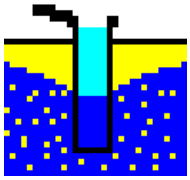

GGU-PUMPTEST manual

Pumping test evaluation

Exported on 6.11.2026

Technische Umsetzung, Layout und Vertrieb:
Civilserve GmbH, Steinfeld

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Theorie. Und Praxis.

Geotechnische Softwarelösungen können so einfach sein. Denn Theorie und Praxis lassen sich mit **GGU-Software** und den neuen Angeboten der **civilserve Academy** prima kombinieren: Knackige theoretische Aufgaben lösen und als Sahnehäubchen Ihr

Know-how durch Praxisseminare vertiefen!

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1 GGU-PUMPTEST: Preface

The **GGU-PUMPTEST** program allows the evaluation of pumping tests using the following methods:

- time-drawdown method;
- distance-drawdown method;
- distance-time-drawdown method;
- Theis recovery method;
- Theis type curve method.

Besides the evaluation of pumping tests, the program allows pumping test planning ("**Test planning**" menu). Here, you can simulate a pumping test using estimated values for permeability, etc. It is then possible, based on the simulation results, to estimate the measurement precision required and the time required for the pumping test.

In addition, in the "**Info/Simple analyses**" menu item, the program offers two equations for confined and unconfined groundwater, which allow you to perform a quick, approximate determination of the permeability.

The program includes convenient data input. The system is permanently displayed on the screen. Every change to the data is displayed on the screen, so that optimum control of the input data is guaranteed.

There are "**?**" and "**Info**'" buttons in the dialog boxes for many technical and program-specific questions. Click on the "**?**" buttons or "**Info**" buttons to obtain the necessary information.

The graphic output supports the true type fonts provided by WINDOWS, so that an excellent layout is guaranteed. Colour output and numerous graphic formats (BMP, TIF, JPG etc.) are supported. PDF and DXF files can also be imported via the integrated **Mini-CAD** system (see "**Mini-CAD**" manual).

The program has been extensively tested. No errors have been found. Nevertheless, liability for completeness and correctness of the program and the manual, and for any damage resulting from incompleteness or incorrectness, cannot be accepted.

2 GGU-PUMPTEST: Licence protection

To protect the GGU software from unauthorised access, each GGU program is equipped with the ***CodeMeter software protection system*** from WIBU-Systems. Each GGU program is bound to a so-called ***CmContainer*** via a licence with the corresponding product code.

To be able to use the GGU licences in a CmContainer, a runtime environment, the ***CodeMeter Runtime Kit***, must be installed on your computer via driver software. You can obtain the current version from Software for Users - Wibu-Systems (CodeMeter User Runtime for Windows).

You can work with the following CmContainer types on your PC with the CodeMeter Runtime Kit installed (= ***CodeMeter licence server***):

- **CmStick**
  The licence for your GGU program is stored in a USB dongle.
- **CmActLicense** (soft licence, not for virtual PC/servers)
  The licence for your GGU program is stored in a licence file that is linked to the hardware of a computer.
- **CmCloudContainer**
  The licence is located on a CmCloud server of WIBU-Systems and is mirrored to your CodeMeter licence server. The advantages of this type of licence binding are described on the following website: Licence binding | GGU Software.

The GGU programs check at start-up and during runtime whether a corresponding license is available in a CmContainer.

3 GGU-PUMPTEST: Language selection

The GGU programs can be used in German and English. The program always starts with the language in which it was terminated.

The language preferences can be changed at any time in the "**Info**" menu, using the menu item "**Spracheinstellung**" (for German) or "**Language preferences**" (for English).

4 GGU-PUMPTEST: Starting the program

After starting the program, you will see two menus at the top of the window**:**

- File
- Info

By going to the "**File**" menu, a previously saved file can be loaded by means of the "**Load**" menu item, or a new one created using "**New**". When you click "**New**", you must first select the required method in a dialog box. An empty form is then displayed on the screen. Seven menus are visible in the menu bar:

- File
- Edit
- Evaluation
- Test planning
- Graphics preferences
- Output preferences
- Info

After clicking one of these menus, the so-called menu items roll down, allowing you access to all program functions.

The program works on the principle of ***What you see is what you get***. This means that the screen presentation represents, overall, what you will see on your printer. In the last consequence, this would mean that the screen presentation would have to be refreshed after every alteration you make. For reasons of efficiency and as this can take several seconds for complex screen contents, the screen is not refreshed after every alteration.

