User manual for the Groundwater Atlas for pesticides version 2022

R. Kruijne, D. van Kraalingen and J.A. te Roller

WOt-technical report 231

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This WOt-technical report was produced in accordance with the Quality Management System of Wettelijk Onderzoekstaken (WOT) Natuur & Milieu (Statutory Research Tasks Unit for Nature & the Environment), part of Wageningen University & Research.

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The 'WOt-technical reports' series presents the findings of research projects implemented for WOT Natuur & Milieu by various centres of expertise.

WOt-technical report 231 presents the findings of research funded by the Dutch Ministry of Agriculture, Nature and Food Quality (LNV).

User manual for the Groundwater Atlas for pesticides version 2022

R. Kruijne[1], D. van Kraalingen[1], J.A. te Roller[1]

1 Wageningen Environmental Research

BAPS-project number WOT-04-008-024

Wettelijke Onderzoekstaken Natuur & Milieu
Wageningen, December 2022

WOt-technical report 231
ISSN 2352-2739
DOI 10.18174/582307

WAGENINGEN
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Abstract

Kruijne, R., D. van Kraalingen and J.A. te Roller (2022). *User manual for the Groundwater Atlas for pesticides version 2022.* Wettelijke Onderzoekstaken Natuur & Milieu, WOt-technical report 231.

The aim of the Groundwater Atlas for pesticides is to improve access to the groundwater monitoring results for use in the registration. The user manual for the Groundwater Atlas version 2022 describes how the measurement results for a selected substance can be explored. The user can generate a report for registration with a summary of the measurement results and the land use within the area of influence of sampling points. There are no fixed values for the period and depth to evaluate the presence of each substance in the groundwater. The user has the option to choose these values himself.

Het doel van de Grondwateratlas voor bestrijdingsmiddelen is om grondwatermonitoringresultaten te ontsluiten voor het gebruik in de toelating door het Ctgb. De gebruikershandleiding voor de Grondwateratlas versie 2022 beschrijft hoe de gebruiker de meetresultaten in de Grondwateratlas kan verkennen voor de geselecteerd stof. De gebruiker kan een rapport voor de toelating genereren met een samenvatting van de meetresultaten van het landgebruik in het invloedsgebied van de meetpunten. Er zijn geen vaste waarden voor de periode en diepte om het voorkomen van elke stof in het grondwater te evalueren. De gebruiker heeft de optie om deze waarden zelf te kiezen.

Keywords: Pesticide, groundwater, monitoring, drinking water, registration, plant protection product, atlas

Photo cover: Tjitske Sluis Foto's

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This report can be downloaded free of charge from https://doi.org/10.18174/582307 or from www.wur.nl/wotnatuurenmilieu.
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Preface

In the registration procedure for plant protection products in the Netherlands, the leaching of active substances and relevant metabolites is assessed using models that describe the fate of these substances in the plant-soil system. If a safe use cannot be demonstrated based on these calculations according to the decision tree leaching, data from targeted groundwater monitoring studies can be used. The aim of such targeted monitoring studies is to provide proof of the safe use of a plant protection product. However, in the Netherlands the number of these cases of targeted monitoring is very limited.

According to the Uniform Principles (EC 546/2011), Member States must include monitoring data on the presence or absence of the active substance and relevant metabolites in groundwater in their evaluation of a plant protection product. In the Netherlands the groundwater quality has been monitored regularly by regional government authorities (Provinces of the Netherlands) and by drinking water companies for many years. These monitoring data are not generated for the purpose of authorisation of plant protection products, but to monitor the chemical status of the groundwater.

Because these regular monitoring data could be used by the Board for the Authorisation of Plant Protection Products and Biocides (Ctgb) as feedback on the results obtained in the other parts of the decision tree on leaching, the Dutch Ministry of Agriculture, Nature and Food Quality (LNV) and the Ministry of Infrastructure and Water Management (I&W) have commissioned Wageningen Environmental Research (WEnR) and the National Institute for Public Health and the Environment (RIVM) to improve access to these monitoring results and to propose a methodology for the use of monitoring results in the Groundwater Atlas in the assessment. The methodology and a new Groundwater Atlas version 2022 were delivered at the end of the year 2022. This manual for the Groundwater Atlas version 2022 was published on behalf of the Statutory Research Tasks Unit for Nature and the Environment (WOT Natuur & Milieu).

Wageningen, November 2022

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Summary

In the Netherlands, approximately 60% of drinking water is abstracted from groundwater. The risk assessment of a plant protection product based on an active ingredient which is already on the market must take into account all relevant groundwater monitoring results. The aim of the Groundwater Atlas for pesticides is to improve access to these groundwater monitoring results for the Board for the Authorisation of Plant Protection Products and Biocides (Ctgb). A procedure for the use of these results in the assessment was proposed by Kruijne et al., 2022 and was implemented in the Groundwater Atlas version 2022. This WOt-technical report contains the user manual for the Groundwater Atlas version 2022.

In the Netherlands the groundwater quality is monitored on a regular basis by the regional authorities (Provinces of the Netherlands) and by the water companies that use groundwater for the production of drinking water. The regional authorities select sampling points which belong to the national and regional groundwater quality monitoring networks for their pesticide monitoring activities. The drinking water companies select sampling points which belong to the observation well fields surrounding their groundwater abstraction sites for pesticide monitoring activities. The results from these activities were transferred by the owners to the developers of the Groundwater Atlas who made these available for use by the Ctgb. The Groundwater Atlas version 2022 contains measurement results from the regional authorities and the water companies originating from the last two and three decades, respectively.

The Groundwater Atlas contains a substance list with attributes of active ingredients, metabolites and other components of plant protection products and biocides. These are stored in the Groundwater Atlas database together with the monitoring network data, sample data and measurement results from the regional authorities and drinking water companies. Both the substance list, the database and the user interface are part of the Groundwater Atlas version control. The application and relevant documents are available at www.pesticidemodels.eu/groundwateratlas.

This user manual describes how the user can explore the monitoring data in the Groundwater Atlas version 2022 interactively by selecting a substance of interest, period, sampling depth range and monitoring networks. The selected measurement results can be summarised by means of common statistics for each category, a frequency distribution, and several spatial and temporal presentations of the data. Tables, graphs and maps shown on the screen can be printed to a bitmap file. The user can generate a report for registration which contains a summary of measurement results and land use within the area of influence of the sampling points from the regional authorities. Original sampling point, sample data and measurement results for the substance selected can be exported to output files in Excel format.

The report for registration gives a summary of the measurement results selected within the evaluation period and the depth of the target layer as proposed for registration. There are no recommended settings for the evaluation period and the depth of the target layer regardless of the substance. For this reason, the user has the option to choose the values for the start and end of the evaluation period and for the depth of the target layer and to generate the report for registration based on these settings.

Samenvatting

In Nederland wordt circa 60% van het drinkwater gemaakt uit grondwater. De risicobeoordeling van een gewasbeschermingsmiddel op basis van een werkzame stof die reeds is toegelaten dient gebruik te maken van alle relevante grondwatermonitoringgegevens. Het doel van de Grondwateratlas voor bestrijdingsmiddelen is om deze grondwatermonitoringresultaten te ontsluiten voor het gebruik door het College voor de toelating van Gewasbeschermingsmiddelen en Biociden (Ctgb). Het voorstel voor een procedure voor dit gebruik (Kruijne et al, 2022) is geïmplementeerd in de Grondwateratlas versie 2022. Dit WOt-technical report bevat de gebruikershandleiding voor de Grondwateratlas versie 2022.

In Nederland wordt het grondwater gemonitord door de provincies en door de waterbedrijven die grondwater gebruiken voor drinkwaterproductie. De provincies selecteren meetpunten die deel uitmaken van het Landelijk Meetnet Grondwaterkwaliteit en de Provinciale Meetnetten Grondwaterkwaliteit voor deze monitoringactiviteiten. De waterbedrijven selecteren meetpunten die deel uitmaken van het puttenveld rondom hun winlocaties voor deze monitoring activiteiten. De meetnetgegevens en de meetresultaten zijn door de eigenaren overgedragen aan de ontwikkelaars van de Grondwateratlas. De Grondwateratlas versie 2022 bevat meetresultaten van de provincies uit de afgelopen twee decennia en van de waterbedrijven uit de afgelopen drie decennia.

De Grondwateratlas bevat een stoffenlijst met attributen van actieve stoffen, metabolieten en andere componenten van de formulering van het product. De stoffenlijst is opgeslagen in de Grondwateratlas database; samen met de meetnetgegevens, monstergegevens en meetresultaten van provincies en waterbedrijven. Zowel de stoffenlijst, de database als het gebruikersinterface zijn onderdeel van het versiebeheer en zijn beschikbaar op www.pesticidemodels.eu/groundwateratlas.

De gebruikershandleiding illustreert en beschrijft hoe de gebruiker de selectie van meetresultaten in de Grondwateratlas kan verkennen voor een combinatie van de stof, periode, bemonsteringsdiepte en monitoringnetwerk. De mogelijkheden zijn een samenvatting met beschrijvende statistieken per categorie, een frequentieverdeling, weergave in een aantal kaartvormen, en weergave in een aantal vormen uitgezet tegen de tijd. Elke tabel, grafiek of kaart kan als bitmap bewaard worden. De gebruiker kan een rapport voor de toelating genereren met een samenvatting van de meetresultaten van de geselecteerde stof en van het landgebruik in het invloedsgebied van de meetpunten van de provincies.

Het rapport bevat een samenvatting van de meetresultaten die afkomstig zijn van de grondwatermonsters uit de periode en de meetpunten binnen de bodemlaag op de diepte zoals voorgesteld voor gebruik in de toelating. Er zijn geen vaste waarden voor de periode en diepte die geschikt zijn om het voorkomen van elke stof in het grondwater te evalueren. Om deze reden heeft de gebruiker de optie om zelf een waarde te kiezen voor het begin en het eind van de evaluatieperiode en voor de boven- en ondergrens van de bodemlaag en om op basis van deze waarden een rapport voor de toelating te genereren.

1 Introduction

In the Netherlands, approximately 60% of drinking water is abstracted from groundwater. The need to protect this source is described in the European and national guidance and covers all groundwater in bodies of water which are suitable for drinking water production. The risk assessment of a plant protection product based on an active ingredient which is already on the market must take into account all relevant groundwater monitoring results. The aim of the Groundwater Atlas for pesticides is to improve access to these groundwater monitoring results for the Board for the Authorisation of Plant Protection Products and Biocides (Ctgb). A procedure for the use of these results in the assessment was proposed by Kruijne et al., 2022 and was implemented in the Groundwater Atlas. This WOt technical report contains the user manual for the Groundwater Atlas version 2022.

1.1 The Groundwater Atlas for pesticides

In the Netherlands the groundwater quality is monitored on a regular basis by the regional authorities (Provinces of the Netherlands) and by the water companies that use groundwater for the production of drinking water. The regional authorities select sampling points which belong to the national and regional groundwater quality monitoring networks for their pesticide monitoring activities. The drinking water companies select sampling points which belong to the observation well fields surrounding their groundwater abstraction sites for pesticide monitoring activities. The results from these activities were transferred by the owners to the developers of the Groundwater Atlas and made available for the intended use at the Ctgb. The Groundwater Atlas version 2022 contains measurement results from the regional authorities and from the water companies originating from samples taken in the last two and three decades, respectively.

The Groundwater Atlas contains a substance list with attributes of active ingredients, metabolites and other components of plant protection products and biocides. These are stored in the Groundwater Atlas database together with the monitoring network data, sample data and measurement results from the regional authorities and drinking water companies. Both the substance list, the database and the user interface are part of the Groundwater Atlas version control. In the future, regular updates with recent measurement results from the regional authorities and the drinking water companies may lead to the release of new versions of the Groundwater Atlas substance list and/or the Groundwater Atlas database. The Groundwater Atlas versions and documentation are available at www.pesticidemodels.eu/groundwateratlas.

1.2 Reading guide

The current report contains a quick start guide (Chapter 2) and a description of the features of the Graphical User Interface (Chapter 3). A glossary is included in Annex 1. Installation details are provided in Annex 2. The export file content is given in Annex 3. The background and specifications of the substance list and other components of the Groundwater Atlas are described in the documentation (see References).

2 Getting started

The Groundwater Atlas installation file can be downloaded from www.pesticidemodels.eu.

The Groundwater Atlas software package consists of a Graphical User Interface (GUI) and a Firebird ® database. The Groundwater Atlas version number according to version control consists of the GUI version number, the database version number, and the substance list version number. The Groundwater Atlas version 3.2.2 described in this user manual is also referred to as the Groundwater Atlas version 2022.

The Groundwater Atlas version 2022 can be installed (1) by a network administrator and (2) by a user with administration rights for a local PC.

