of distance queried by the RDSMG

The following distances can be queried if you input corresponding data:

- Query point ↔ Nearest surface water body (mandatory)
- Query point ↔ Nearest wastewater treatment plant (optional)

This algorithm uses purely Cartesian calculations for distance and does not consider geodetic or ellipsoid properties when determining feature proximity.

3.3.2 Obstacles

Figure 3 shows a flowchart of the internal calculations for obstacles. If you input location data for the obstacles, the tool outputs the type and number of obstacles between the query point and the nearest surface water body.

You can use data for:

- nature reserves
- drinking water protection areas

- roads (motorways, federal roads, country road, county roads)

Other kinds of obstacles cannot generate an output.

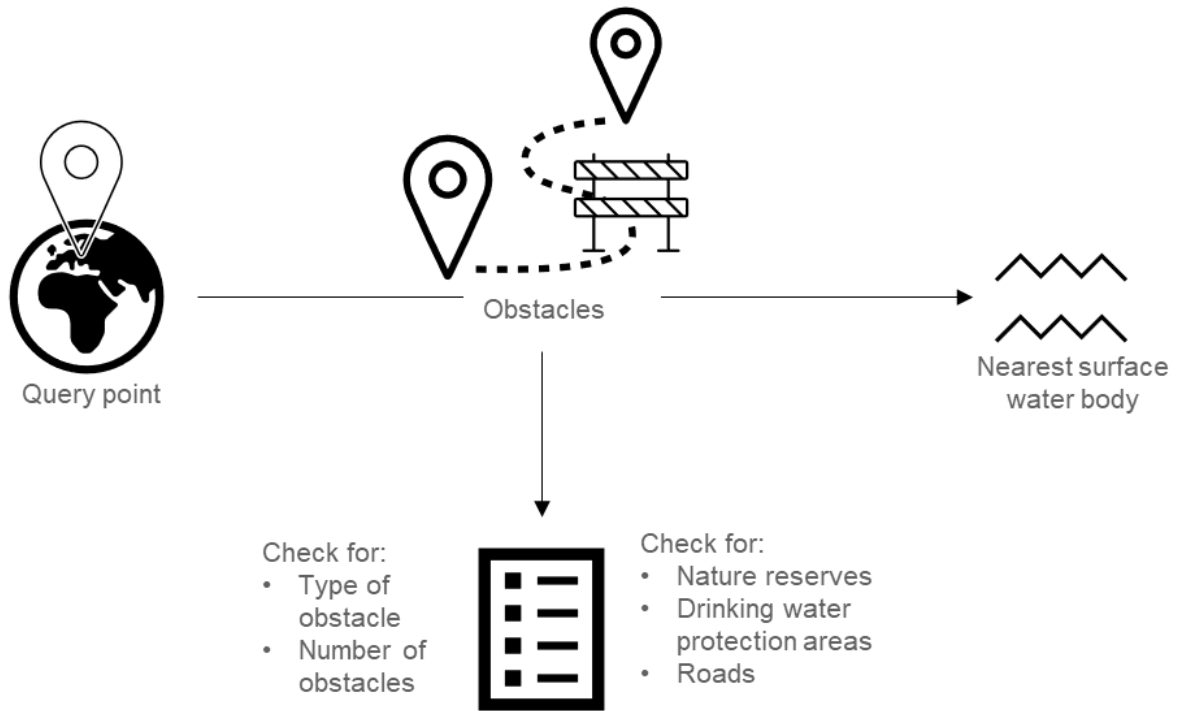


Figure 3: Intern calculation of obstacles

3.3.3 Water demand

Drinking water demand per capita

The drinking water demand per capita is an optional data layer you can use for further information. If you use the data, the drinking water demand per capita at the query point will be categorized by the RDSMG according to Figure 4.

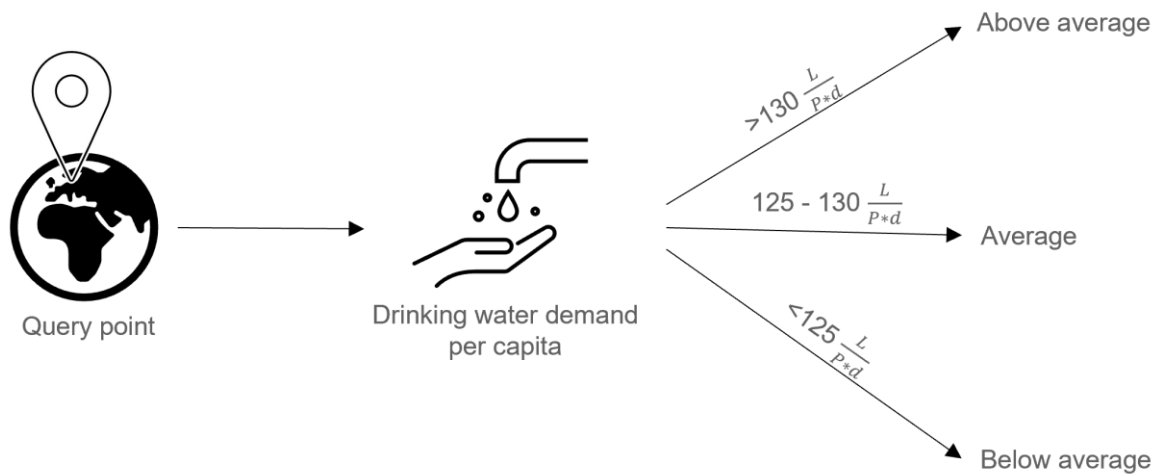


Figure 4: Categorisation of drinking water demand per capita by the RDSMG

The Categorization assumes that the average drinking water per capita demand is about $128 \frac{L}{P*d}$. This value is corresponding to the average drinking water per capita demand in Germany in 2019 (Umweltbundesamt (UBA) 2022), which was chosen since the RDSMG was firstly applied in East Frisia.

Drinking water demand per sector

The calculation of the drinking water demand per sector uses optional data layers. If you use data for drinking water consumption by households and small businesses, the RDSMG calculated the consumption by Industry and other sectors as follows:

$$consumption_{Industry\ and\ other} = consumption_{Total} - consumption_{Households\ and\ small\ businesses}$$

A visualization of this calculation by the RDSMG is shown in Figure 5.

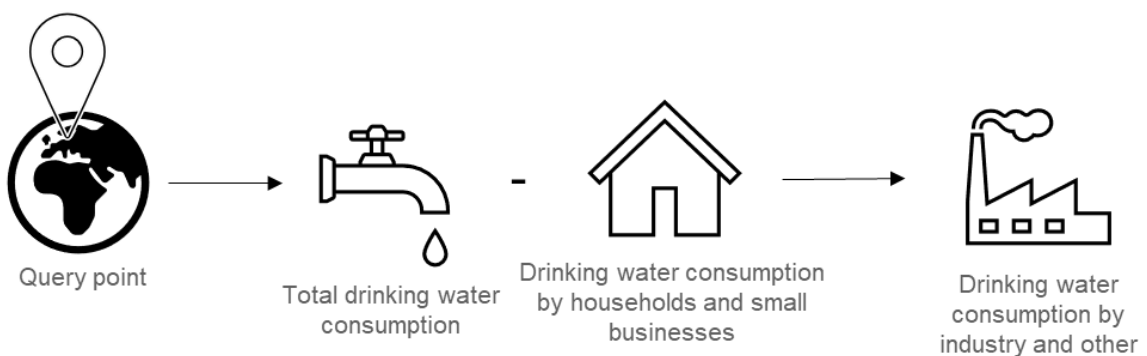


Figure 5: Calculation of drinking water consumption for industry and other sectors by the RDSMG

At the query point, the drinking water consumption by households and small businesses is subtracted from the total drinking water consumption and results in the drinking water consumption by industry and other sectors.