If you would like to refresh the screen contents, press either [**F2**] or [**Esc**]. The [**Esc**] key also resets the screen display to your current image zoom, which is usually preset to 1.0, which corresponds to an A3 or A4 sheet in most GGU programs (see menu item "**Graphics preferences/Refresh and zoom**").

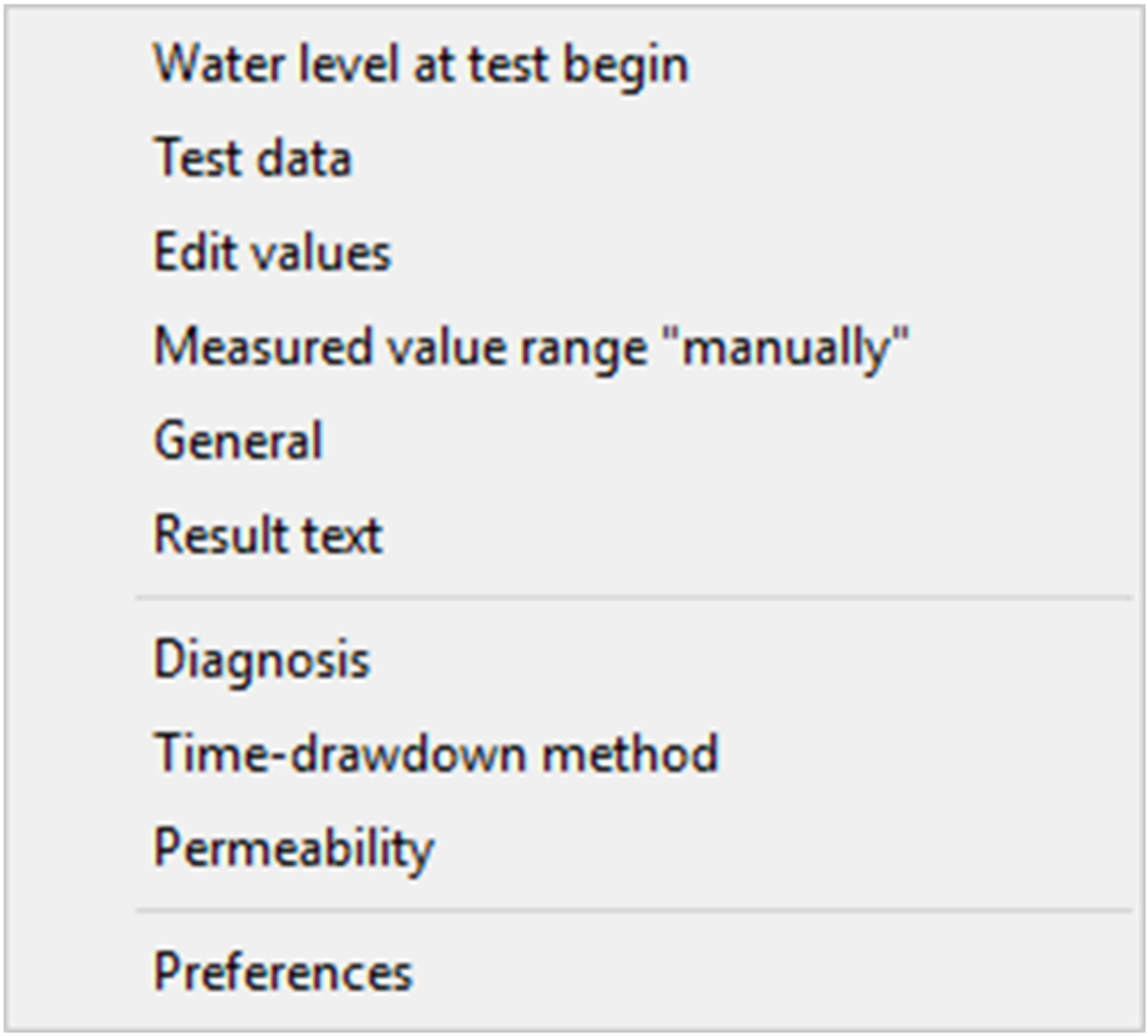
5 Tips and tricks

5.1 GGU-PUMPTEST: Keyboard and mouse

You can scroll the screen with the keyboard using the cursor keys and the [**Page up**] and [**Page down**] keys. By clicking and pulling with the mouse, with [**Ctrl**] pressed, you activate the zoom function, i.e. the selected section will fill the screen. Furthermore you can use the mouse wheel to zoom in/out or scrolling the screen presentation. The following mouse wheel functions are available:

- Mouse wheel up = move screen image up
- Mouse wheel down = move screen image down
- [**Ctrl**] + mouse wheel up = enlarge screen image (zoom in)
- [**Ctrl**] + mouse wheel down = shrink screen image (zoom out)
- [**Shift**] + mouse wheel up = move screen image right
- [**Shift**] + mouse wheel down = move screen image left

If you click the right mouse button anywhere on the screen a context menu containing the principal menu items opens.



By double-clicking the left mouse button on legends or **Mini-CAD** objects, the editor for the selected object immediately opens, allowing it to be edited. By double-clicking output sheet elements while holding the [**Shift**] key, the preferences for the position, size and appearance of the element open for editing in the editor.

5.2 GGU-PUMPTEST: Function keys

Some of the function keys are assigned program functions. The allocations are noted after the corresponding menu items. The individual function key allocations are:

- [**Esc**] refreshes the screen content and resets the screen section to your current image zoom, which is preset to 1.0. This is useful, for example, if you have used the magnifying glass function to display sections of the drawing on the screen and want to quickly return to the overall view.
- [**F1**] opens the manual file.
- [**F2**] refreshes the screen without altering the current magnification.

- [**F11**] activates the menu item "**Move objects**", which appears in the GGU programs under various menu titles, e.g. "**Page size + margins**", "**Graphics preferences**" or "**Output preferences**".

In this GGU program, the following function keys are also assigned to program functions:

- [**F3**] opens the menu item "**Evaluation/**".
- [**F5**] opens the menu item "**Evaluation/Hand fit**".
- [**F7**] opens the menu item "**Edit/Value range "manually**"".
- [**F8**] opens the menu item "**Edit/All**".
- [**F9**] opens the menu item "**Edit/Fit in**".
- [**F12**] opens the menu item "**Evaluation/Permeability**".

5.3 GGU-PUMPTEST: "Copy/print area" icon

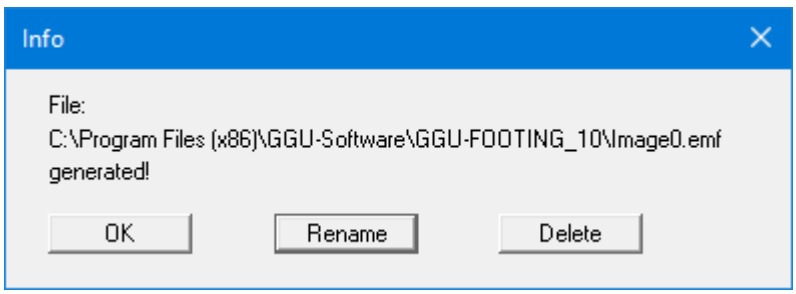
A dialog box opens when the "**Copy/print area**" icon

in the menu toolbar is clicked, describing the options available for this function. For example, using this icon it is possible to either copy areas of the screen graphics and paste them into the report, or send them directly to a printer.

In the dialog box, first select where the copied area should be transferred to: "**Clipboard**", "**File**" or "**Printer**". The cursor is displayed as a cross after leaving the dialog box and, keeping the left mouse button pressed, the required area may be enclosed. If the marked area does not suit your requirements, abort the subsequent boxes and restart the function by clicking the icon again.

If "**Clipboard**" was selected, move to the MS Word document (for example) after marking the area and paste the copied graphics using "*Edit/Paste*".

If "**File**" was selected, , the following dialog box appears after defining the area, shown here as an example for the **GGU-FOOTING** program:



The default location of the file is the folder from which the program is started (here: GGU-FOOTING_10) and, if several files are created, the file is given the file name "**Image0.emf**" with sequential numbering. If the
"**Rename**" button in the dialog box is clicked, a file selector box opens, and the copied area can be saved under a different name in a user-defined folder. Saving can be aborted by pressing the "**Delete**" button.

If the "**Printer**" button was pressed in the first dialog box, a dialog box for defining the printer settings opens after marking the area. Following this, a dialog box for defining the image output settings opens. After confirming the settings, the defined area is output to the selected printer.