Install the software on a network drive
Network administrators can install the Groundwater Atlas on a network share. A read-only access to the network share and a personal directory on a local drive or a network drive are required for the user. For better performance, installation of the Groundwater Atlas database on a local drive is recommended. If a local drive is not available, a network share must be chosen. Take the following steps:

1. Unzip the installer;

2. Start the installer and browse to the network share;

3. Don't select a desktop icon;

4. After completing the installation, inform the users of the name of the network share.

Install the software on your PC

To install the software on your PC

1. Start the installation file;

2. Select the folder on your PC where the Groundwater Atlas is to be installed;

3. Select the folder where the Groundwater Atlas database file is to be installed. Note that this must be a folder on a local drive;

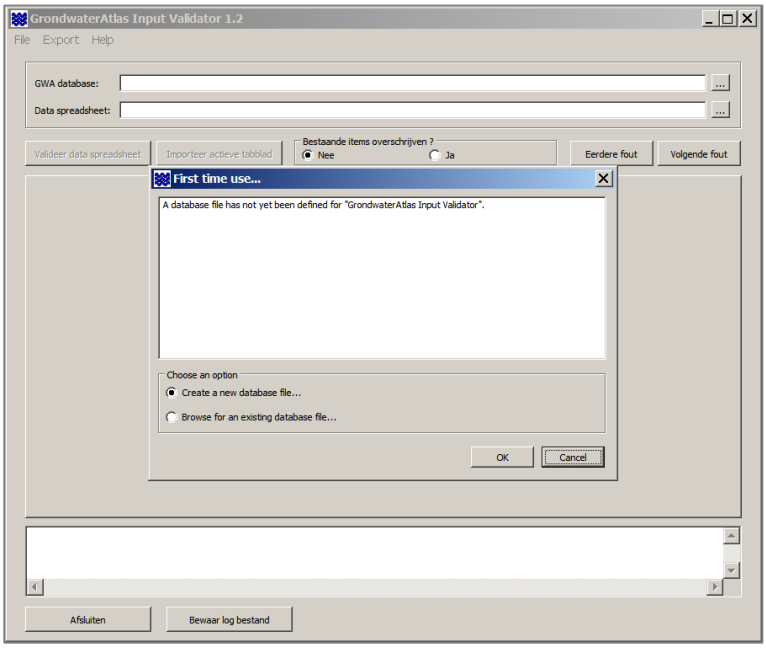
4. If desired, check the box to create a desktop shortcut;

5. Finish the installation procedure, and restart your PC.

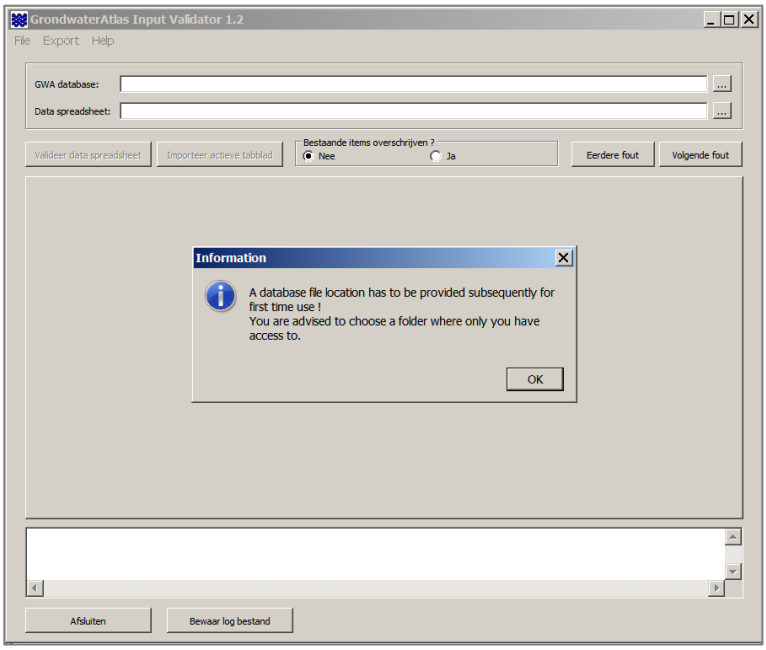
The Groundwater Atlas is installed, e.g. at C:\Users\<userID>\AppData\Local\Programs\PesticideModels\GrondwaterAtlas_3. During the installation the user can choose another location.

First time use

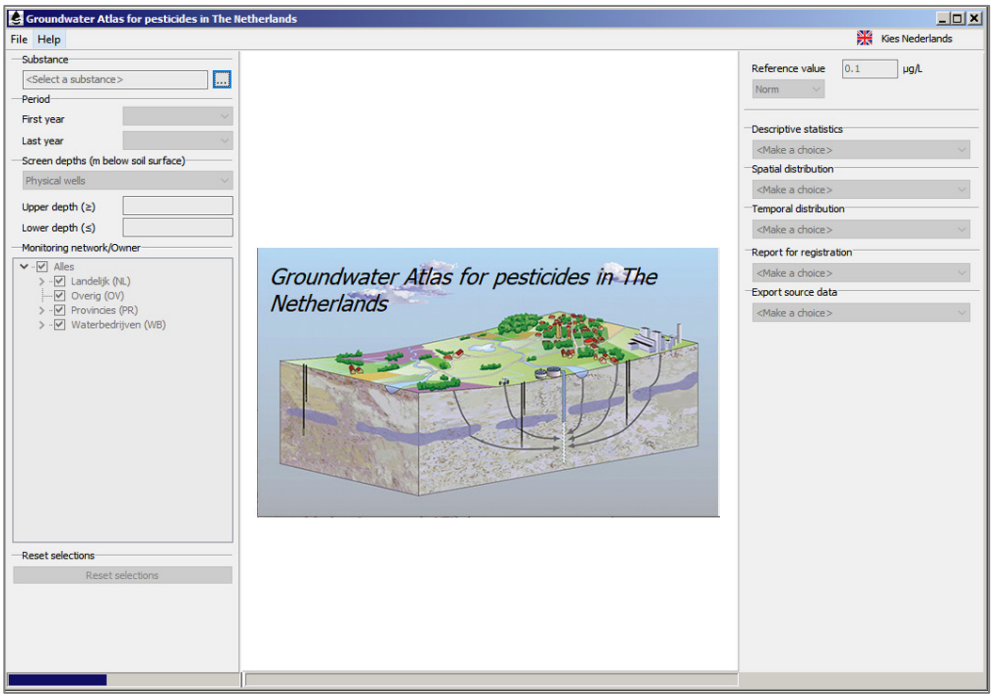
For first time use, the user is requested to save (create) a personal copy of the Groundwater Atlas database;



Next, the user is advised to create this personal copy of the Groundwater Atlas database in a folder with exclusive access;



Start the Groundwater Atlas: either from the Windows Start Menu folder Pesticide Models, or from the icon on your desktop. While loading, the progress bar is visible in the bottom left corner of the main screen.



Press Enter to start the application.

Some hardware requirements and other installation details are given in Annex 2 of this report.

3 User Guide

This chapter describes how the user can explore the monitoring data in the Groundwater Atlas interactively, i.e. by selecting a substance of interest, a period in time, a sampling depth range, and monitoring networks. The user may choose a type of reference value and enter the corresponding concentration value. The user can export the monitoring network data and the measurement results within the selection to output files in Excel format. General statistics of the measurement results can be shown, as well as spatial and temporal presentations of the data. These tables, graphs and maps shown on the screen can be printed to a bitmap file. A new feature is the report for registration with a summary of the measurement results and the land use in the area of influence of the sampling points.

3.1 Main screen

The user can choose between Dutch and English (UK) via the button in the top right corner of the main screen.

The main screen consists of three parts. On the left, the user can set selections from the database. In the centre is a simple map with the sampling sites present in the database (pink marker). On the right, the user can set a reference value, browse through the categories of data presentation (descriptive statistics, spatial distribution, temporal distribution), generate a report for registration, and use the export function (Figure 1).

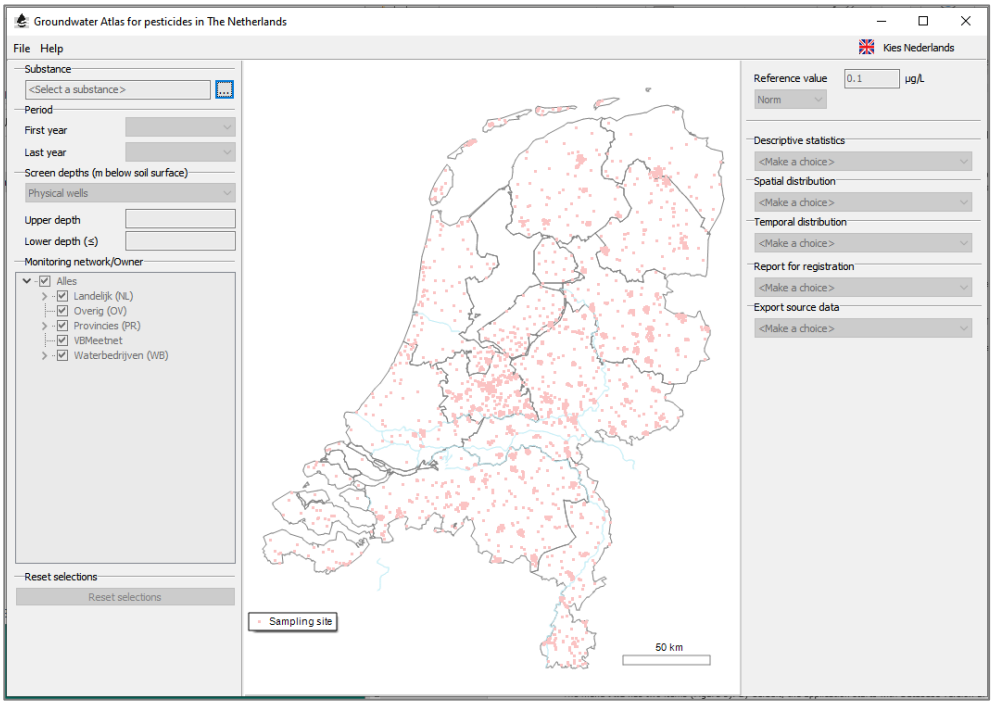


Figure 1 *Groundwater Atlas main screen.*

3.2 Menu options

The **File** menu has two items (Figure 3). By default, the application starts with Database version 8.2.2. In the future, more database versions may become available at www.pesticidemodels.eu. The user can select the Open database ... option and navigate to the location with the other Groundwater Atlas database file.

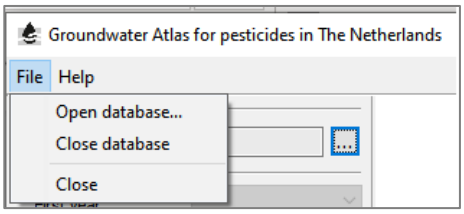


Figure 2 *Groundwater Atlas File menu items.*

The **Help** menu has four items (Figure 3) with the link to: 1) the user manual, 2) the installation file at www.pesticidemodels.eu/groundwateratlas, 3) the substance list, 4) the disclaimer text, and 5) the version control number and release date of the Groundwater Atlas.

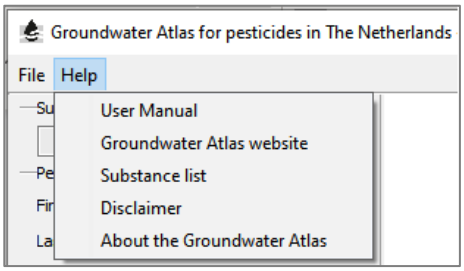


Figure 3 *Groundwater Atlas Help menu items.*

3.3 Sampling site information

With the mouse pointing at a sampling site on the map on the main screen, click the mouse button to view the sampling site attributes (Figure 4): Sampling site codes, Location, Type, Installation date/year, Owner, Monitoring network(s), X-coordinate, Y-coordinate, and Quality label. The coordinates of sampling sites owned by drinking water companies are not shown and not written to export files.

To zoom in: Make a rectangle with the mouse. The map can be panned by moving the mouse while still holding the button down. To zoom out to the full map: Make a rectangle with the mouse (start in any position, move towards the upper left, and release the mouse button).

Use the <Esc> button to clear the map from the screen.

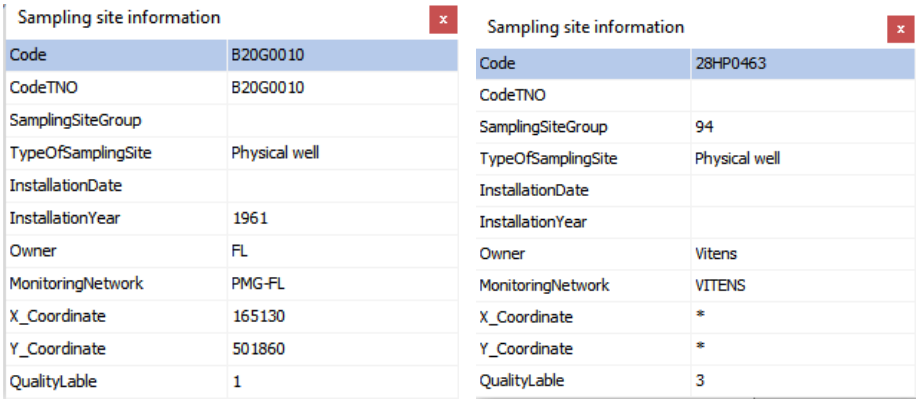


Figure 4 *Attributes of arbitrary sampling sites from two groups of monitoring networks. Left: national and regional monitoring networks. Right: monitoring networks owned by a drinking water company.*

3.4 User selections

Arbitrary substances were chosen to show the features of the Groundwater Atlas. These are for demonstration purposes in this user manual only and referred to as 'Example selection'.