Percentage drinking water demand per sector

Based on the drinking water consumption by households + small businesses and industry + other sectors (see Figure 5), the percentage drinking water consumption by these sectors is calculated as follows, if you use corresponding layers or data sets.

$$\% \text{consumption}_{\text{Households and small businesses}} = \left(\frac{\text{consumption}_{\text{Households and small businesses}}}{\text{consumption}_{\text{Total}}} \right) * 100\%$$

$$\% \text{consumption}_{\text{Industry and other}} = \left(\frac{\text{consumption}_{\text{Industry and other}}}{\text{consumption}_{\text{Total}}} \right) * 100\%$$

. Figure 6 shows a visualization of the calculation process by the RDSMG.

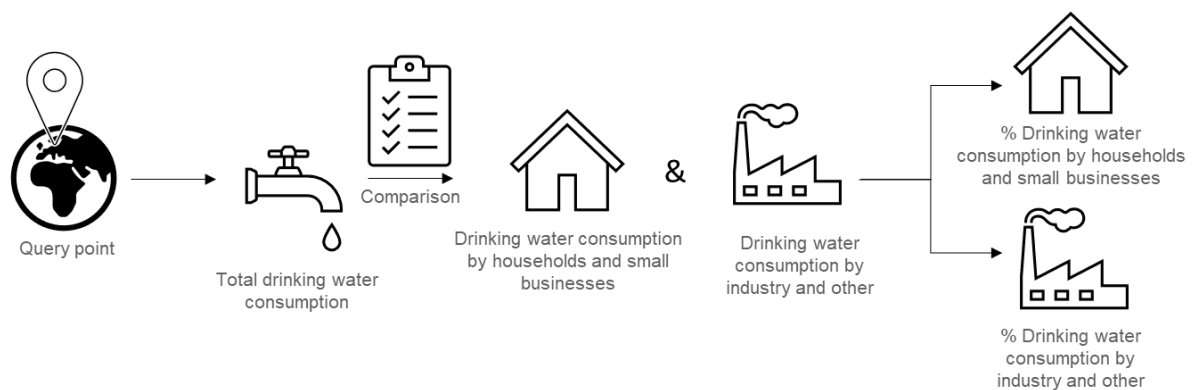


Figure 6: Calculation of the percentage drinking water consumption of households, small businesses, industry and other sectors in relation to total drinking water consumption by the RDSMG

At the query point, the total drinking water consumption is compared with the drinking water consumption by households + small businesses and industry + other sectors and based on this comparison the percentage drinking water consumption by these sectors is calculated.

administrative unit-related supply coverage

Data for total drinking water consumption and production are mandatory for the RDSMG. The administrative unit-related supply coverage (AURSC) and the percentage administrative unit-related supply coverage (%AURSC) are calculated as follows, assuming that the total drinking water consumption equals the total drinking water demand.

$$AURSC = \text{total drinking water production} - \text{total drinking water consumption}$$

$$\%AURSC = \left(\frac{\text{total drinking water production}}{\text{total drinking water consumptions}} \right) * 100\%$$

Figure 7 visualizes the estimation of the AURSC and the %AURSC by the RDSMG.

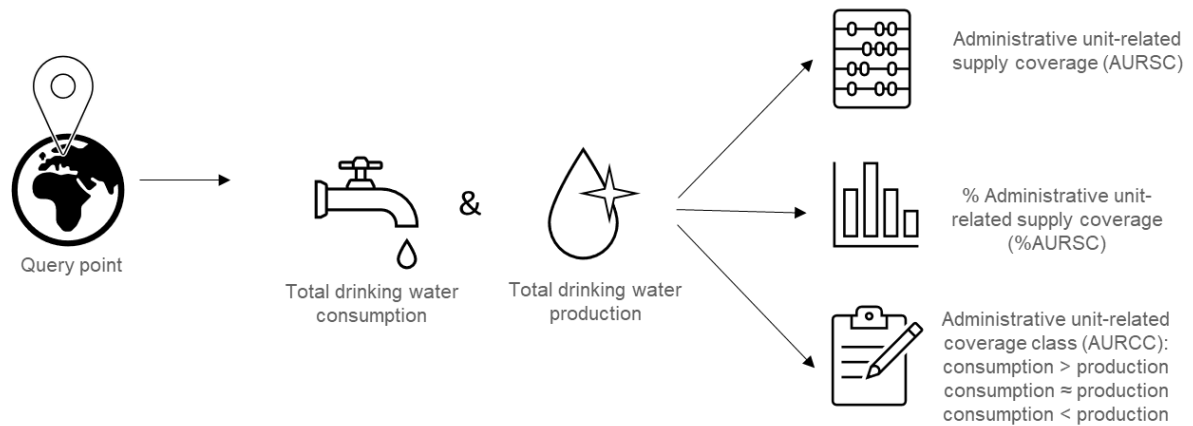


Figure 7: Calculation of the administrative unit-related supply coverage (AURSC) and the percentage administrative unit-related supply coverage (%AURSC) by the RDSMG and categorisation of the administrative unit-related supply coverage into administrative unit-related coverage classes (AURCC).

The RDSMG compares the total drinking water consumption and the total drinking water production as the query point and groups the administrative unit-related supply coverage (AURSC) based on that. The percentage administrative unit-related supply coverage (%AURSC) is calculated as well.

The AURSC is grouped by the administrative unit-related coverage classes (AURCC):

- consumption > production
- consumption ≈ production
- consumption < production

3.3.4 Costs

The RDSMG estimates the treatment costs based on the requested water quality and the available water quality in groundwater and surface water and groups it into three groups: high, medium and low as shown in Figure 8.

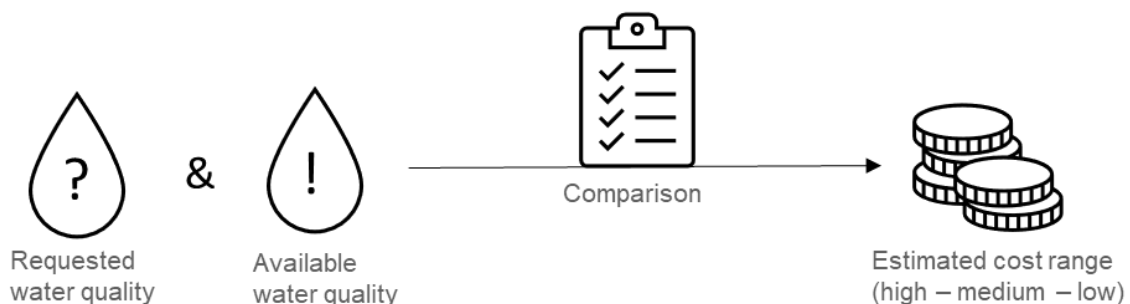


Figure 8: Estimation of treatment costs based on water quality by the RDSMG

Table 6 explains the classification for all possible cases that can be handled by the RDSMG.

Table 6: Estimation of treatment costs based by the RDSMG by direct comparison of requested and available water quality

Requested Water Quality \ Available Water Quality	1	2	3	4
1	low	medium	high	high
2	low	low	medium	high
3	low	low	low	medium
4	low	low	low	low

A lower water quality class always represents better water quality in the RDSMG.

It applies:

- Requested water quality class \geq available water quality class \rightarrow low costs
- Requested water quality class $<$ available water quality class \rightarrow medium costs
- Requested water quality class \ll available water quality class \rightarrow high costs

4 Installation

4.1 Installation of QGIS

You can download QGIS here: <https://www.qgis.org/en/site/forusers/download.html>

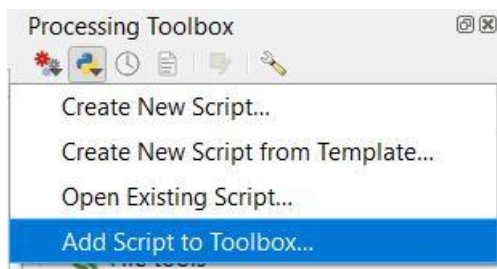
To install QGIS, please refer to the QGIS user manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html, chapter 5).