6 Theoretical principles and examples

6.1 GGU-PUMPTEST: Overview

6.1.1 Overview

The program is based on the theoretical principals described in:

- **Langguth/Voigt**
  Hydrogeologische Methoden (Hydrogeological Methods)
  Springer-Verlag
  ISBN 3-540-10174-8
  ISBN 0-387-10174-8

You can also acquaint yourself very quickly with the data input methods without reading the user-manual by going directly to the "**File/New**" menu.

Then select the evaluation method of your choice. After this, go to the "T**est planning**" menu. Enter the required values according to the selected evaluation method. The program will then simulate a pumping test and you can subsequently view the simulated values in the corresponding menu items.

The individual methods will now be explained in more detail. In addition, an example will be described in each case. All examples are provided as files with the program and can be loaded and viewed.

You must enter a drawdown for all evaluation methods. These drawdown values are so-called depth-to-(ground)water values: That is, the values must be entered as positive downwards (measured from the at-rest water level).

6.2 GGU-PUMPTEST: Time-drawdown method

The theoretical principles are described in **Langguth/Voigt** on pages 165 to 167. The example file "**Time-drawdown method Gauge 3b.pvs**" can be found in the program's example folder.

This method entails a drawdown in a well with a constant pumping rate. At the same time, the course of the drawdown is measured in a nearby monitoring well.

The graphical representation of the test results is in a semi-logarithmic scale (drawdown against time). The following data is required:

- distance between the extraction well and the monitoring well;
- the constant pumping rate in the extraction well;
- the aquifer thickness H;
- the specification of confined or unconfined aquifer;
- the drawdown h against time in the monitoring well.

After defining the input values they are entered against time and the best-fit curve determined. The permeability can then be determined.

Example:

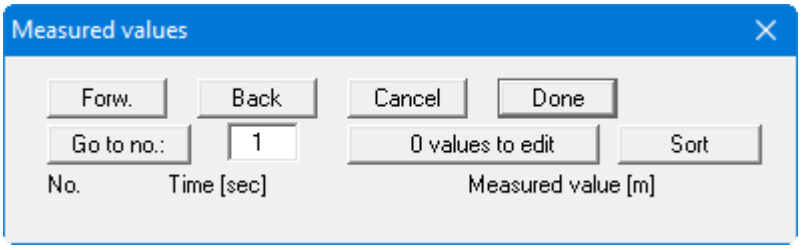
This is the example given for Gauge 3b in **Langguth/Voigt**. The following values were measured in Gauge 3b:

Table 1 Gauge 3b measured data

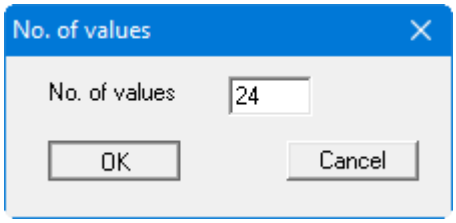
Time [s]	h [m]	Time [s]	h [m]
12.0	0.050	861.0	1.000
18.0	0.100	1080.0	1.050
22.0	0.150	1420.0	1.110
36.0	0.250	1800.0	1.150
54.0	0.350	2160.0	1.200
81.0	0.450	2760.0	1.250
122.0	0.550	3480.0	1.300
226.0	0.700	4380.0	1.350
346.0	0.800	5280.0	1.390
434.0	0.850	8100.0	1.480
549.0	0.900	11600.0	1.550
689.0	0.950	14150.0	1.580

The pumping rate in the extraction well is 0.02667 m³/s. Gauge 3b is 23.0 m from the extraction well. The aquifer is 10.0 m thick. It is a confined aquifer.