3.4.1 Substance

The list of substances with measurement results appears when the button at the 'Select a substance' dialogue box is pressed. The columns on the left show the substance name and CAS-Nr. The attribute #MeasurementResults contains the total number of measurement results in the Groundwater Atlas version 2022. The attributes Product group, StartRegistratonPeriod, EndRegistrationPeriod, PermittedPlantProtectionProduct and PermittedBiocide apply to the active substances in the substance list only. These attributes do not apply to metabolites and other components of formulated products in the substance list.

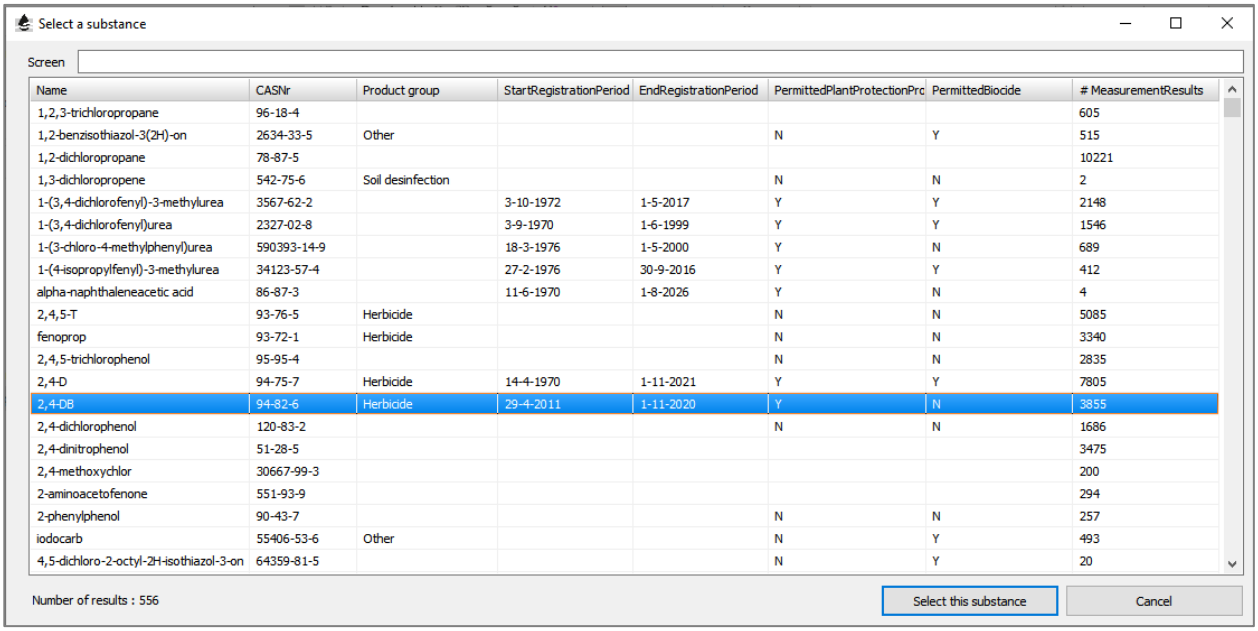


Figure 5 *Substances with measurement results and attributes shown in the dialogue box 'Select a substance'.*

Only those substances with measurement results available are shown. The entire substance list, i.e. the substance table which also includes those substances with no measurement results available and the list of synonyms for substance names, is available via the Help menu option. More information about substance attributes is given in Kruijne et al., 2022, Annex B. For a limited number of the active substances with measurement results, some of the attributes mentioned above are currently not available. For these instances a no data label is shown in the 'Select a substance' dialogue box.

While typing, the text appears in the dialogue box and only those records (substances) remain visible which contain the text in the dialogue box. This text filter function works for all columns in the table and helps the user to find a substance (by name, CAS-Nr., etc.).

When a substance is selected, the program loads the measurement results with the related data into the memory cache. The values for the first year and last year of appearance in the database (Period) and for the upper depth (≥) and lower depth (≤) (Screen depths in metre below soil surface) are entered in the dialogue boxes (Figure 6). These values can be changed to select appropriate measurement results. The map legend includes three classes:

- pink marker: sampling site
- black marker: sampling sites with measurement results outside the selection
- green marker: sampling sites with measurement results within the selection

In Figure 6, with substance 2,4-DB (Example selection 1), the 2nd class (black marker) is empty because no sampling sites with measurement results are deselected yet. The 3rd class (green marker) contains all sampling sites with measurement results.

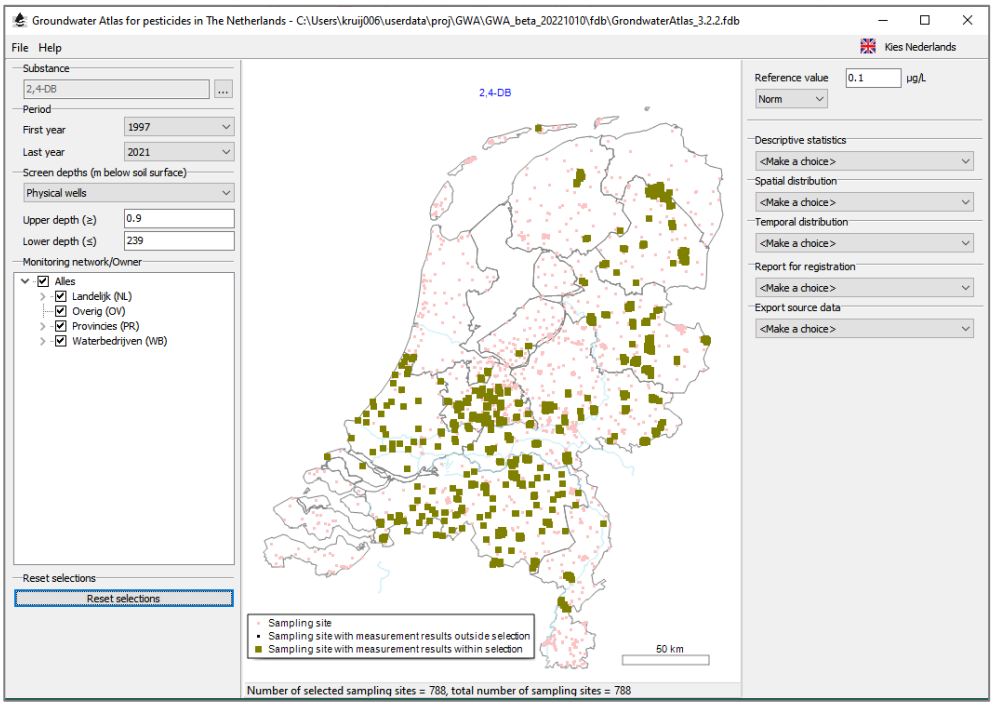


Figure 6 *All sampling sites with measurement results for the substance selected (Example selection 1).*

The total number of sampling sites with measurement results for this substance (788) is shown at the bottom of the screen.

3.4.2 Period

The user can replace the values for the first year and last year according to the period of interest. The map in the centre of the main screen will show which sampling sites fall outside the selection as a result of this change in the settings (Figure 7). This dynamic feature allows the user to explore the distribution of measurement results in spatial extent, time and depth.

The number of sampling sites within the selection (710) and the total number of sampling sites with measurement results (788) are shown at the bottom of the screen.

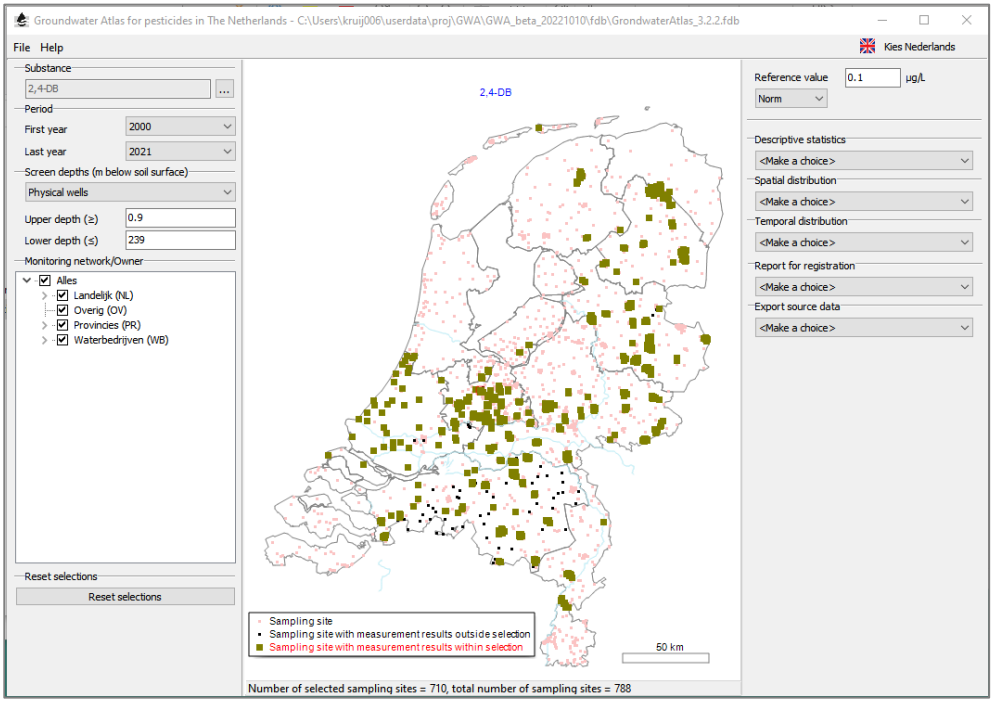


Figure 7 *Sampling sites with measurement results for the period 2000-2021 (Example selection 1).*

3.4.3 Screen depths

When the user adjusts the values for the screen depth to 5 and 15 m below the soil surface, the number of sampling sites within the selection is reduced from 710 to 280. The map in the centre of the main screen will show the resulting distribution of the sampling sites outside the selection and the sampling sites within the selection (Figure 8).

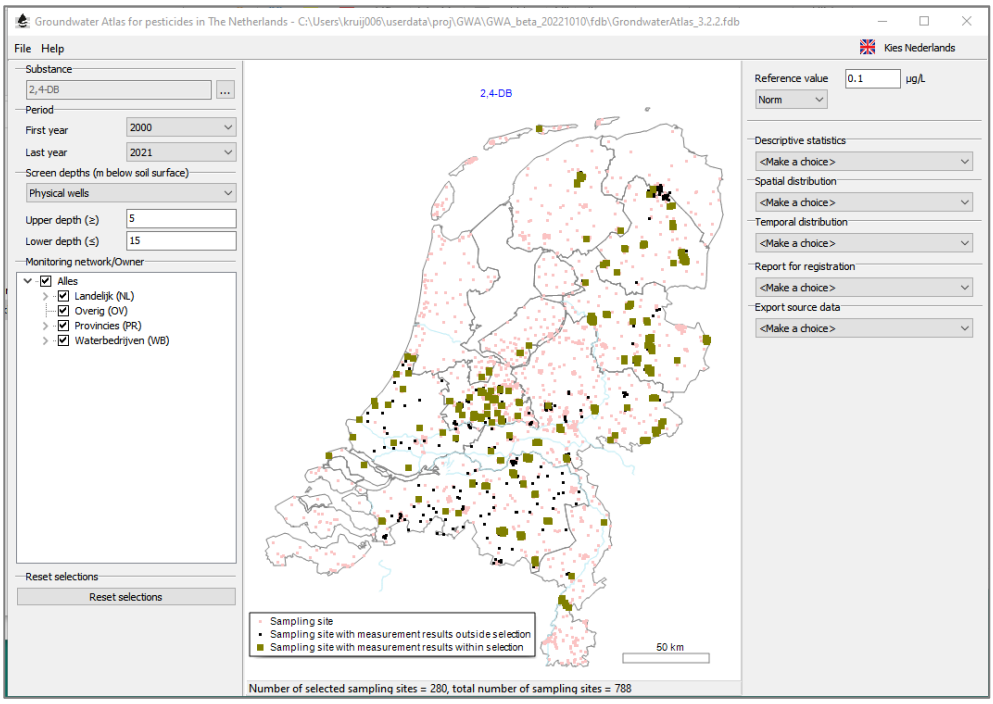


Figure 8 *Sampling sites with measurement results for the period 2000-2021 and screen depth between 5 and 15 m below soil surface (Example selection 1).*

A sampling point (screen) is selected:

1. If the top of the screen (m-ss.) is equal to or below the upper screen depth set by the user, and
2. the bottom of the screen (m-ss.) is equal to or above the lower screen depth set by the user.

This is illustrated in Figure 9, where only Screen Nr. 3 meets the criteria. The largest amount of measurement results in the Groundwater Atlas originate from samples taken at 10 (22%) and 25 (14%) m depth approximately and from sampling points with 2 (63%) or 1 m (32%) screen length.

Note that the 1st criterion is different from the previous version of the Groundwater Atlas v1.1 (see also Section 3.10).