4.2 Installation of the plug-in

4.2.1 Version v1.2 and earlier


Version v0.01 and earlier are available as python scripts. If you are using one of these versions, please load the scripts using the QGIS processing toolbox.

QGIS → "Processing Toolbox" → function "Add Script to Toolbox..."



The latest versions can be downloaded here: <https://mp.uwmh.eu/d/Product/35>

4.2.2 Version v2.0 and later

To install the plug-in, go to "Plugins"-menu and select "Manage and install plugins..." (see upper half of Figure 9). To use the corresponding zip files with the plug-in from your computer, select "Install from zip". The window shown in the lower half of Figure 9 opens. You can select the files from your computer using the three dots . Then click on "Install Plugin".

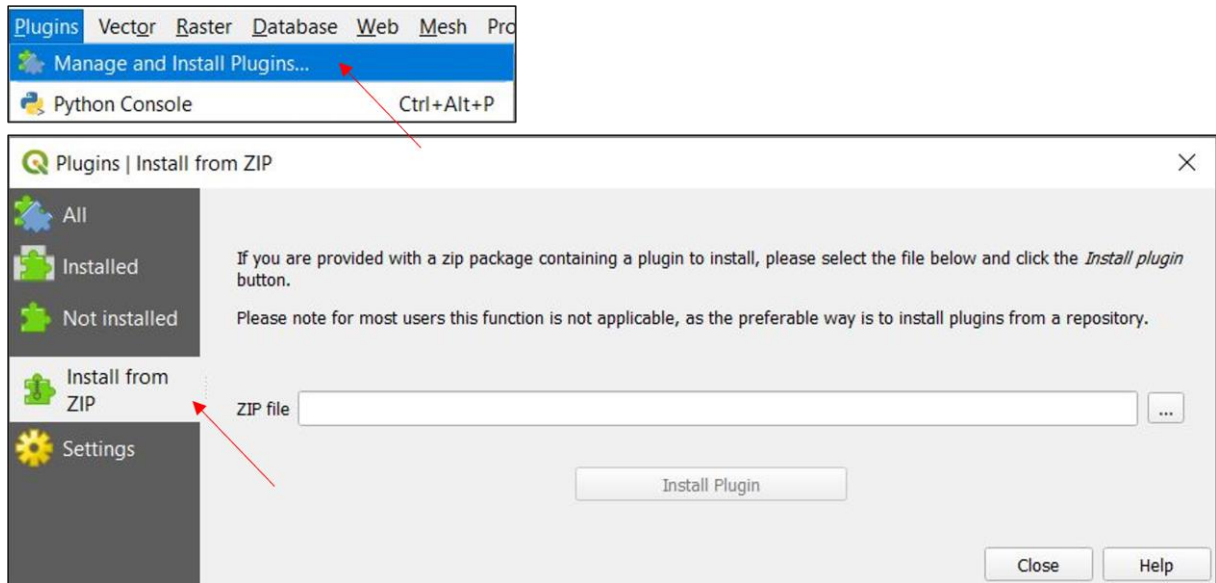


Figure 9: How to install a plug-in from ZIP

If you need further help to install the plug-ins, please refer to the QGIS manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html, chapter 4.6 and 28).

If you need help to decide which plug-in you need, please see chapter 5.3

You can download the plug-ins here: <https://mp.uwmh.eu/d/Product/35>

5 Step-by-step guide for using the RDSMG

The following chapters contain a step-by-step guide from data preparation to the use of the RDSMG and the interpretation of the output.

5.1 Preparing the data

Table 1 lists all the provided data for this tool and shows which data is used for which purpose. To use the regional demand-supply matching GIS tool (RDSMG), you need the mandatory data given in Table 2. Please make sure that you have downloaded all the mandatory data: (<https://mp.uwmh.eu/d/Product/35>).

If you want to use further data, please download them as well (<https://mp.uwmh.eu/d/Product/35>) or collect them yourself. Select the optional data (see Table 3) depending on your research question. For the data you do not input, you will not receive any information.

- For more detailed information on the geographical location of the query point(s), use maps for **Countries of the world, Communities** and the **water supplier association area**.
- For more detailed information on land use in the vicinity of the query point(s) and possible obstacles on the way to the nearest surface water, use a **Corine Land Cover** map, maps of **nature reserves, drinking water protection areas** and/or **roads**.
- For more detailed information on the use of drinking water, use maps or tables for **drinking water consumption per capita** and/or **per sector** (households, industry etc.)
- For more detailed information on possible water sources, use maps for **groundwater yield, precipitation** and/or **waste water treatment plants**.
- Additionally, **UWOT** output tables can be used if available.

Figure 10 shows a screenshot of the *Water Europe Marketplace* product page with a red marker where you can find the download button for the datasets.

Search for anything... Any type

Product

RDSMG - Regional demand-supply matching GIS tool

Download as PDF

1 user is interested in this product



County -> Community -> Sections

Description

< Back to all products

Product type

- A service, offered as part of a Circular Economy enabling portfolio
- A methodology or a process related with the Circular Economy

Costs

Open source. Costs may relate to a further regionalized study. The amount of costs refers to the scope of the analysis, and work expense e.g., integration of non-commercial data and data evaluation.

Downloads

- Data package 1 - mandatory data

Demo data package 1 for use with the RDSMG tool. Please refer to the user manual for legal notice.

Figure 10: Where to download the provided data

You can replace the data in Table 1 at any time with your own data. If you want to use your own data, prepare it according to the specifications in Table 2 and Table 3, so that the required attributes are present (column “Required attributes”) and have the name defined in column “Required names“. It is particularly important that the units and column names correspond to the specifications in Table 2 and Table 3.

You can also use your own data in multiple datasets, e.g. separate datasets for total drinking water consumption and water demand per capita (unlike the “ProductionConsumption”-shape layer, which contains multiple information). You must specify these data sets as input in the tool accordingly (see chapter 5.5).

For a higher informational value, it is recommended to use data from the same year. Please check that all data used (and your “points of interest”-layer) are in the same coordinate reference system, otherwise errors and inaccuracies may occur in the internal calculations and queries of the plug-in. The data provided on the *Water Europe Marketplace* product page are in the coordinate reference system EPSG:3035 - ETRS89-extended / LAEA Europe (unit: metre).

5.2 Preparation of the program

To use the RDSMG, please make sure that you have finished the following tasks:

- Make sure you have at least QGIS version 3.28.5 Firenze installed (<https://www.qgis.org/en/site/forusers/download.html>).
- Start QGIS 3.28.5 Firenze, open a new or an existing QGIS project.

- Make sure you have installed at least one of the “regional demand-supply matching GIS tool” plug-ins in QGIS (How to install a plug-in for QGIS: see QGIS user manual; https://docs.qgis.org/3.28/en/docs/user_manual/index.html, chapter 4.6 and 28). If you need help to decide which plug-in you need, see chapter 275.3.
- Add all the mandatory data-layer and all your chosen optional data-layer to your QGIS project (Need help adding data to a QGIS project? Consult the QGIS manual: (https://docs.qgis.org/3.28/en/docs/user_manual/index.html)).

5.3 Selecting the plug-in

There are two versions of the RDSMG, depending on your input method. Table 7 summarises the most important information on this to help you choose the right plug-in for your query.

Table 7: Choosing the right plug-in

Plug-ins	RDSMG – From point layer	RDSMG – From point on map
Download link	https://mp.uwmh.eu/d/Product/35	https://mp.uwmh.eu/d/Product/35
Purpose	<ul style="list-style-type: none"> • Already known query point(s) • Several query points at the same time 	<ul style="list-style-type: none"> • Point query via coordinates • Point query on map
Input method	Shape Layer	Click or Coordinates
limitations	No short-term changes possible	Multiple queries at the same time must be made via QGIS Batch process.