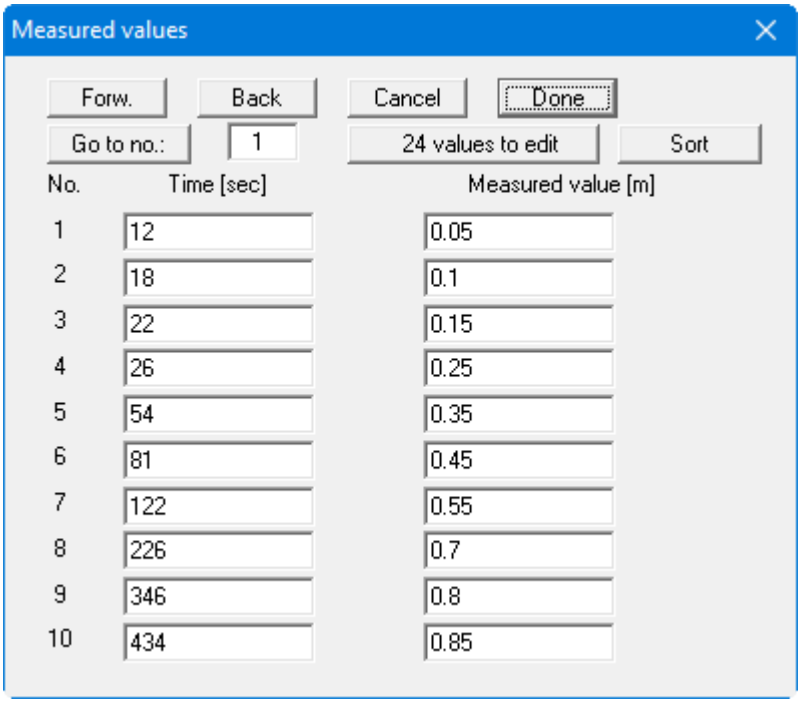
In the menu item "**File/New**", press the "Distance-drawdown method" button and then go to the menu item "**Edit/Edit values**".



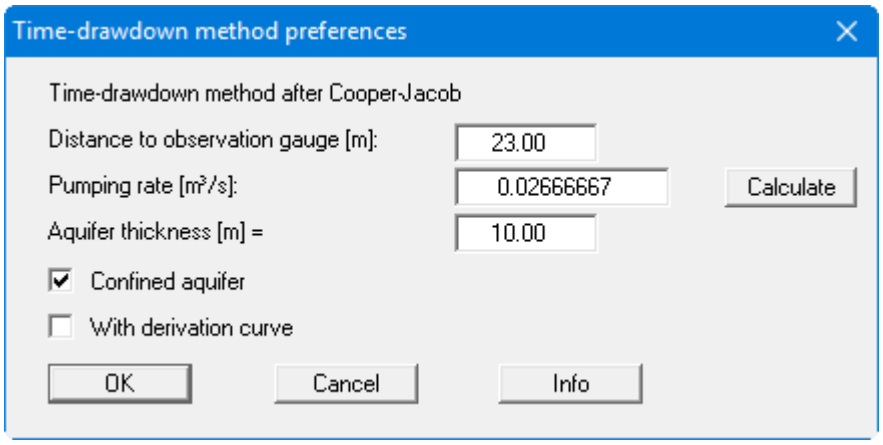
After selecting the "**0 values to edit**" button enter "**24**" as new number, because the test comprises 24 measured values.



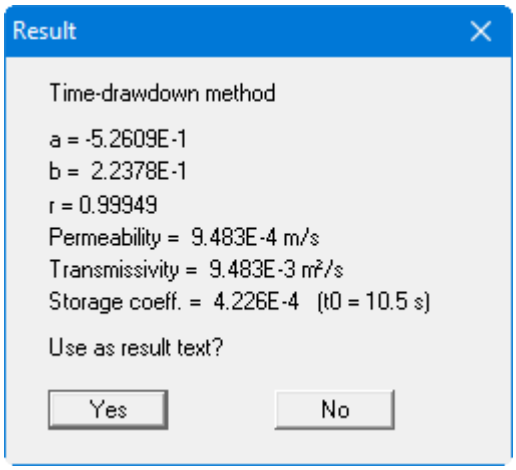
Enter the values given in Table 1.



These values represent the times and corresponding drawdown in the monitoring well relative to the at-rest groundwater level. Navigate through the table using the "**Forw**." button in order to enter further values. After leaving the input box clicking on "**Done**" go to the "**Evaluation/Time-drawdown method**" menu item.



Enter the values in the dialog box and confirm with "**OK**". The following result box will be shown.



The "**a**" and "**b**" values describe the course of the best-fit curve through the data. The "**r**" value is the correlation coefficient, representing the quality of the best-fit curve. Below this, the permeability, the transmissivity and the storage coefficient are given. The t0 value describes the intersection of the best-fit curve with the time axis.

The solution given in **Langguth/Voigt** is:

- T = 9.4 · 10-3m²/s;
- S = 4.6 · 10-4m²/s.