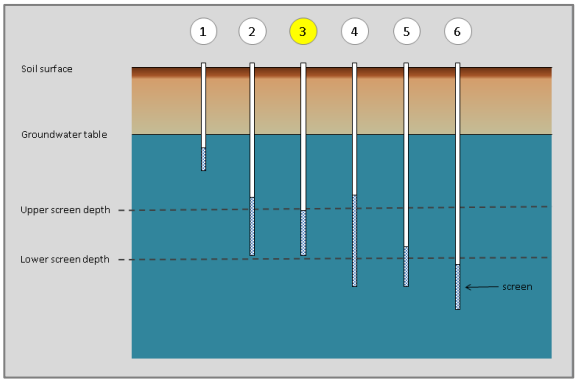


Figure 9 *Selection of Screen Nr. 3 by the upper and lower screen depth (m below soil surface).*

3.4.4 Type of sampling site

The Groundwater Atlas contains two types of sampling sites: Physical wells and Springs. By definition, a natural spring has no screen (Annex 1). Therefore, any adjustment made in the screen depth values implies deselection of the sampling site type Spring and the measurement results from these sites. Figure 9 with substance bentazone (Example selection 2) shows the location of these natural springs in the southern part of the Province of Limburg.

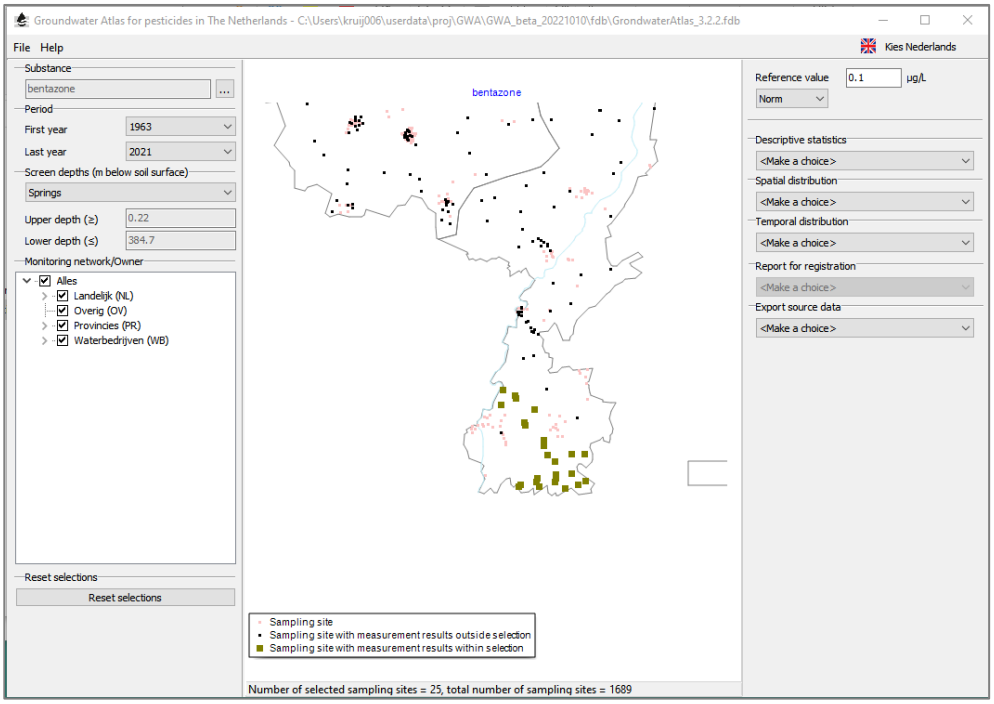


Figure 10 *Selection of measurement results from the sampling site type Spring in the southern part of the Province of Limburg (Example selection 2).*

3.5 Monitoring networks

The sampling sites in the Groundwater Atlas are part of the monitoring networks from the regional authorities and from drinking water companies. All monitoring networks present in the Groundwater Atlas version 2022 are described in Kruijne et al., 2017.

The user may select any combination or group of monitoring networks for the data presentation types shown in Sections 3.7, 3.8 and 3.9. Contrary to the presentation types in these sections, the report for registration (Section 3.10) can only be generated based on the selected monitoring results from all monitoring networks together.

3.6 Reference value

The user may choose the type of reference value from a picklist in the top right section of the main screen: norm, criterion, or limit. These types are commonly referred to in documents from Dutch and European registration dossiers. The concentration value can be entered by the user. For most substances, the drinking water criterion will apply (0.1 µg/L). This value is the default reference value (Figure 11).

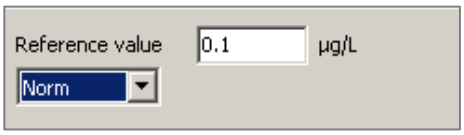


Figure 11 *The default type of reference value Norm with default value 0.1 µg/L (see text).*

Data regarding the substances in groundwater are referred to as measurement results, both when given as an upper limit value and when given as a real concentration value. The measurement results given as a real concentration are referred to as measurement values.
Three categories are available for the measurement results which represent an upper limit:

1. Below the limit of detection (< LOD),
2. Below the limit of quantification (< LOQ),
3. Below the reporting limit (< LOR).

The measurement values are divided by the reference value into two categories and presented separately in the features explained in Section 3.8:

4. Concentration less than or equal to the reference value,
5. Concentration exceeding the reference value.

3.7 Export source data

The Groundwater Atlas offers the possibility to export measurement results, including sampling site characteristics. The export file can be used for further exploration of the data. The dialogue box at the Export source data section includes three options:

1. Monitoring network data
2. Monitoring network data and sample data
3. Monitoring network, sample, measurement data

The source data are exported to an Excel file. The user settings (substance, periods, screen depths, monitoring network) and Groundwater Atlas version number are written to a separate text file. The Excel file contains a row with data for each screen (Option 1) or each measurement result (Options 2, 3). The field names are given in Annex 3.

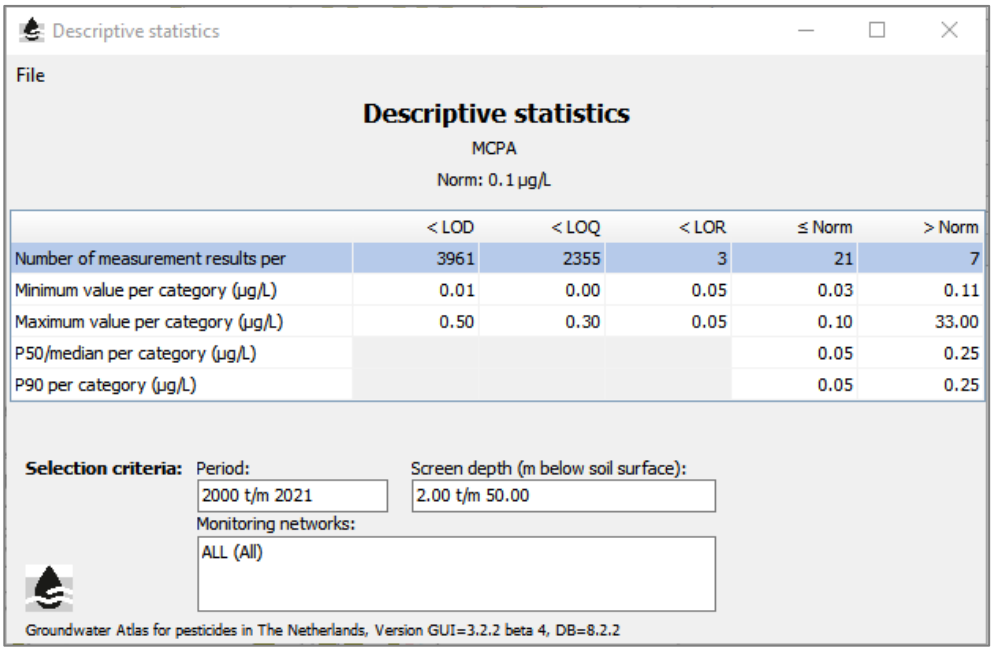
3.8 Statistics of the selected measurement results

Four report functions with descriptive statistics are available: one table and three graphs.

3.8.1 Descriptive statistics per category of measurement results

The table in Figure 12, with substance MCPA (Example selection 3), shows the number, the minimum and maximum of the measurement results per category and, for the measurement values the 50 percentile (median) and 90 percentile. The type of reference value is shown in the header of the two categories with measurement values. The 90 percentile is calculated according to the routine in the GeoPEARL model (without weighting factors). The 90 percentile is shown if there is more than one value, and the calculated

90 percentile is less than the maximum measurement value. If one of these conditions is not met, a note is printed beneath the table ('Not enough data').



	< LOD	< LOQ	< LOR	≤ Norm	> Norm
Number of measurement results per	3961	2355	3	21	7
Minimum value per category (µg/L)	0.01	0.00	0.05	0.03	0.11
Maximum value per category (µg/L)	0.50	0.30	0.05	0.10	33.00
P50/median per category (µg/L)				0.05	0.25
P90 per category (µg/L)				0.05	0.25

Figure 12 *Descriptive statistics per category of measurement results (Example selection 3).*

3.8.2 Number of measurement results per category

The graph in Figure 13 shows the total number of measurement results per category.

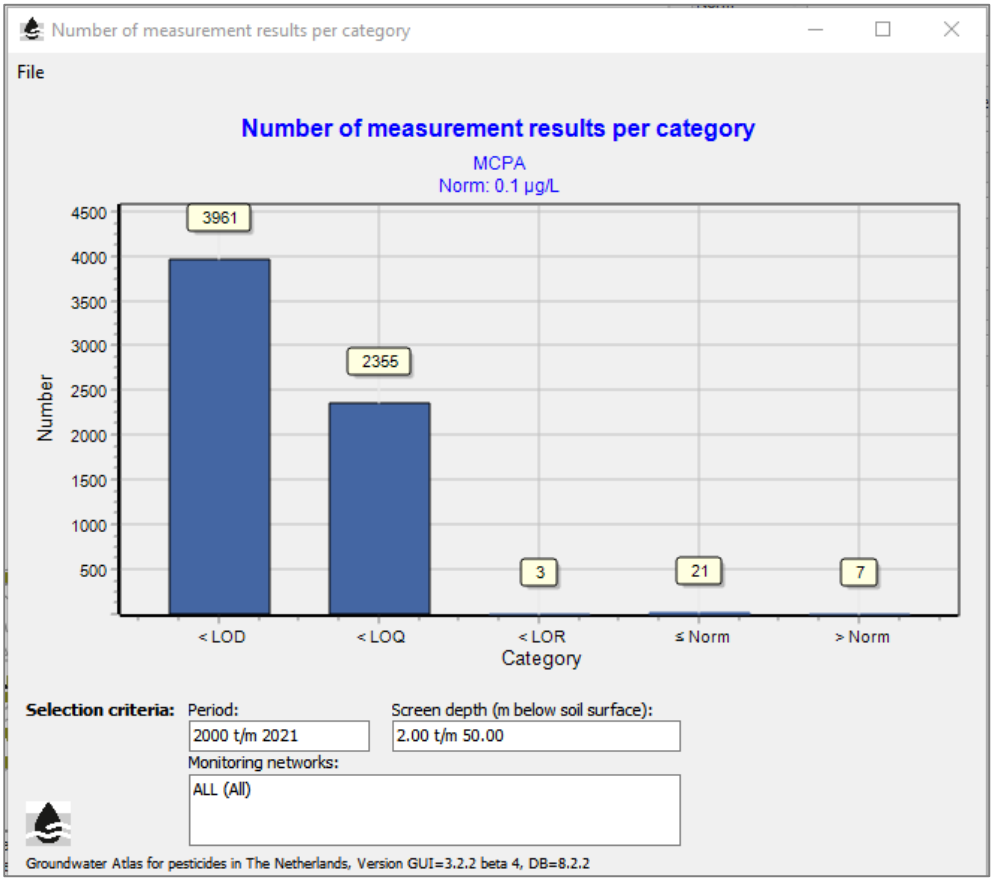


Figure 13 *Number of measurement results per category (Example selection 3).*

3.8.3 Number of sampling sites and screens with measurement results per category

The graph in Figure 14 shows the number of sampling sites and sampling points (screens) with measurement results per category. For example: The number of measurement results exceeding the norm = 7 (Figure 13). These measurement results originate from samples taken at 5 sampling points (screens) which are part of 4 sampling sites (Figure 14).