If you have a **shape file** with one or more points (and possibly their coordinates) for which you want to make the query, use the plug in “RDSMG – From point layer ”. This plug-in is particularly suitable if you already know the point for which a query is to be made or if there are several points. When querying several points via shape layer, only one requested water quality can be selected for the whole shape layer. If you want to query different points with different water qualities, use different shape layers and the QGIS function "Run as Batch Process" .

If you want to enter a query point yourself using **coordinates**, use the plug-in "RDSMG – From point on map ". If you have several points that you want to query in this way, use the QGIS function "Run as Batch Process" . This function can also be used to input a different requested water quality per process.

If you want to select a query point by **clicking** directly on the map, use the plug-in “RDSMG – From point on map”. If you want to view several query points at the same time, use the QGIS function "Run as Batch Process" . This function can also be used to input a different requested water quality per process.

5.4 Open the plug-in in QGIS

If you have already installed the plug-in, you will find it in the QGIS Processing Toolbox.

If you need help to find and to open the plug-in in QGIS, please refer to the QGIS manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html, chapter 4.6 and 28).

5.5 Input data

As soon as you have opened the plug-in, you will see the following interface. If you use the plug-in “RDSMG – From point layer” you will see Figure 11 and if you use the plug-in “RDSMG – From point on map” you will see Figure 12.

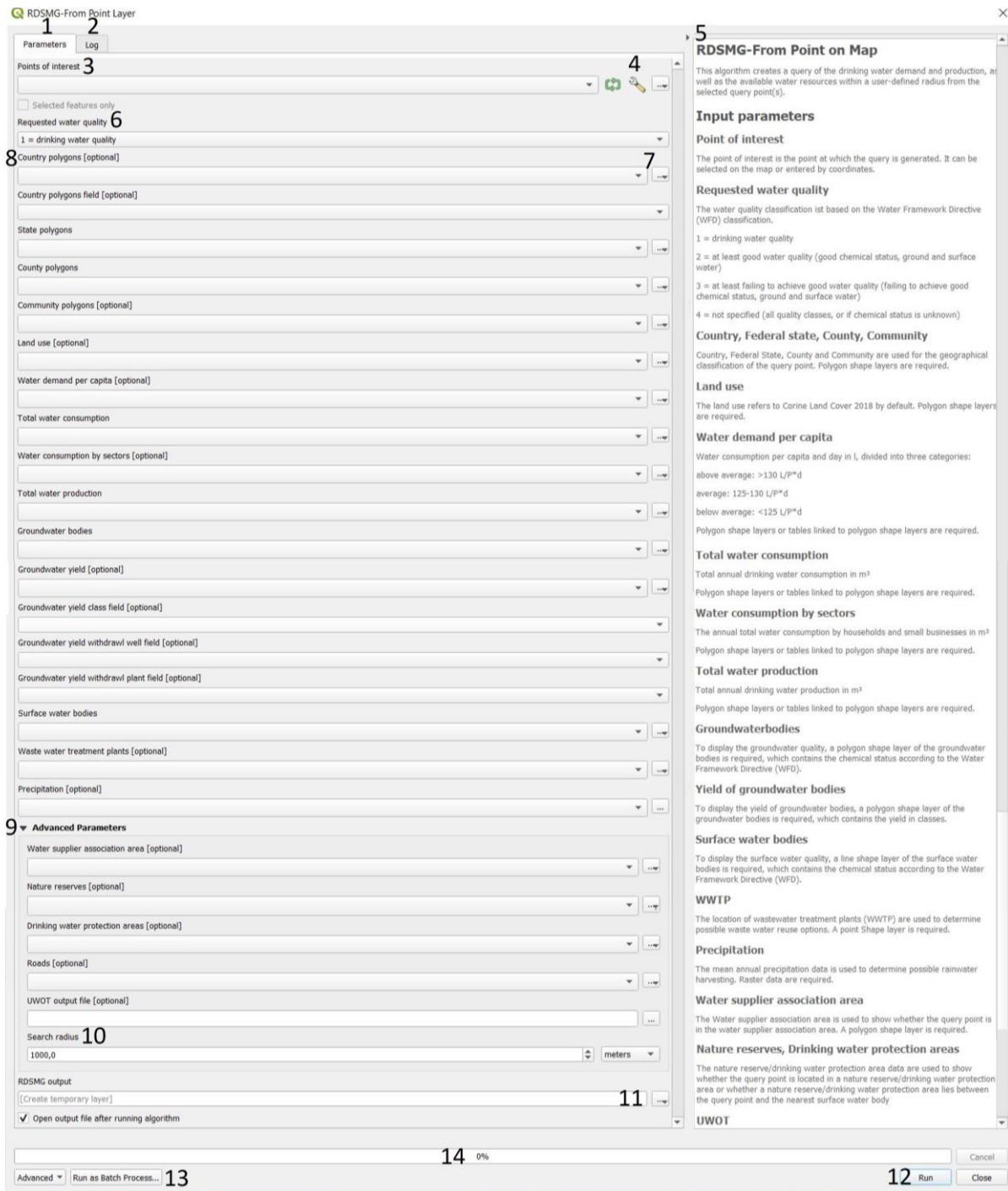
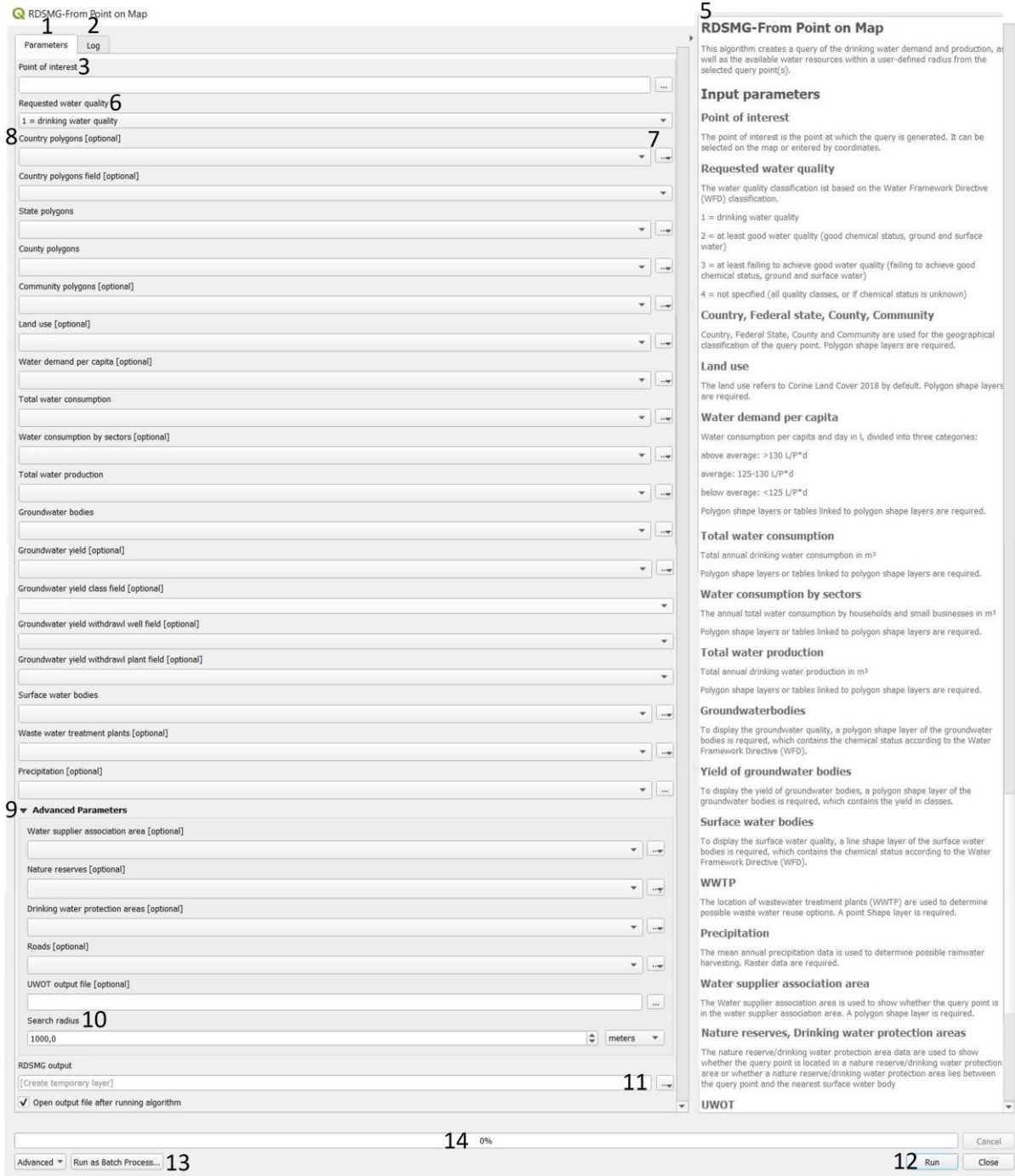