The minor differences are due to the purely visual evaluation employed by **Langguth/Voigt**.

If you adopt the result text, it is entered into the "**Result text**" box in the form.

6.3 GGU-PUMPTEST: Distance-drawdown method

The theoretical principles are described in **Langguth/Voigt** on pages 167 to 169. The example file "**Distance-drawdown method.pvs**" can be found in the program's example folder.

This method entails a drawdown in a well with a constant pumping rate. At the same time, the drawdown at a given time is measured in at least two nearby monitoring wells.

The graphical representation of the test results is in a semi-logarithmic scale (drawdown against distance). The following data is required:

- the distances between the extraction well and the monitoring wells (>= 2);
- the drawdown h in the monitoring wells at a given time;
- the constant pumping rate in the extraction well;
- the aquifer thickness H;
- the specification of confined or unconfined aquifer.

After defining the input values they are entered against the distances to the extraction wells and the best-fit curve determined. The permeability can then be ascertained.

Example:

This is the example for Gauges 3b, 11b and 6b in **Langguth/Voigt**.

The pumping rate in the extraction well is 0.02667 m³/s. In table 2 the distances of the three gauges to the extraction well and the drawdown at time t = 5400 seconds are given.

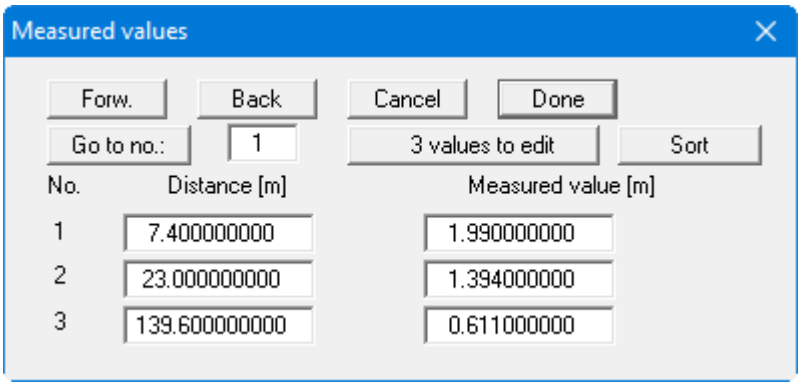
Table 2 Gauges 3b, 6b and 11b measured data

Gauge	Distance [m]	Drawdown h [m]
11b	7.40	1.990
3b	23.00	1.394
6b	139.60	0.611

The aquifer is 10.0 m thick. It is a confined aquifer.

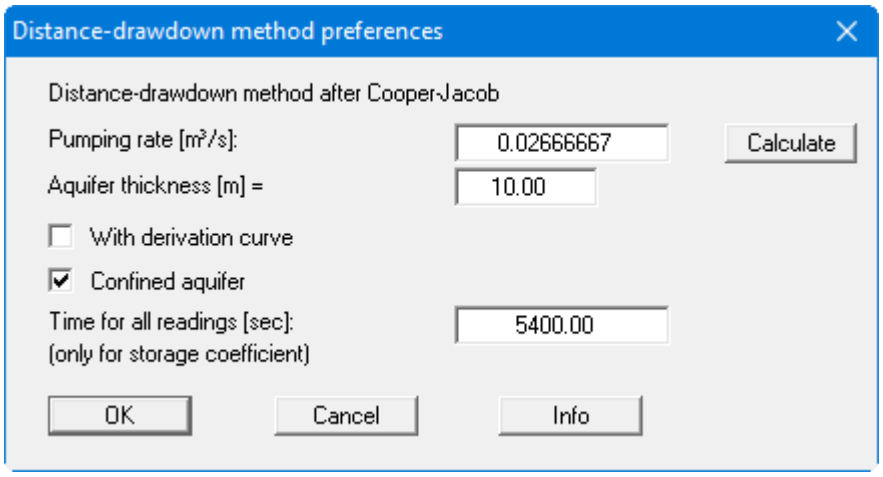
In the menu item "**File/New**", press the "**Distance-drawdown method**" button and then go to the menu item "**Edit/Edit values**".

Select the "**0 values to edit**" button and enter "**3**", because the test comprises measured values from 3 wells. Enter the values given in Table 2.