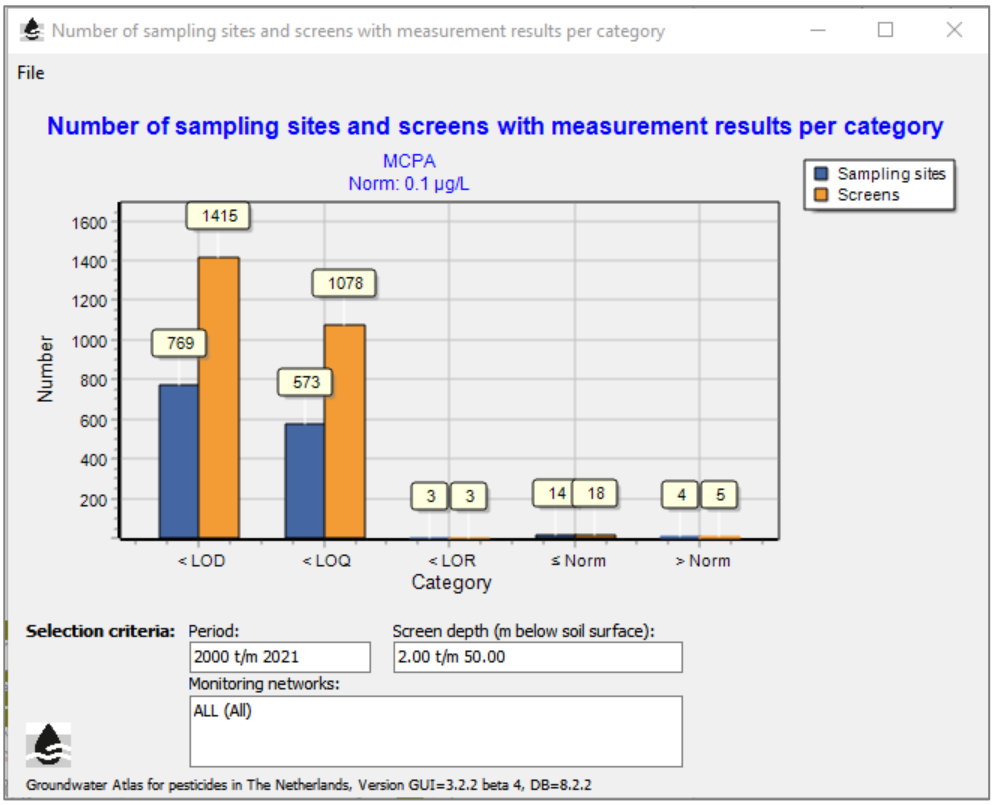


Figure 14 *Number of sampling sites and screens with measurement results per category (Example selection 3).*

3.8.4 Cumulative frequency distribution of measurement results

The graphs in Figure 15 and Figure 16 show the cumulative frequency distribution of the measurement values. The scale of the vertical axis is based on the number of measurement results (= 100%).

This graph is available in two types:
- with linear scale of the horizontal axis (concentration)
- with logarithmic scale of the horizontal axis (concentration)

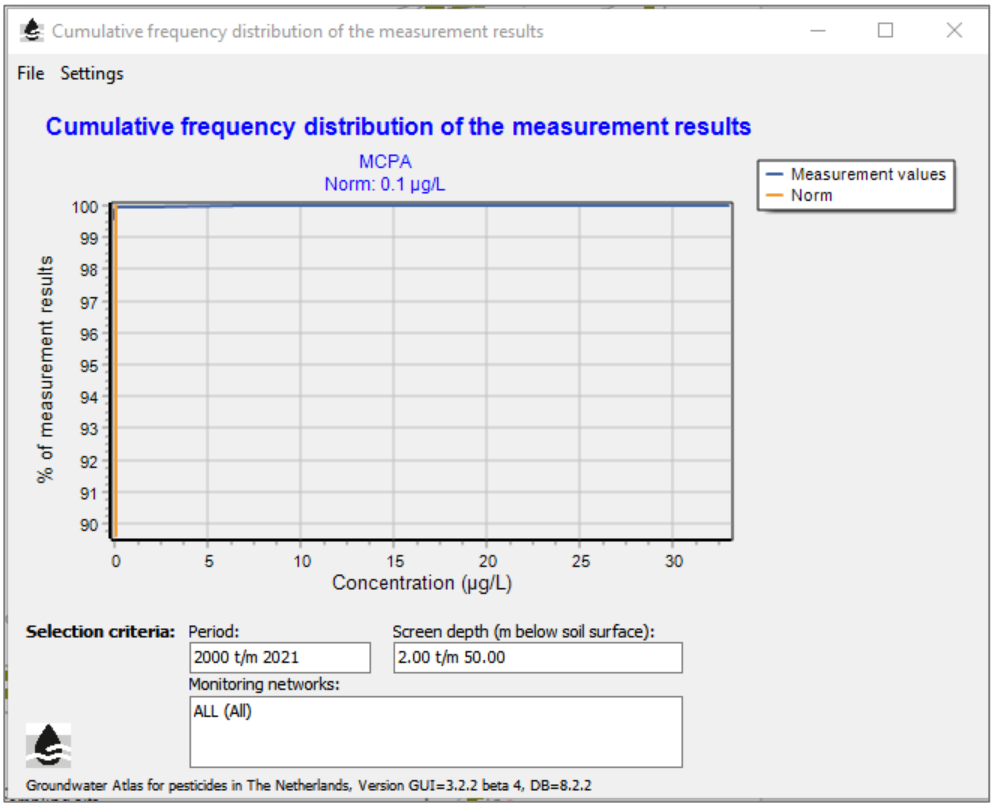


Figure 15 *Cumulative frequency distribution of measurement results – graph with linear horizontal axis (Example selection 3).*

The type of horizontal axis (concentration) can be toggled in the Settings tab. To zoom in in the graph area: Make a rectangle with the mouse. To zoom out: Make a rectangle with the mouse (start in any position, move towards the upper left, and release the mouse button).

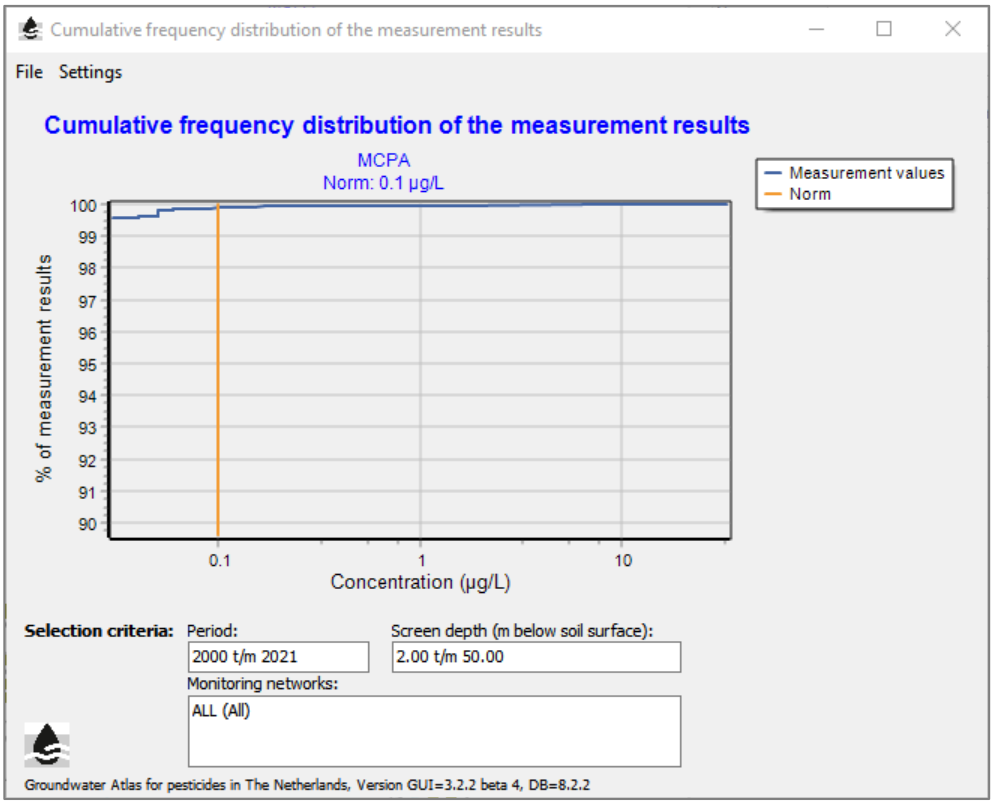


Figure 16 *Cumulative frequency distribution of measurement results – graph with logarithmic horizontal axis (Example selection 3).*

3.9 Spatial distribution of the selected measurement results

Four maps are available to explore the spatial distribution of measurement results.

3.9.1 Number of screens with measurement results per sampling site

This map (Figure 17) allows the user to evaluate the presence of sampling sites with more than one sampling point (screen). In general, the range in the number of screens per sampling site, screen depths and screen lengths in the population of sampling sites from the drinking water companies exceeds the range of these features in the population of sampling sites from the national and regional monitoring networks.

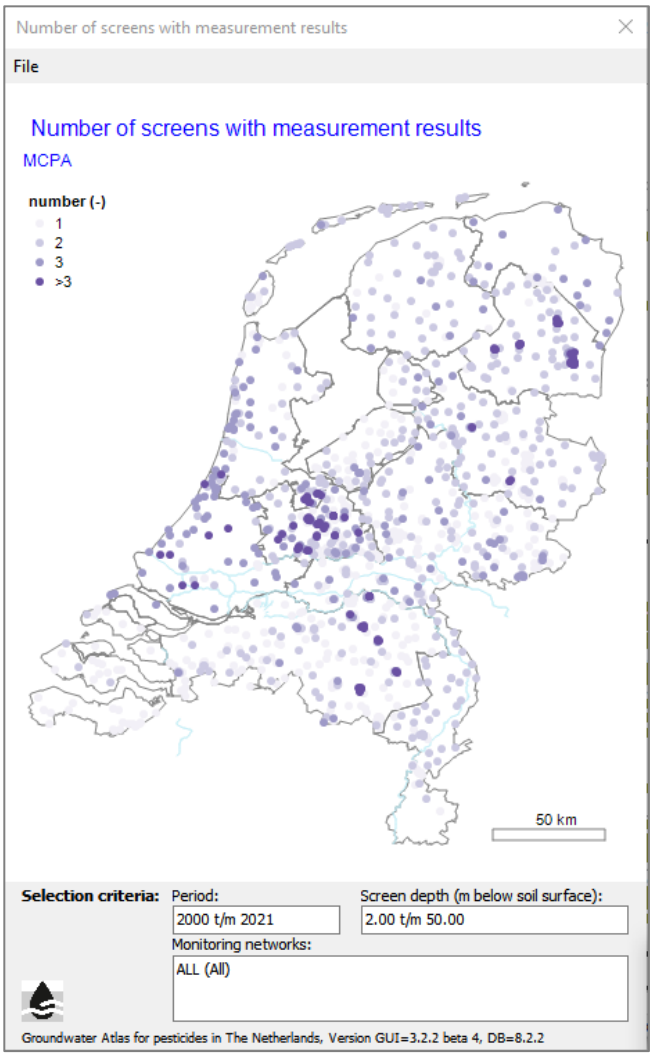


Figure 17 *Number of sampling points (screens) with measurement results per sampling site (Example selection 3).*

3.9.2 Number of measurement results per sampling site

This map (Figure 18) allows the user to evaluate the number of measurement results per sampling site.

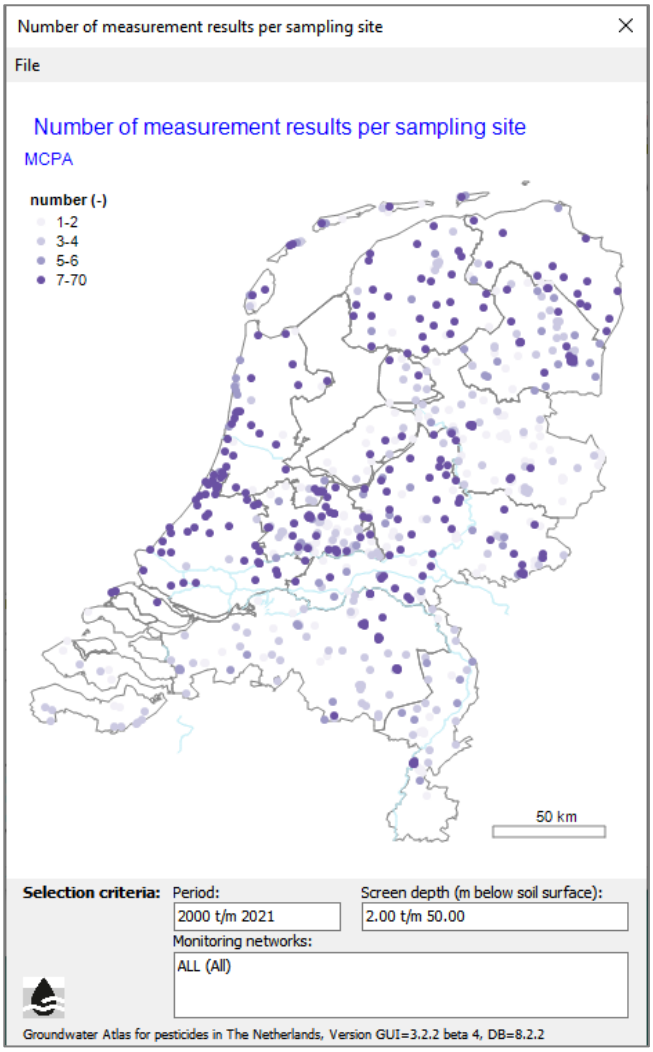


Figure 18 *Number of measurement results per sampling site (Example selection 3).*

3.9.3 Number of measurement values per sampling site

This map (Figure 19) allows the user to evaluate the number of measurement values per sampling site.