Figure 11: RDSMG input interface for plug-in "RDSMG – From point layer". The numbering is explained in Table 8.



1 Parameters | **2** Log

3 Point of interest

6 Requested water quality
1 = drinking water quality

8 Country polygons [optional]

7 Country polygons field [optional]

State polygons

County polygons

Community polygons [optional]

Land use [optional]

Water demand per capita [optional]

Total water consumption

Water consumption by sectors [optional]

Total water production

Groundwater bodies

Groundwater yield [optional]

Groundwater yield class field [optional]

Groundwater yield withdrawal well field [optional]

Groundwater yield withdrawal plant field [optional]

Surface water bodies

Waste water treatment plants [optional]

Precipitation [optional]

9 Advanced Parameters

Water supplier association area [optional]

Nature reserves [optional]

Drinking water protection areas [optional]

Roads [optional]

UWOT output file [optional]

Search radius **10**
1000,0 meters

RDSMG output
[Create temporary layer] **11**

Open output file after running algorithm

14 0%

13 Run as Batch Process... | **12** Run | Close

5 RDSMG-From Point on Map

This algorithm creates a query of the drinking water demand and production, as well as the available water resources within a user-defined radius from the selected query point(s).

Input parameters

Point of interest
The point of interest is the point at which the query is generated. It can be selected on the map or entered by coordinates.

Requested water quality
The water quality classification list based on the Water Framework Directive (WFD) classification.
1 = drinking water quality
2 = at least good water quality (good chemical status, ground and surface water)
3 = at least failing to achieve good water quality (failing to achieve good chemical status, ground and surface water)
4 = not specified (all quality classes, or if chemical status is unknown)

Country, Federal state, County, Community
Country, Federal State, County and Community are used for the geographical classification of the query point. Polygon shape layers are required.

Land use
The land use refers to Corine Land Cover 2018 by default. Polygon shape layers are required.

Water demand per capita
Water consumption per capita and day in l, divided into three categories:
above average: >130 L/P^{cap}d
average: 125-130 L/P^{cap}d
below average: <125 L/P^{cap}d
Polygon shape layers or tables linked to polygon shape layers are required.

Total water consumption
Total annual drinking water consumption in m³
Polygon shape layers or tables linked to polygon shape layers are required.

Water consumption by sectors
The annual total water consumption by households and small businesses in m³
Polygon shape layers or tables linked to polygon shape layers are required.

Total water production
Total annual drinking water production in m³
Polygon shape layers or tables linked to polygon shape layers are required.

Groundwaterbodies
To display the groundwater quality, a polygon shape layer of the groundwater bodies is required, which contains the chemical status according to the Water Framework Directive (WFD).

Yield of groundwater bodies
To display the yield of groundwater bodies, a polygon shape layer of the groundwater bodies is required, which contains the yield in classes.

Surface water bodies
To display the surface water quality, a line shape layer of the surface water bodies is required, which contains the chemical status according to the Water Framework Directive (WFD).

WWTP
The location of wastewater treatment plants (WWTP) are used to determine possible waste water reuse options. A point Shape layer is required.

Precipitation
The mean annual precipitation data is used to determine possible rainwater harvesting. Raster data are required.

Water supplier association area
The Water supplier association area is used to show whether the query point is in the water supplier association area. A polygon shape layer is required.






Nature reserves, Drinking water protection areas
The nature reserve/drinking water protection area data are used to show whether the query point is located in a nature reserve/drinking water protection area or whether a nature reserve/drinking water protection area lies between the query point and the nearest surface water body

UWOT

Figure 12: RDSMG input interface for plug-in "RDSMG – From point on map". The numbering is explained in Table 8.

The numbering on Figure 11 and Figure 12 is explained in Table 8.

Table 8: Explanation of plug-in interfaces (Figure 11 and Figure 12)

Number	Explanation
1	All data used is entered in the "Parameters" tab.
2	In the "Log" tab you will find the algorithm log after the calculation.
3	In the "Points of interest" parameters, enter either your point layer with the points to be queried (if you are using the "RDSMG – From point layer" plug-in). If you are using the "RDSMG – From point on map" plug-in, enter coordinates or click on the point on the map you want to query.
4	These settings are only available for the "RDSMG – From point layer" plug-in. Via the two green arrows  you can iterate over this layer and create a separate output for each feature in this level. The spanner  gives you access to advanced options (for more details see the QGIS manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html)). The three dots  allow you to select a layer from your computer as input layer.
5	In this field you will find explanations about the RDSMG and the input parameters.
6	The "Requested water quality" can be selected from a drop-down menu. For more detailed information, see chapter 5.5.1.
7	Use the drop-down menu  to select the corresponding data layer from the current QGIS project. Use the three dots  to select layers from the computer.
8	Here you will find all the standard input parameters. Some are mandatory, others are optional. For more detailed explanations, see Table 9.
9	Here you will find the advanced input parameters. They are all optional. For more detailed explanations, see Table 9.
10	Here you can enter the search radius. If your input layer or QGIS project uses a coordinate reference system with the unit metre, it is set to 1000 m by default. For more information, see Table 9.
11	Here you can determine the storage location. For more information, see chapter 5.6.
12	Here you can start the calculation of your query.
13	Here you can set a batch process and make some advanced settings. For more information, see the QGIS manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html).
14	This is the progress bar of your query calculation.

you can make some entries, which are roughly divided into three parts: Your points of interest, the requested water quality and any other mandatory or optional data about the environment you are querying.



To select the corresponding input layers, click on the drop-down button  (if you have already imported the shape layers into the current QGIS project), or click on the three dots  if you want to use a shape file from your computer. The drop-down menu only shows shape or raster layers that are permitted for this entry, i.e. that are available in the correct variant (lines, polygons, points, raster data etc.). Table 9 explains the input options and their purpose.