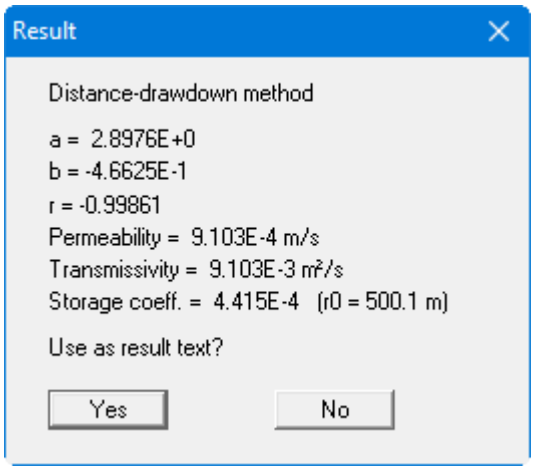


These values represent the distances of the monitoring wells to the extraction well and the corresponding drawdown relative to the at-rest groundwater level.

Go to the "**Evaluation/Distance-drawdown method**" menu item.



Enter the values in the dialog box and confirm with "**OK**". The following result box will be shown.



The "**a**" and "**b**" values describe the course of the best-fit curve through the data. The "**r**" value is the correlation coefficient, representing the quality of the best-fit curve. Below this, the permeability, the transmissivity and the storage coefficient are given. The r0 value describes the intersection of the best-fit curve with the distance axis.

The solution given in **Langguth/Voigt** is:

- T = 9.0 · 10-3m²/s
- S = 4.8 · 10-4m²/s.

The minor differences are due to the purely visual evaluation employed by **Langguth/Voigt**.

If you adopt the result text, it is entered into the "**Result text**" box in the form .

6.4 GGU-PUMPTEST: Distance-time-drawdown method

The theoretical principles are described in **Langguth/Voigt** on pages 169 to 171. The example file "**Distance-time-drawdown method.pvs**" can be found in the program's example folder.

This method entails a drawdown in an extraction well with a constant pumping rate. At the same time, the course of the drawdown in this well is measured in at least two nearby monitoring wells.

The graphical representation of the test results is in a semi-logarithmic scale (drawdown against "Time/square of distance [t/r²]"). The following data is required:

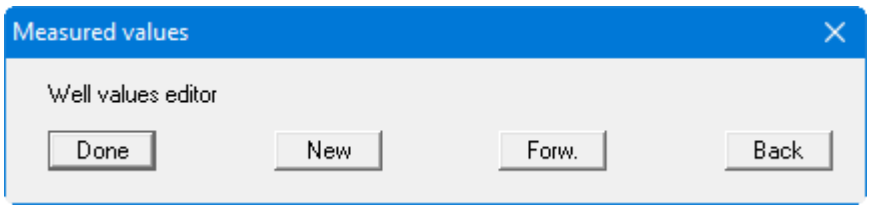
- distances (r) between the extraction well and the monitoring wells;
- the constant pumping rate in the extraction well;
- the aquifer thickness H;
- the specification of confined or unconfined aquifer;
- the drawdown h against time in the monitoring wells.

After defining the input values they are entered against t/r² (t = time, r = distance to monitoring well) and the best-fit curve determined.

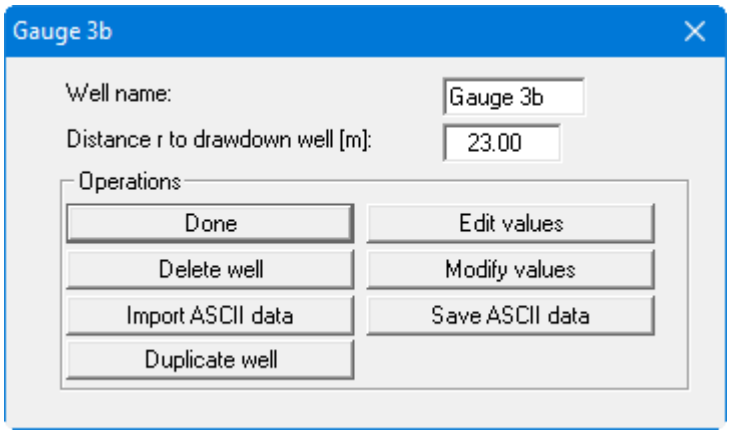
Example:

This is the example for Gauges 3b, 11b and 6b in **Langguth/Voigt**. The principal boundary conditions correspond to those of the previous two examples.