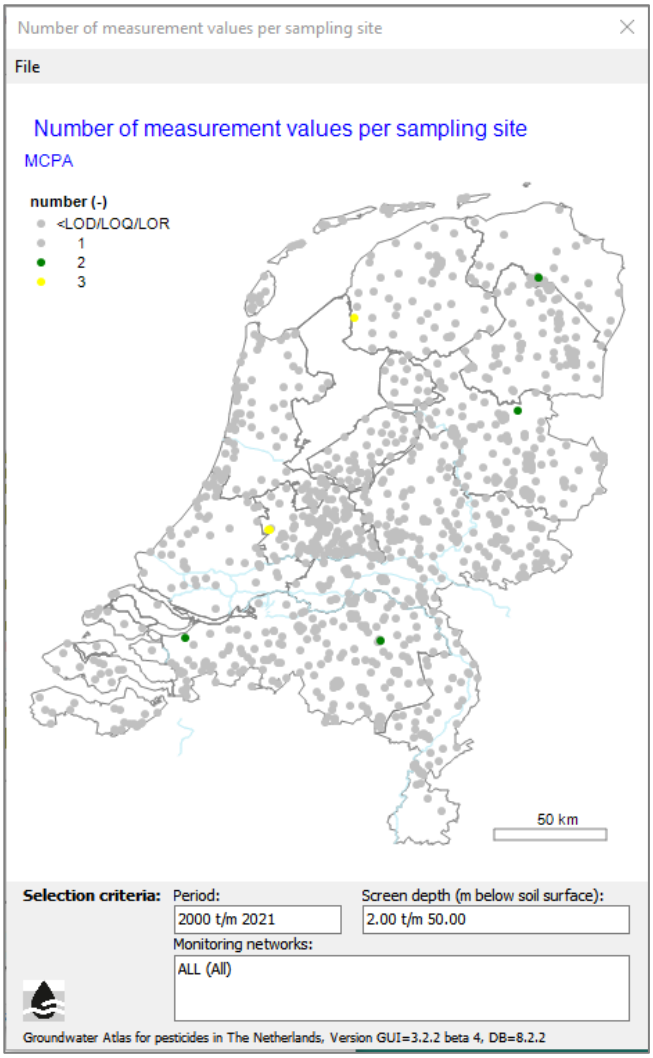


Figure 19 *Number of measurement values per sampling site (Example selection 3).*

3.9.4 Maximum measurement value per sampling site

The map legend (Figure 20) contains two items:

1. the maximum measurement value per sampling site, with four legend classes and the legend class boundaries relative to the reference value (concentration),
2. the sampling sites with measurement results and with no measurement values (not a concentration).

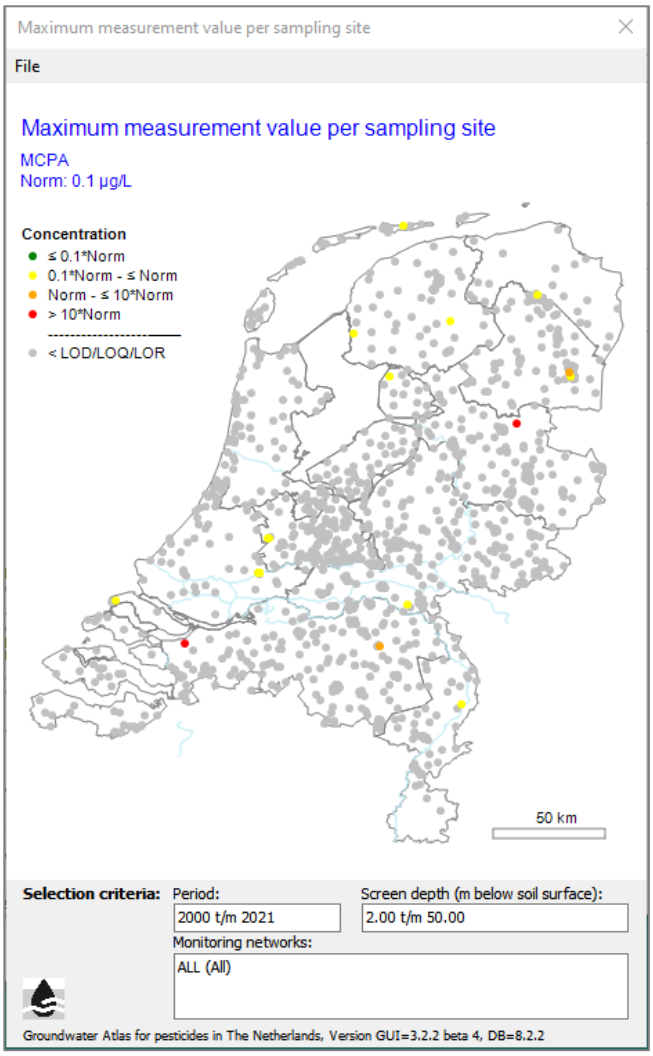


Figure 20 *Maximum measurement value per sampling site (Example selection 3).*

3.10 Temporal distribution of the selected measurement results

Four report functions with the temporal distribution of measurement results are available: three graphs and one table.

3.10.1 Number of measurement results per year and per monitoring network group

Figure 21 shows the number of measurement results per monitoring network group per year, including total numbers per year and total numbers for the entire period. Two groups of monitoring networks are shown:

1. the national and regional monitoring networks (no Other monitoring networks are present in the current Groundwater Atlas database), and
2. the monitoring networks owned by the drinking water companies.

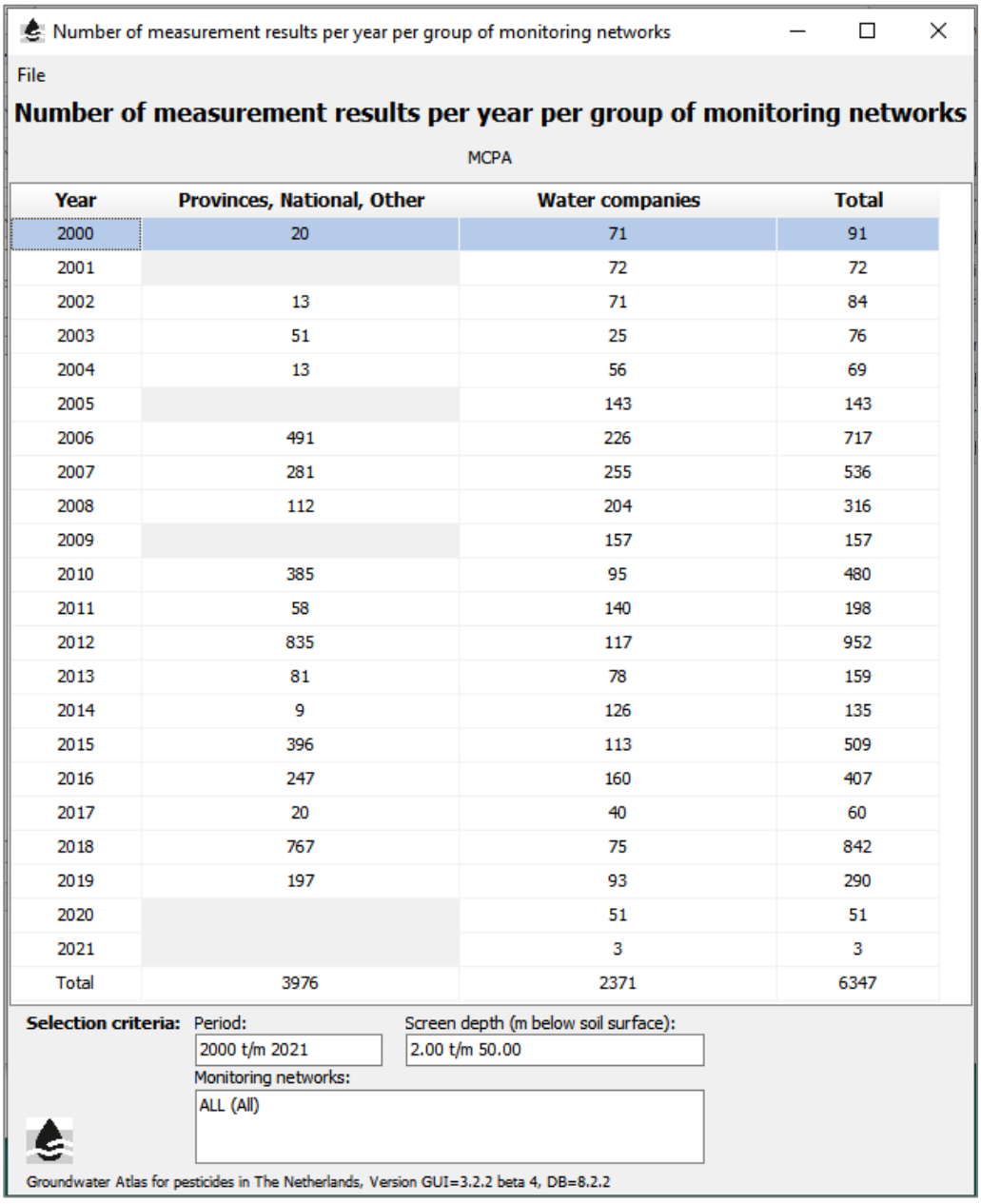


Figure 21 *Number of measurement results per year and per monitoring network group (Example selection 3).*

3.10.2 Number of measurement results per category per year

The legend of this graph (Figure 22, Figure 23) contains the number of measurement values, in four classes with the class boundaries relative to the reference value, and the number of measurement results.

The graph is available in two types:
- with linear scale of the vertical axis (number)
- with logarithmic scale of the vertical axis (number)

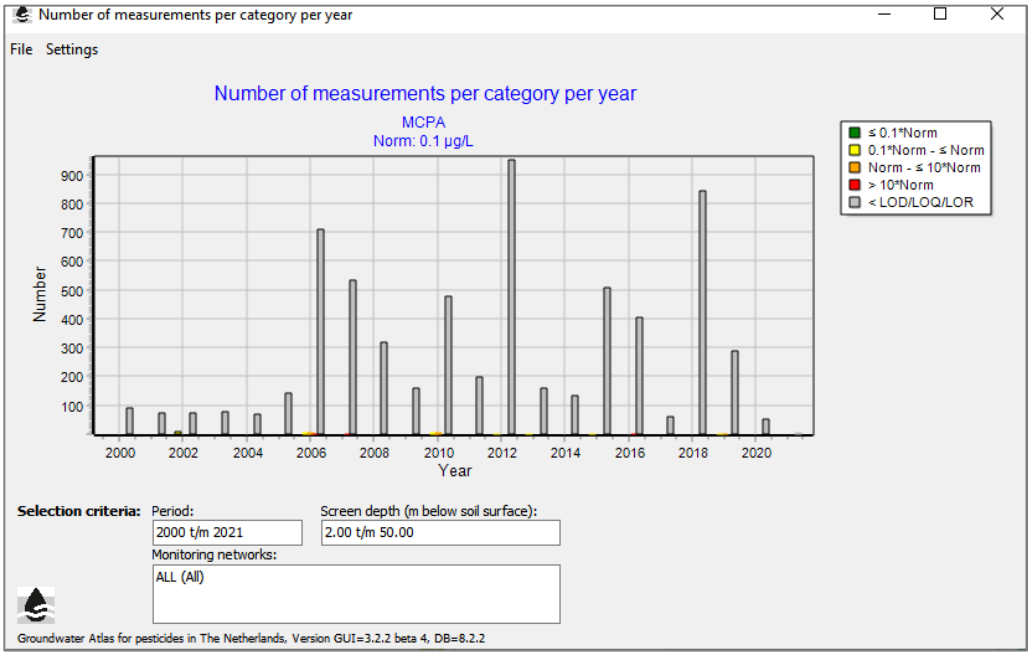


Figure 22 *Number of measurement results per category per year and the vertical axis with linear scale (Example selection 3).*

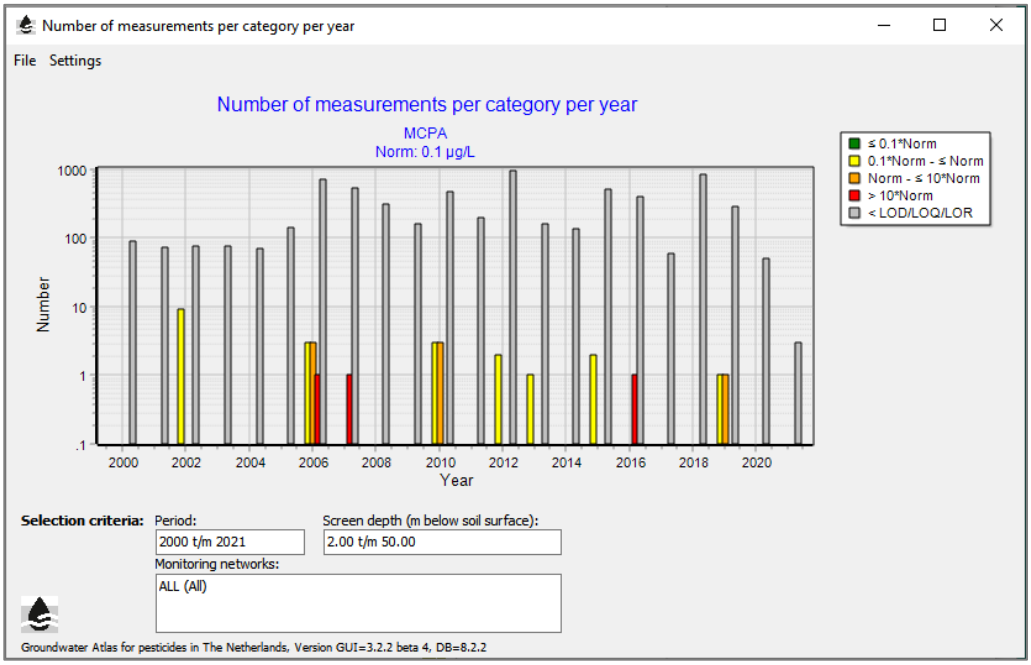


Figure 23 *Number of measurement results per category per year and the vertical axis with logarithmic scale (Example selection 3).*

The type of horizontal axis (concentration) can be toggled in the Settings tab. To zoom in in the graph area: Make a rectangle with the mouse. To zoom out: Make a rectangle with the mouse (start in any position, move towards the upper left, and release the mouse button).