Table 9: Input Options and explanation/purpose

Input options		Explanation/Purpose
RDSMG – From point on map	Point of interest	The point of interest is the point at which the query is generated. It can be selected on the map or entered by coordinates. If you have several points that you want to query in this way, use the QGIS function "Run as Batch Process" This function can also be used to input a different requested water quality per process. For more detailed information, see chapter 5.3.
RDSMG – From point layer	Point of interest	The point of interest is the point at which the query is generated. A point shape layer with the point(s) to be queried must be used as input. If you want to query different points with different water qualities, use different shape layers and the QGIS function "Run as Batch Process". For more detailed information, see chapter 5.3. The input layer must be in the same coordinate reference system as all the other shape layers.
Standard Parameters	Requested water quality	The water quality classification is based on the Water Framework Directive (WFD) classification (Directive 2000/60/EC 2000). 1 = drinking water quality 2 = at least good water quality (good chemical status, ground and surface water) 3 = at least failing to achieve good water quality (failing to achieve good chemical status, ground and surface water) 4 = not specified (all quality classes, or if chemical status is unknown) For more detailed information, see chapter 5.5.1.
	Country polygons [optional]	Country, Federal State, County and Community are used for the geographical classification of the query point. Polygon shape layers are required. For "Country polygons field", the field containing the necessary information for the countries must be specified (name).
	Country polygons field [optional]	
	State polygons	

County polygons	
Community polygons [optional]	
Land use [optional]	The land use refers to Corine Land Cover 2018. Polygon shape layers are required.
Water demand per capita [optional]	<p>Water consumption per capita and day in L, divided into three categories:</p> <p>above average: >130 L/P*d average: 125-130 L/P*d below average: <125 L/P*d</p> <p>Polygon shape layers or tables linked to polygon shape layers are required. If you use the data provided on the <i>Water Europe Marketplace</i> product page, this information is located on the shape layer "ProductionConsumption".</p>
Total water consumption	Total annual drinking water consumption in m ³ . Polygon shape layers or tables linked to polygon shape layers are required. If you use the data provided on the <i>Water Europe Marketplace</i> product page, this information is located on the shape layer "ProductionConsumption".
Water consumption by sectors [optional]	The annual total water consumption by households and small businesses in m ³ . Polygon shape layers or tables linked to polygon shape layers are required. If you use the data provided on the <i>Water Europe Marketplace</i> product page, this information is located on the shape layer "ProductionConsumption".
Total water production	Total annual drinking water production in m ³ . Polygon shape layers or tables linked to polygon shape layers are required. If you use the data provided on the <i>Water Europe Marketplace</i> product page, this information is located on the shape layer "ProductionConsumption".
Groundwater bodies	To display the groundwater quality, a polygon shape layer of the groundwater bodies is required, which contains the chemical status according to the Water Framework Directive (WFD).
Groundwater yield [optional]	To display the yield of groundwater bodies , a polygon shape layer of the groundwater bodies is required, which contains the yield in classes.

	Groundwater yield class field [optional]	Here the corresponding column of the layer specified in "Groundwater yield" must be entered, which contains the information on the yield class.
	Groundwater yield withdrawal well field [optional]	Here the corresponding column of the layer specified in "Groundwater yield" must be entered, which contains the information on the withdrawal via wells.
	Groundwater yield withdrawal plant field [optional]	Here the corresponding column of the layer specified in "Groundwater yield" must be entered, which contains the information on the withdrawal via water plants.
	Surface water bodies	To display the surface water quality , a line shape layer of the surface water bodies is required, which contains the chemical status according to the Water Framework Directive (WFD).
	Waste water treatment plants [optional]	The location of wastewater treatment plants (WWTP) are used to determine possible waste water reuse options. A point shape layer is required.
	Precipitation [optional]	The mean annual precipitation data is used to determine possible rainwater harvesting. One band raster data are required.
Advanced Parameters	Water supplier association area [optional]	The Water supplier association area is used to show whether the query point is in the water supplier association area. A polygon shape layer is required.
	Nature reserves [optional]	The nature reserve/drinking water protection area data are used to show whether the query point is located in a nature reserve/drinking water protection area or whether a nature reserve/drinking water protection area lies between the query point and the nearest surface water body.
	Drinking water protection areas [optional]	
	Roads [optional]	The road map is used to find roads (motorways, federal roads, country road, county roads) on the direct line from the query point to the nearest surface water body. Line shape layers are required.
	UWOT output file [optional]	The UWOT data must be geographically assigned and preferably presented at county level as annual values. This function is still limited to the county Ammerland. You can select a date and the RDSMG will generate the corresponding output.
	Search radius	The search radius can be variably adjusted. It specifies the radius in which the search is carried out to determine

		whether the searched water quality is present in groundwater or surface water. If your input layer or QGIS project uses a coordinate reference system with the unit metre, it is set to 1000 m by default. The unit can be adjusted as well.
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5.5.1 Water quality

To use the RDSMG, first specify the requested water quality using the drop-down menu shown in Figure 13.

Requested water quality
1 = drinking water quality
2 = at least good water quality (good chemical status, ground and surface water)
3 = at least failing to achieve good water quality (failing to achieve good chemical status, ground and surface water)
4 = not specified (all quality classes, or if chemical status is unknown)

Figure 13: Drop down menu for the requested water quality

The “Requested water quality” can be set variably, depending on which water quality is of interest for your query. The classification is based on the Water Framework Directive (Directive 2000/60/EC 2000). The following water qualities can be selected:

1 = drinking water quality

Return:

- Drinking water quality

2 = at least good water quality

Return:

- Drinking water quality
- Good chemical status for ground and/or surface water

3 = at least failing to achieve good water quality

Return:

- Drinking water quality
- Good chemical status for ground and/or surface water
- Failing to achieve good chemical status for ground and/or surface water

4 = not specified

Return:


- Drinking water quality

- ➔ Good chemical status for ground and/or surface water
- ➔ Failing to achieve good chemical status for ground and/or surface water
- ➔ Not specified water quality/chemical status unknown

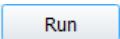
The RDSMG compares your requested water quality with the available qualities of ground and surface waters in the vicinity of your query point (set by the “Search radius”) and based on this, shows you whether your requested water quality is available or whether a higher (financial) effort must be made to achieve it.

5.6 Determine saving location


It is pre-set that the output layer is transferred to the project as a temporary layer.

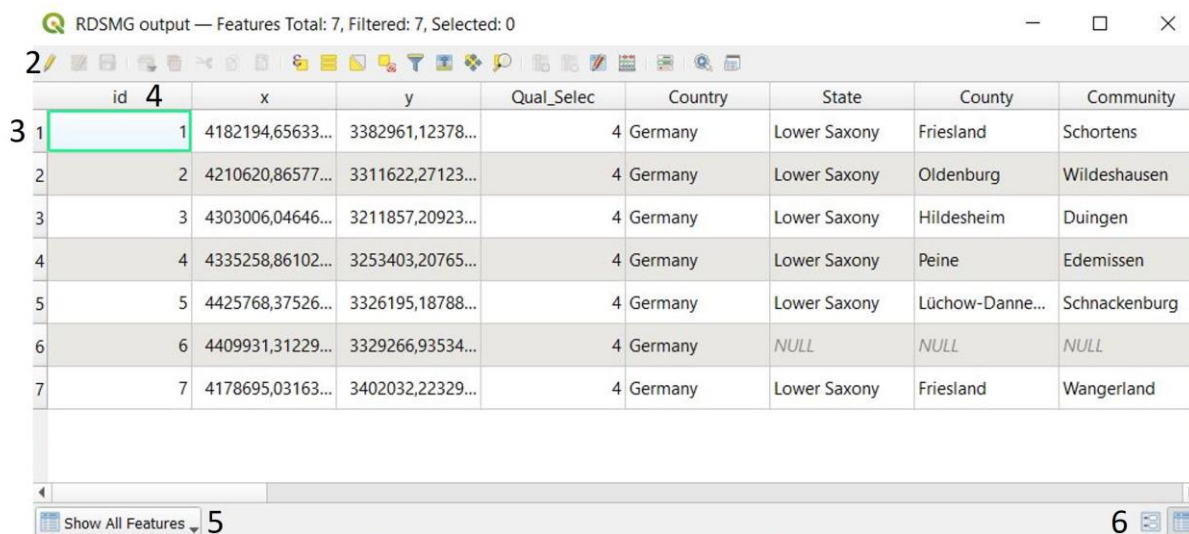
If you want to save it permanently, navigate to “RDSMG output”. There you click on the drop-down button  (to the right of “[Create temporary layer]”). You have the choice between “**Create Temporary Layer**”, “**Save to File...**”, “**Save to GeoPackage...**” and “**Save to Database Table...**”. To save the output layer as a shape file, select “**Save to File...**” and select “**SHP files (*.shp)**” as file type. If you want to add the RDSMG output layer to your current QGIS program, please make sure the checkbox “Open output file after running algorithm” is ticked.

5.7 Run

When you have entered all the mandatory data and any optional data you want to use, press “Run” . After the algorithm is finished, you will get a point shape layer as output.

5.8 Open output layer

After the algorithm of the RDSMG executed the calculation successfully, a point shape layer named “RDSMG output” will be added to your current QGIS project, if you ticked the checkbox “Open output file after running algorithm”. To see the results of the query, open the attribute table  (to find via [right click](#) on the output layer: Open Attribute Table or in the [Attributes Toolbar](#)). A table like in Figure 14 will open.



	id	x	y	Qual_Selec	Country	State	County	Community
1	1	4182194,65633...	3382961,12378...	4	Germany	Lower Saxony	Friesland	Schortens
2	2	4210620,86577...	3311622,27123...	4	Germany	Lower Saxony	Oldenburg	Wildeshausen
3	3	4303006,04646...	3211857,20923...	4	Germany	Lower Saxony	Hildesheim	Duingen
4	4	4335258,86102...	3253403,20765...	4	Germany	Lower Saxony	Peine	Edemissen
5	5	4425768,37526...	3326195,18788...	4	Germany	Lower Saxony	Lüchow-Danne...	Schnackenburg
6	6	4409931,31229...	3329266,93534...	4	Germany	NULL	NULL	NULL
7	7	4178695,03163...	3402032,22329...	4	Germany	Lower Saxony	Friesland	Wangerland

Figure 14: Example of the output point shape layer of the RDSMG. The numbering is explained in Table 10.

Text The numbering on Figure 14 is explained in Table 10.

Table 10: Explanation of Output attribute table (Figure 14)

Number	Explanation
1	Here you can see the name of the output layer and whether you have selected attributes and if so, how many.
2	Here you can edit the output layer. Use the pencil button to start the editing mode of QGIS.
3	Here you can see the different query points listed one below the other. If you only have one query point, you have only one entry here.
4	The output attributes are listed one after the other as columns. For more detailed explanations of the column names, see Table 11. For help interpreting the output data, see 5.9.
5	The "Show All Features" button can be used to display either all features or only a filtered selection.
6	Here you can switch between "form view" and "table view". For more information, please consult the QGIS manual (https://docs.qgis.org/3.28/en/docs/user_manual/index.html).

Table 11 contains all possible attributes that your output layer can have. The order and number may vary, as some attributes are only created by providing optional data. If you have not input the optional data, you will not receive the corresponding output.

Table 11: All possible attributes of the RDSMG output-shape layer and their explanations

Attribute name	Full name	Explanation
id	Identification	Identification number of query point.
x	x-coordinate	x-coordinate (In the case of the "RDSMG – From point layer" plug-in, the coordinate reference system corresponds to the coordinate reference system of the "Point of interest" input layer. In the case of the "RDSMG – From point on map" plug-in, the coordinate reference system corresponds to the project coordinate reference system).
y	y-coordinate	y-coordinate (In the case of the "RDSMG – From point layer" plug-in, the coordinate reference system corresponds to the coordinate reference system of the "Point of interest" input layer. In the case of the "RDSMG – From point on map" plug-in, the coordinate reference system corresponds to the project coordinate reference system).
Qual_Select	Selected requested quality	The requested water quality class that was chosen as input. For more information on the water quality classes, see chapter 5.5.1.
Country	Country	The country in which the query point is located.
State	Federal State	The federal state in which the query point is located.
County	County	The county in which the query point is located.
Community	Community	The community in which the query point is located.
WatDemCap	Drinking water demand per capita	The water demand per capita in the federal state of the query point categorised in above average (>130 L/P*d), average (125-130 L/P*d) and below average (<125 L/P*d).
TotConsM3	Total drinking water consumption in m ³ /a	The total drinking water consumption in the federal state of the query point in m ³ /a.
ConsHouse%	Percentage usage of drinking water consumption by households and small businesses	Calculated percentage usage of drinking water consumption by households and small businesses sectors based on the total drinking water consumption. For more information on the calculation, please see chapter 3.3.3.

ConsIndus%	Percentage usage of drinking water consumption by industry and other sectors	Calculated percentage usage of drinking water consumption by industry and other sectors based on the total drinking water consumption. For more information on the calculation, please see chapter 3.3.3.
TotProdM3	Total drinking water production in m ³ /a	The total drinking water production in the federal state of the query point in m ³ /a.
AURSC	Administrative unit-related supply coverage	Calculated administrative unit-related supply coverage in m ³ /a. For more information on the calculation, please see chapter 3.3.3.
%AURSC	Percentage administrative unit-related supply coverage	Calculated percentage administrative unit-related supply coverage. For more information on the calculation, please see chapter 3.3.3.
AURCC	Administrative unit-related coverage class	<p>Categorised administrative unit-related coverage class:</p> <ul style="list-style-type: none"> • consumption > production • consumption ≈ production • consumption < production <p>For more information, please see chapter 3.3.3.</p>
SW_Name	Surface water name	Name of the nearest surface water.
SW_Class	Surface water class	Quality class of nearest surface water. The quality classes used for the requested water quality apply here as well. For more information, see chapter 5.5.1.
SW_DistanM	Surface water distance in m	Distance between nearest surface water and query point.
SW_H_Metal	Surface water heavy metals	Information on whether the environmental limit value of a heavy metal is exceeded, and if so, which one.
SW_Pestici	Surface water pesticides	Information on whether the environmental limit value of a pesticide is exceeded, and if so, which one.
SW_Indus	Surface water industry substances	Information on whether the environmental limit value of an industrial chemical is exceeded, and if so, which one.
SW_Other	Surface water other substances	Information on whether the environmental limit value of another substance is exceeded, and if so, which one.

SW_ReqQual	Surface water requested quality	Information on whether the requested water quality can be found in surface water bodies within the selected search radius around the query point.
SW_T_Costs	Surface water treatment costs	Calculated cost class for the use of the nearest surface water body, based on requested and available water quality. For more information on the calculation, see chapter 3.3.4.
GW_Quality	Groundwater quality	Quality class of the corresponding ground water body. The quality classes used for the requested water quality apply here as well. For more information, see chapter 5.5.1.
GW_Yield	Groundwater yield	Information on the groundwater yield in classes.
GW_Well	Groundwater withdrawal via wells	Groundwater withdrawal via wells in l/s.
GW_Plant	Groundwater withdrawal via water plants	Groundwater withdrawal via water plants in hm ³ /a.
GW_ReqQual	Groundwater requested quality	Information on whether the requested water quality can be found in groundwater bodies within the selected search radius around the query point.
GW_T_Costs	Groundwater treatment costs	Calculated cost class for the use of groundwater, based on requested and available water quality. For more information on the calculation, see chapter 3.3.4.
WWTPName	Wastewater treatment plant name	Name of the nearest wastewater treatment plant.
WWTP_DistM	Wastewater treatment plant distance in m	Distance between the nearest wastewater treatment plant and the query point.
PrecipMM	Precipitation in mm	Annual precipitation in the vicinity of the query point in mm (1 km x 1 km resolution).
LandUse	Land use	The land use where the query point is located. The output refers to CLC_Lable 2.
SupplyArea	Water supplier association area	The name of the associated water supplier for the area in which the query point is located.
NatRes	Nature reserves	Information on whether the query point is located in a nature reserve or not.