3.10.3 Statistics of measurement values per year (graph)

This graph (Figure 24) shows the maximum concentration, the 50 percentile/median concentration, and the 90 percentile concentration of the measurement values per year. The 90 percentile concentration is shown if there is more than one value, and if the 90 percentile concentration is less than the maximum concentration. If one of these conditions is not met, a note is printed beneath the table ('Not enough data').

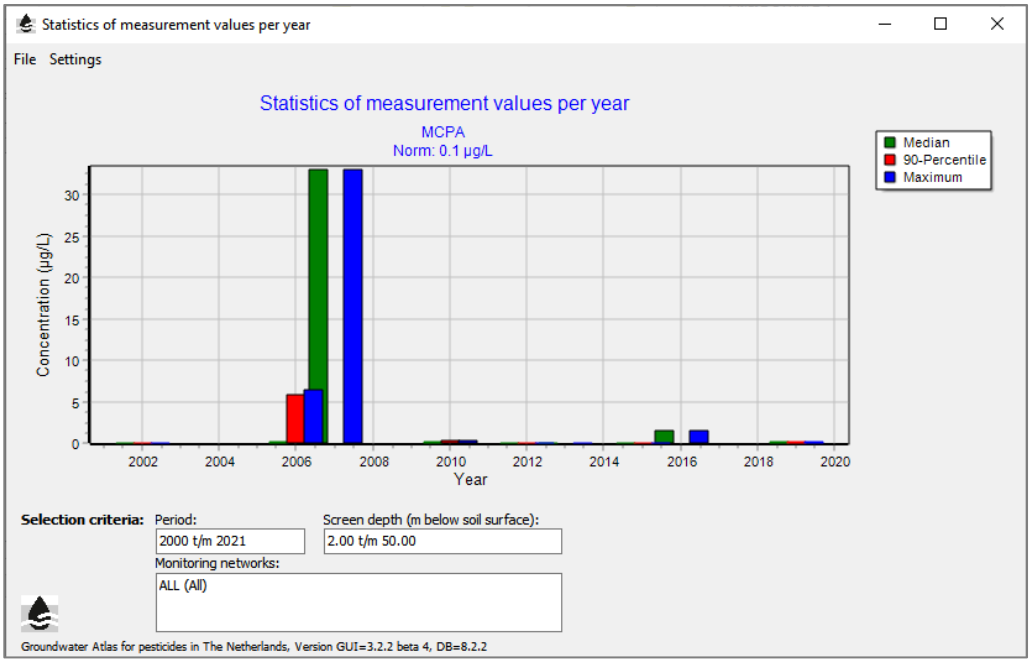


Figure 24 *Statistics of measurement values per year (Example selection 3).*

3.10.4 Statistics of measurement results per year (table)

The table (Figure 25) shows the number of measurement results, the number of measurement values, and the maximum concentration (µg/L), 50 percentile/median concentration and 90 percentile concentration of the measurement values per year. The 90 percentile concentration is shown if there is more than one value, and the 90 percentile concentration is less than the maximum concentration. If one of these conditions is not met, a note is printed beneath the table ('Not enough data').

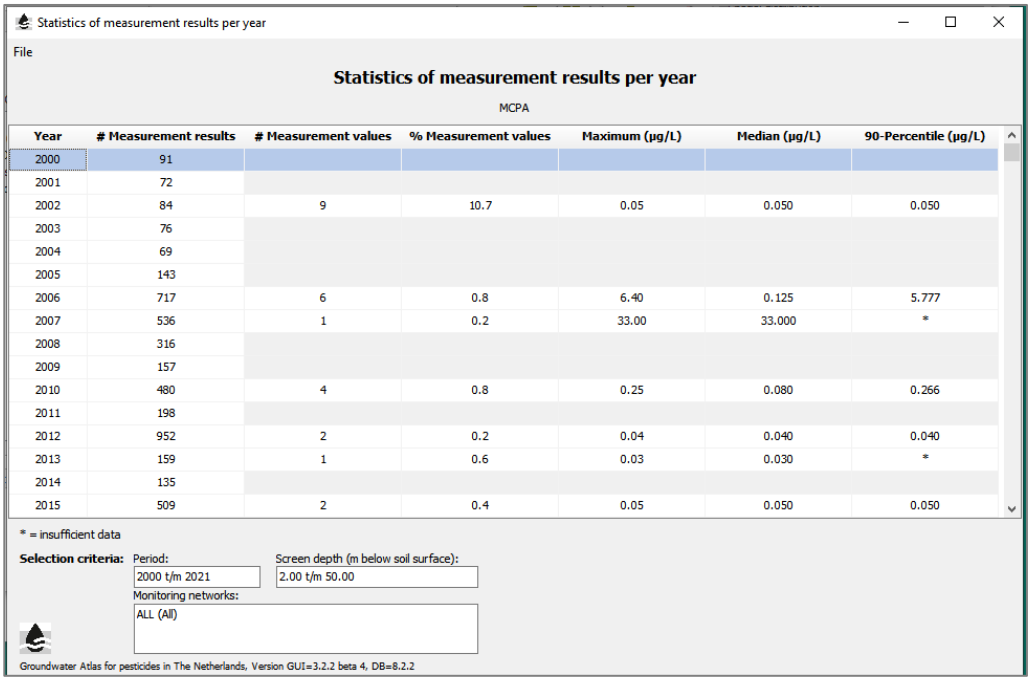


Figure 25 *Statistics of measurement results per year (Example selection 3).*

3.11 Report for registration

The Groundwater Atlas version 2022 includes the feature to generate a report intended for use in registration. The procedure for selection of the measurement results and the other data in the report is described in Kruijne et al., 2022, Chapter 5.

The 'Report for registration' dialogue box (Figure 26) contains two options for the period selection and for the screen depth selection:

- with the setting proposed for registration, or
- with the settings according to the current, user-defined selection.

The report can only be generated for the measurement results from the regional authorities and the drinking water companies together, as stated in the dialogue box.

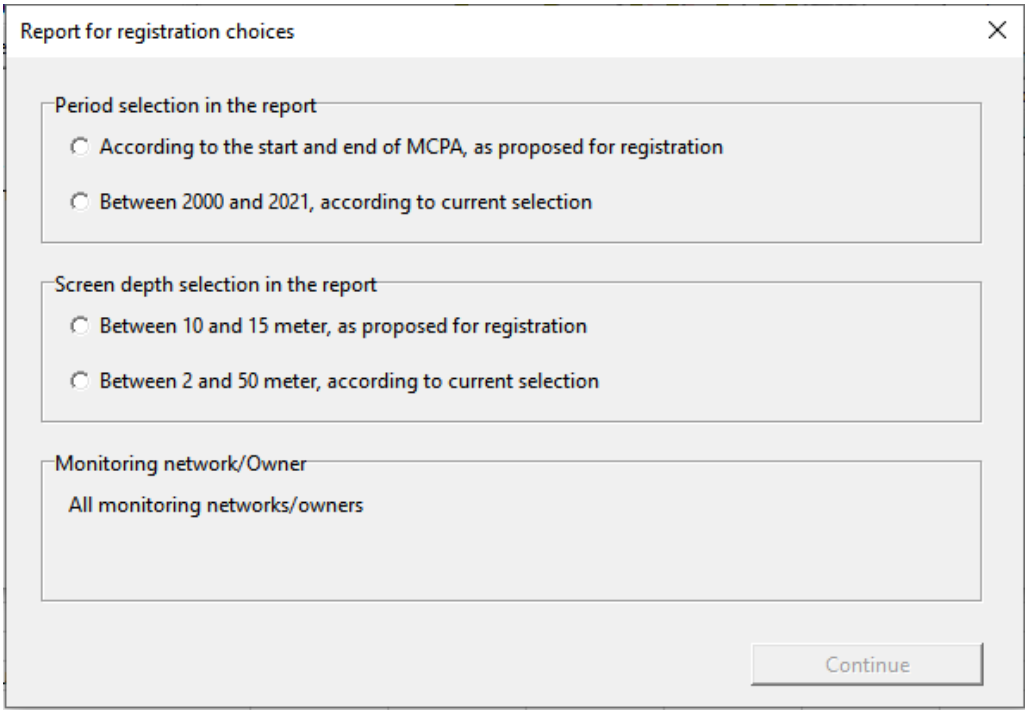


Figure 26 *Dialogue box with two options for the period selection and for the screen depth selection: as proposed for registration or according to the selection made by the user.*

When the options are checked in the 'Report for registration' dialogue box, the user may continue with choosing the file name and navigate to the location for the report using the 'Save as' box. When the Save button is pressed, the program will start generating the report. The following message appears:

The report can be opened in Excel and the width of the columns may need to be adjusted. Figure 27 shows the content of a report for the substance MCPA as generated with the option for the evaluation period and the screen depth as proposed for registration. These overrule the settings for the Example selection 3 in the previous sections of this chapter (period 2000-2021 and depth between 2 and 50 m below soil surface).

The report contains:

- The substance identification and the name of related metabolite(s) with measurement results present in the Groundwater Atlas database
- The date of first authorisation and the expiration date (according to the Groundwater Atlas database)
- The selection of the evaluation period (as proposed for registration)
- The depth of the target layer (as proposed for registration)
- For the target layer (for each group of monitoring networks and for both together):
  - The number of measurement values
  - The number of measurement results
  - The number of measurement values / results (%)
  - The maximum measurement value (µg/L)
  - The 90 percentile of measurement values (µg/L)
- In the layer above the target layer: Counts of the measurement results and the measurement values, and the ratio (%)
- In the layer below the target layer: Counts of the measurement results and the measurement values, and the ratio (%)
- The average land use in the area of influence of the sampling points from the regional authorities:
  - with measurement values (%, n=2)
  - with measurement results (%, n=126)
- The land use codes are explained below these figures in the report
- The Groundwater Atlas version number

The percentage of measurement values in the three layers gives information on the presence of the substance in the groundwater according to the results from these regular monitoring activities as distributed with depth. A relatively high percentage, e.g. in the layer above the target layer, may be further explored by generating similar reports with an alternative position of the target layer, and by using other features of the Groundwater Atlas presented in this user manual.

The report for registration gives a summary of the measurement results selected within the evaluation period and the depth of the target layer as proposed for registration. There are no recommended settings for the evaluation period and the depth of the target layer regardless of the substance. For this reason, the user has the option to choose the values for the start and end of the evaluation period and for the depth of the target layer and to generate the report for registration based on these settings.

The report covers active ingredients which have, or have had, a registration as a plant protection product, and metabolites from these substances. The evaluation period starts at the date of first authorisation and ends at the last expiration date according to the substance list. If this date is in the future (an expiration date), the current date is selected. This includes the most recent measurement results currently available in the Groundwater Atlas database. If the end date is in the past, the substance may be less relevant strictly from a registration point of view. The presence of that particular substance in the groundwater may still be relevant from the point of view of environmental protection or the drinking water function. Also from the registration point of view, details in the history of authorised use, which are not available in the Groundwater Atlas but may have an effect on the groundwater monitoring results, may be reason to use alternative settings for the evaluation period and/or the depth of the target layer.

	A	B	C	D	E	F	G
1	Report for registration						
2							
3	Substance	MCPA (CASNr 94-74-6)					
4	This substance has 1 metabolite(s)s						
5	Metabolite 1	4-chloro-2-methylfenol (CASNr 1570-64-5)					
6	This substance has no parents						
7							
8	Date of first authorization	1-12-1969					
9	Expiration date	1-6-2025					
10	Productgroup	Herbicide					
11	Selection of period						
12	Begin date	1-12-1969					
13	End date	29-12-2022					
14							
15	Depth of target layer (m-ss.)						
16	Top	10					
17	Bottom	15					
18							
19	Target layer	regional	water	both			
20		authorities	companies	groups			
21	Number of measurement values	5	2	7			
22	Number of measurement results	366	249	615			
23	Number of measurement values / results (%)	1.4	0.8	1.1			
24	Maximum measurement value (ug/L)	1.52	0.15	1.52			
25	P90 of measurement values (ug/L)	1.52	0.18	1.25			
26							
27	Layer above the target layer						
28	Number of measurement values/number of measurement results	11/2757 (0.4%)					
29							
30	Layer below the target layer						
31	Number of measurement values/number of measurement results	15/3703 (0.4%)					
32							
33	Land-use in sampling points from the regional authorities						
34							
35	Sampling points with land-use data	AGRI	URBA	NATU	SWAT		
36	Land-use for the sampling points with measurement values (%, n=2)	95	1	3	0		
37	Land-use for the sampling points with measurement results (%, n=126)	69	14	14	3		
38							
39	Agricultural land-use (AGRI) break down	PAST	MAIZ	ARCR	GRHO	ORCH	FBLB
40	Land-use for the sampling points with measurement values (%, n=2)	48	2	46	0	0	0
41	Land-use for the sampling points with measurement results (%, n=126)	37	7	21	1	2	2
42							
43	Land-use explanation:						
44	AGRI=agriculture						
45	URBA=non-agricultural land-use in urban area						
46	NATU=non-agricultural land-use and fallow in rural area						
47	SWAT=surface water						
48	PAST=pasture						
49	MAIZ=maize						
50	ARCR=arable crops						
51	GRHO=greenhouses						
52	ORCH=fruit orchard						
53	FBLB=flower bulbs						
54							
55	Groundwater Atlas for pesticides in The Netherlands, Version 3.2.2						

Figure 27 *Report for registration with a summary of measurement results in the period and the target layer as proposed for registration (period 1969-2022 and target layer between 2 and 50 m below soil surface, Example selection 4).*

References

Kruijne, R., A.M.A. van der Linden, J.A. te Roller and D. van Kraalingen, 2017a. Groundwater Atlas for pesticides in The Netherlands - User Manual. Wageningen Environmental Research/WENR (Alterra), Report 2786. June 2017.