DrinkProt	Drinking water protection area	Information on whether the query point is located in a drinking water protection area or not.
Obs_Road	Obstacle roads	Number of roads (motorways, federal roads, country road, county roads) between query point and nearest surface water body.
Obs_Nature	Obstacle nature reserves	Number of nature reserves between query point and nearest surface water body.
Obs_Drink	Obstacle drinking water protection area	Number of drinking water protection areas between query point and nearest surface water body.
Obs_Urban	Obstacle urban fabric	Number of urban fabric areas between query point and nearest surface water body. This data comes from the land use layer, which is searched for Corine Land Cover Code 111 and 112.

5.9 Interpretation of the data

5.9.1 Disclaimer

When interpreting the data, it should be noted that the data provided may differ from reality. The responsibility for the correctness lies with the providers of the original data. Therefore, we cannot assume any liability (see also disclaimer in chapter 2.3). For applications that go beyond a test of the tool, we recommend downloading the original data sets or extending/replacing them with user-owned data.

Up to date, most available public data is based on administrative units, which may not necessarily reflect the conditions and limits of water supply-related units. For a refined representation, user owned data can be used in the RDSMG tool instead or in addition to public data. This applies not only to the conditions and limits of water supply-related units, but also to certain data, such as for example the sectoral distribution of water use, for which there is little data public available.

This tool is intended to provide an overview of the possibilities in an area to match water supply and demand - it cannot replace cost planning, preliminary and specialist planning or even construction planning.

5.9.2 Administrative unit-related data

The following data outputs refer to the level of the administrative unit county:

- Drinking water demand per capita (WatDemCap)
- Total drinking water consumption in m³/a (TotConsM3)
- Percentage usage of drinking water consumption by households and small businesses (ConsHouse%)

- Percentage usage of drinking water consumption by industry and other sectors (ConsIndus%)
- Total drinking water production in m³/a (TotProdM3)
- Administrative unit-related supply coverage (AURSC)
- Percentage administrative unit-related supply coverage (%AURSC)
- Administrative unit-related coverage class (AURCC)

The AURSC describes the difference between the amount of drinking water produced and consumed in a county. The AURSC, %AURSC and AURCC refer to the total water production (TotProdM3) and total water consumption (TotConsM3) at the level of the administrative unit county. Since the actual supply areas differ greatly from this in some cases, the values given in the output attribute table cannot be used to make a statement about the actual situation regarding water surpluses or a possible supply gap.

5.9.3 Groundwater data

The data on groundwater yield (GW_Yield) and abstraction via wells (GW_Well) and water plants (GW_Plant) can help to decide whether groundwater could be considered as a water source for a possible project. The RDSMG cannot make any statement about the actual on-site conditions and does not hold any information about the current utilization of groundwater as a water resource (overuse of groundwater). Therefore, this data can only be taken as a rough guide. Depending on the particular question, it may be ecologically and economically sensible to consider the use of water from alternative sources, such as WWTP (see chapter 5.9.5) or rainwater harvesting (see chapter 5.9.6).

5.9.4 Costs data

The information on treatment costs for the usage of groundwater or surface water can deviate greatly from reality. They are based on the assumptions explained in chapter 3.3.4. No statements can be made about actual treatment methods and the associated costs.

5.9.5 Data for wastewater treatment plants

The information which is the nearest wastewater treatment plant (WWTP_Name, WWTP_DistM) can be used for considering a possible alternative water resource.

5.9.6 Precipitation data

The precipitation data (PrecipMM) can be used to calculate potential rainwater harvesting on e.g. hall roof tops. For an annual precipitation of e.g. 500 mm, a roof area of only 100 m² has the potential to recover 50 000 l/a. Since a hall roof is many times larger, the amount of water potentially available is many times greater.

5.9.7 Data for obstacles between query point and nearest surface water body

The information on whether a query point is located within a nature reserve (NatRes), or a drinking water protection area (DrinkProt) can be used to decide whether, for example, an industrial expansion at a query point can even be considered. Furthermore, the information about the obstacles (Obs_Road, Obs_Nature, Obs_Drink, Obs_Urban) can be used to show possible impediments or difficulties in the water supply/water use of this site.

6 Troubleshooting

6.1 General Check list to avoid problems during usage of the RDSMG

To prevent problems while using the RDSMG or if you encounter problems while using the RDSMG, first check the following points:

- Do you have the **latest version of QGIS** installed, at least version 3.28.5 Firenze (see chapter 3.1)?
- Have you installed the **correct plug-in** for your purpose (see chapter 5.3)?
- Do all the data you use have the **same coordinate reference system** (the data provided are in EPSG: 3035)?
- Is your “points of interest” layer in the **same coordinate reference system** as all the other data?
- Do your input parameters used for internal calculations (total drinking water production and consumption, usage of drinking water consumption by households and small businesses [m³/a], drinking water demand per capita [L/P*d], see chapter 3.3) have the **correct units**?
- Do you use raster data that have **only one band**?
- Do you use all the **mandatory** data?
- Do you have **all the data** for the environments of the query points? only where data is available can the tool give an output.

6.2 Common Problems

6.2.1 QGIS does not run

If you have general difficulties using QGIS, please consult the **QGIS manual** (https://docs.qgis.org/3.28/en/docs/user_manual/index.html).

6.2.2 The RDSMG plug-in cannot be installed

If you have difficulties installing the QGIS plug-in, please consult the **QGIS manual** (https://docs.qgis.org/3.28/en/docs/user_manual/index.html) and make sure you have the **latest version of QGIS** installed, at least version 3.28.5 Firenze. Please also check if you **downloaded** the plug-in correctly.

6.2.3 The RDSMG plug-in cannot be started

If you have installed the RDSMG plug-in correctly but cannot start it, please check the following points:

- Do you have the **latest version of QGIS** installed, at least version 3.28.5 Firenze (see chapter 3.1)?
- Have you installed the **correct plug-in** for your purpose? (see chapter 5.3)

6.2.4 The RDSMG plug-in cannot be run

If you have installed the RDSMG plug-in correctly and can start it, but the algorithm does not run, please check the following points:

- Have you entered **all mandatory data**?
- Have you entered all layer data (and columns, if possible) in the **correct input parameter**?
- If you are using the plug-in “RDSMG – From point layer”, are you using the **correct input layer** for point of interests?

6.2.5 The output layer contains strange results

If the results in your output layer seem strange to you (negative values, unrealistic values, etc.), please check the following points:

- Do all the data you use have the **same coordinate reference system** (the data provided are in EPSG: 3035)?
- Is your “points of interest” layer in the **same coordinate reference system** as all the other data?
- Do your input parameters used for internal calculations (total drinking water production and consumption, usage of drinking water consumption by households and small businesses [m³/a], drinking water demand per capita [L/P*d], see chapter 3.3) have the **correct units**?
- Do you use raster data that have **only one band**?

6.2.6 The output layer contains (partially) no results

If your output layer contains (partially) empty columns or the value *NULL* is displayed, please check the following points:

- Do you have **all the data** for the environments of the query points? Only where data are available can the tool give an output.
- Do all the data you use have the **same coordinate reference system** (the data provided are in EPSG: 3035)?
- Is your “points of interest” layer in the **same coordinate reference system** as all the other data?
- Do your input parameters used for internal calculations (total drinking water production and consumption, usage of drinking water consumption by households and small businesses [m³/a], drinking water demand per capita [L/P*d], see chapter 3.3) have the **correct units**?
- Do you use raster data that have **only one band**?
- Do you use **all the mandatory** data?
- Have you entered all layer data (and columns, if possible) in the **correct input parameter**?
- If you have used your own data, check that all necessary parameters have the **correct column names**, otherwise the RDSMG cannot access them (see Table 2 and Table 3).

6.3 Related links

If you have questions about the regional demand-supply matching GIS tool that are not answered in this user manual, you can find information on the following websites:

- QGIS website: <https://www.qgis.org/en/site/index.html>
- QGIS manual: https://docs.qgis.org/3.28/en/docs/user_manual/index.html
- *Water Europe Marketplace* product page: <https://mp.uwmh.eu/d/Product/35>

7 References

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