Kruijne, R., A.M.A. van der Linden and H. van den Berg, 2017b. Grondwateratlas voor bestrijdingsmiddelen gepubliceerd. H2O-vakartikelen. September 2017. (*in Dutch*)

Kruijne, R., D. van Kraalingen, J. te Roller and A.M.A. van der Linden, 2018. Gegevens van waterbedrijven voor de Grondwateratlas; Technische rapportage, handleiding GWA Input Validator, Protocol updates. Wageningen Environmental Research, Rapport 2854. 60 blz. (*in Dutch*) http://edepot.wur.nl/459983

Kruijne, R., M. Montforts, G. Janssen, A. Poot, M. de Jonge, E. van den Berg and M. Meering, 2022. Proposal for the use of regular groundwater monitoring results for the authorisation of plant protection products in the Netherlands; Working Group Groundwater Atlas. Wageningen, Wageningen Environmental Research, Report 3217. 66 pp.; 13 fig.; 8 tab.; 19 ref.

Justification

WOt-technical report: 231
BAPS-project number: WOT-04-008-024

This technical document describes the features of the Groundwater Atlas version 2022 for pesticides in the Netherlands and the intended use in the registration procedure. The report was reviewed and approved by Héloïse Thouément, PhD, using the Groundwater Atlas version 2022 beta 4 and the WENR report 'Proposal for the use of regular groundwater monitoring results for the authorisation of plant protection products in the Netherlands' (to be submitted).

This project is part of the WOt theme 'Agromilieu' with theme leader Erwin van Boekel (WOt Natuur & Milieu). The project is funded by the Ministry of Agriculture, Nature and Food Quality (project number WOT-04-008-024) with contact person Eelco Riemens. The authors wish to thank everyone for their constructive contribution to this report.

Approved by External contact person

position: Sr. beleidsmedewerker gewasbescherming - Ministerie LNV

name: Eelco Riemens

date: 12-12-2022

Approved by Internal contact person

name: Erwin van Boekel

date: 12-12-2022

Annex 1 Glossary

Data regarding the substances in groundwater are referred to as **measurement results**. A measurement result is expressed as an upper limit value (<LOD, <LOQ, <LOR) or as a real concentration value.

A measurement result expressed as a real concentration is referred to as a **measurement value**.

A **monitoring network** consists of a group of permanent sampling sites. The monitoring network name refers to a company, a regional authority (province), or a national network.

A **sampling site** is a permanent location which belongs to at least one monitoring network. A sampling site can be either a physical well or a spring. The geographic location of a sampling site is defined by a coordinate pair.

A **physical well** consists of one or more screens.

A **screen** is part of a physical well. The screen has a number according to the construction of the physical well, and an upper depth and a lower depth (m below soil surface).

A **spring** is a location where groundwater emerges at surface level. By definition, a spring has no screen.

A **sampling point** refers to a combination of sampling site (physical well) and screen number or to a spring.

There are four categories of **substances:** Active substance, Metabolite, Other, and Both. The category Other is used for a few substances only, e.g. a contamination or a non-active isomer. The category Both is used for a few substances which have (or have had) a registration as an active substance and which are also known as a metabolite. For substances from the category Metabolite, Other, Both, the relation with the active substance(s) is available in the list of substances.

The **area of influence** of a sampling point is the surface area connected with the groundwater at the sampling point via downward soil moisture flow in the unsaturated zone (through the root zone towards the groundwater table) and groundwater flow in the saturated zone.

Annex 2 Installation details

Grondwateratlas, versie 3.0

Disclaimer (NL)
De Grondwateratlas voor bestrijdingsmiddelen is ontwikkeld door Wageningen Environmental Research (WEnR) en het Rijksinstituut voor Volksgezondheid en Milieu (RIVM), in opdracht van het Ministerie van Landbouw, Natuur en Voedselkwaliteit (LNV) en de Vereniging van Waterbedrijven in Nederland (Vewin). Inzet van het RIVM is gefinancierd door het Ministerie van Infrastructuur en Waterstaat (IenW).

De Grondwateratlas voor bestrijdingsmiddelen ontsluit gegevens die door een grote meetinspanning van waterbedrijven en provincies (de bronhouders) tot stand zijn gekomen. Het primaire doel van de atlas is selectie van relevante gegevens voor gebruik in de toelatingsbeoordeling van gewasbeschermingsmiddelen en biociden. Resultaten en figuren van de selecties mogen vrij worden gedownload en gebruikt, onder voorwaarde dat de bron wordt vermeld op de hierna volgende wijze: "Grondwateratlas voor bestrijdingsmiddelen", en het versienummer.

De gegevens in de Grondwateratlas zijn onder grote zorgvuldigheid tot stand gekomen en door de bronhouders overgedragen aan de ontwikkelaars. Opdrachtgevers, bronhouders en ontwikkelaars van de Grondwateratlas zijn niet aansprakelijk voor de juistheid, noch voor de gevolgen van het gebruik van deze gegevens. Toekomstige, reguliere updates van de Grondwateratlas bieden gelegenheid tot het opnemen van aanvullende gegevens en tot eventuele correctie van bestaande gegevens.

10-oktober-2022

Disclaimer (EN)
The Groundwater Atlas for pesticides has been developed by Wageningen Environmental Research and the National Institute for Health and the Environment (RIVM), on behalf of the Dutch Ministry of Ministry of Agriculture, Nature and Food Quality and the Association of Drinking Water Companies in the Netherlands (Vewin). The contribution of RIVM was funded by the Ministry of Infrastructure and Water Management.

The Groundwater Atlas for pesticides contains monitoring data that were produced through efforts of the Dutch drinking water companies and the provinces of the Netherlands (the owners). The primary objective of the Groundwater Atlas for pesticides is selection of relevant data for use in the registration of plant protection products and biocides. Results and figures of the selections may be downloaded and used freely, provided that the source is indicated in the following manner: "Groundwater Atlas for pesticides", followed by the version number.

The data in the Groundwater Atlas for pesticides were collected and transferred from the owners to the developers with great care. The Dutch Ministry of LNV, Vewin, the owners, and the developers of the Groundwater Atlas are not liable for the correctness, nor for the consequences of using these data. Future, regular updates of the Groundwater Atlas will provide the opportunity to incorporate additional information, and the possibility to correct existing data, if required.

October 10, 2022

Help
Als u problemen ondervindt tijdens de installatie of bij het gebruik van de Grondwateratlas kunt u een mail sturen naar: daniel.vankraalingen@wur.nl

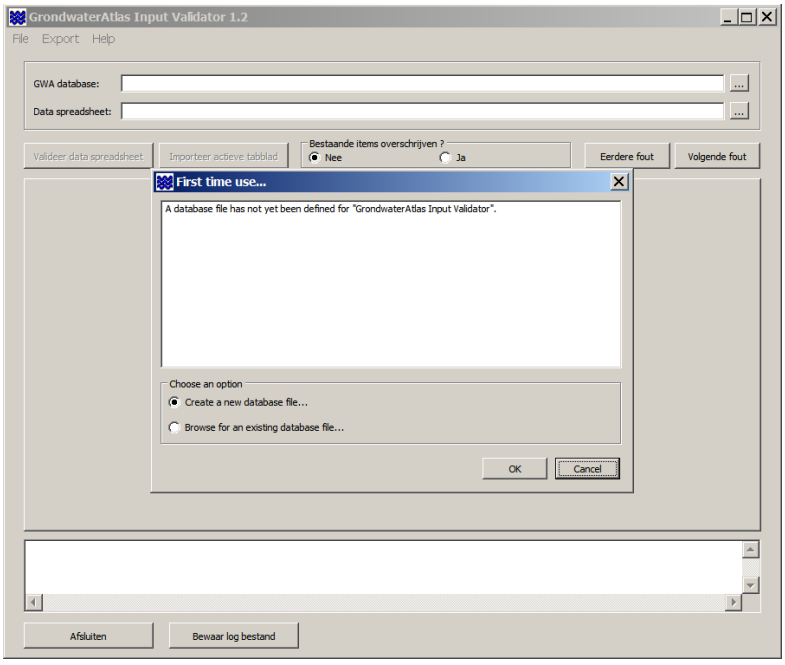
Installatie
De door Wageningen Environmental Sciences beschikbaar gestelde Grondwater Atlas is een Windows desktop applicatie die geschikt is voor installatie op een PC en voor installatie in een netwerkomgeving.

Gewone installatie op PC's waar gebruikers installatie rechten hebben
Installatie loopt eigenlijk zoals dat normaal is voor Windows applicaties. De gebruiker wordt aangeraden te kiezen tijdens installatie voor een desktop icon. Uit snelheidsoverwegingen wordt aanbevolen dat gebruikers de database op een lokale schijf plaatsen. Indien de werkomgeving geen lokale schijf kent, kan voor een personal netwerk share gekozen worden.

Installatie door netwerkbeheerders
De Grondwateratlas kan ook door netwerkbeheerders op een netwerk share gezet worden waar gebruikers toegang toe hebben. De software is zodanig gebouwd dat er eigenlijk geen installatie voor gebruikers nodig is. De enige vereiste is dat gebruikers toegang tot die netwerkshare hebben

Onderneem de volgende stappen:
Start de installer en geef aan op welke netwerkshare de software geplaatst moet worden,
Kies tijdens de installatie voor geen desktop icon,
Beëindig de installatie,
Informeer gebruikers over het netwerk pad naar de desktop applicatie (die heet GrondwaterAtlas.exe) en over het netwerk pad naar de database (die heet GrondwaterAtlas_3.2.2.fdb).

De eerste keer starten zal een gebruiker deze dialoog krijgen:



De gebruiker kiest voor "Browse to an existing database file..." en navigeert vervolgens naar de database lokatie op het netwerk. Deze lokatie wordt onthouden in de registry van de gebruiker, dus deze actie is eenmalig.

N.B. omdat hier feitelijk geen sprake is van een echte installatie hebben gebruikers dus ook geen desktop shortcut o.i.d. op hun machine. Indien gewenst door kunt u gebruikers binnen uw organisatie wellicht helpen met het maken van een desktop shortcut of Start shortcut.

Contacteer voor technische ondersteuning: Daniel van Kraalingen, Wageningen Environmental Research, e-mail adres: daniel.vankraalingen@wur.nl

Hard- en software eisen

De Grondwateratlas versie 3.0 is getest op de volgende combinaties (64 bits): Windows 10-EN, en 10-NL. Deze applicatie stelt geen bijzondere eisen aan hard- of software anders dan een goed werkende 64 bits Windows 10 omgeving en minstens 400MB aan vrije opslagruimte.

Annex 3 Export function

Field names in the Groundwater Atlas export files. These data objects and attributes are explained in Kruijne et al., 2017, Annex 5.

Option 1	Option 2	Option 3
SamplingSiteCode	SamplingSiteCode	SamplingSiteCode
CodeTNO	CodeTNO	CodeTNO
SamplingSiteGroup	SamplingSiteGroup	SamplingSiteGroup
TypeOfSamplingSite	TypeOfSamplingSite	TypeOfSamplingSite
InstallationYear	InstallationYear	InstallationYear
InstallationDate	InstallationDate	InstallationDate
SamplingSiteOwnerCode	SamplingSiteOwnerCode	SamplingSiteOwnerCode
X_Coordinate	X_Coordinate	X_Coordinate
Y_Coordinate	Y_Coordinate	Y_Coordinate
QualityLabelSamplingSite	QualityLabelSamplingSite	QualityLabelSamplingSite
ScreenNr	ScreenNr	ScreenNr
ScreenDepthUpper[m]	ScreenDepthUpper[m]	ScreenDepthUpper[m]
ScreenDepthLower[m]	ScreenDepthLower[m]	ScreenDepthLower[m]
QualityLabelScreen	QualityLabelScreen	QualityLabelScreen
NameMonitoringNetwork	CodeSamplingNetwork	NameMonitoringNetwork
DB version	SampleCode	SampleCode
	SampleDate	SampleDate
	SampleYear	SampleYear
	NameMonitoringCampaign	NameMonitoringCampaign
	LabCode	LabCode
	DB version	ConcentrationCode
		Concentration (µg/L)
		SubstanceName
		CasNr
		ProductGroupCode
		DB version

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ISSN 2352-2739

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