In the menu item "**File/New**", press the "**Distance-time-drawdown method**" button and then go to the menu item "**Edit/Edit values**".

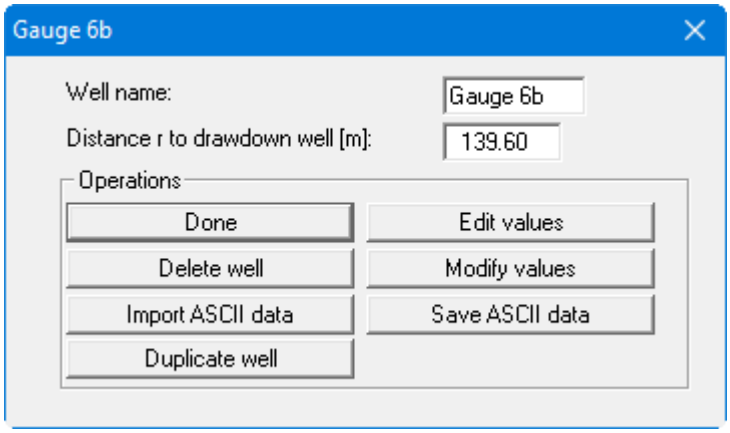


Using this method, you will see a dialog box in which you must first open the input box for the first individual test by clicking the "**New**" button. Enter the well name and the distance to the extraction well. Using the "**Edit values**" button, change the number of values to "**24**" and enter the measured data from Table 1.



Repeat this procedure for the other two gauges, "**6b**" and "**11b**".

Gauge 6 b:



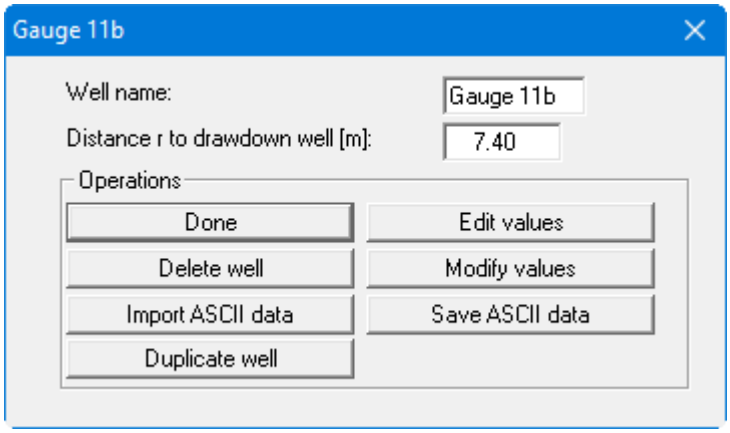
Using the "**Edit values**" button, change the number of values to "**14**" and enter the measured data from the following Table 3

Table 3 Gauge 6b measured data

Zeit [s]	h [m]
240.0	0.140
360.0	0.200
600.0	0.250

780.0	0.290
1140.0	0.350
1500.0	0.400
2040.0	0.450
2760.0	0.500
3900.0	0.550
4800.0	0.590
6450.0	0.650
8650.0	0.710
11450.0	0.760
13900.0	0.800

Gauge 11 b:



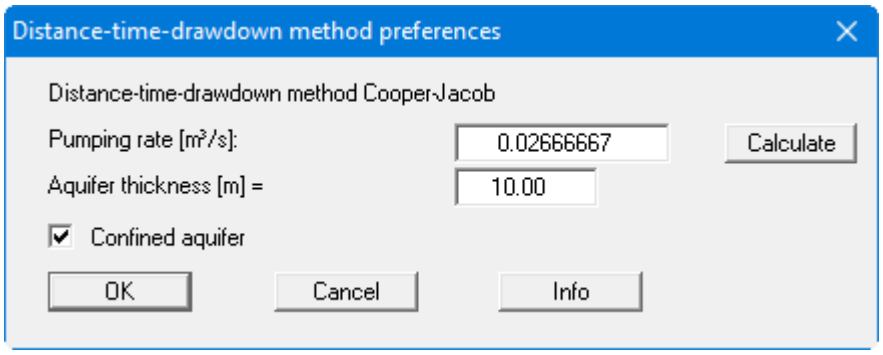
Using the "**Edit values**" button, change the number of values to "**21**" and enter the measured data from the following Table 4

Table 4 Gauge 11b measured data

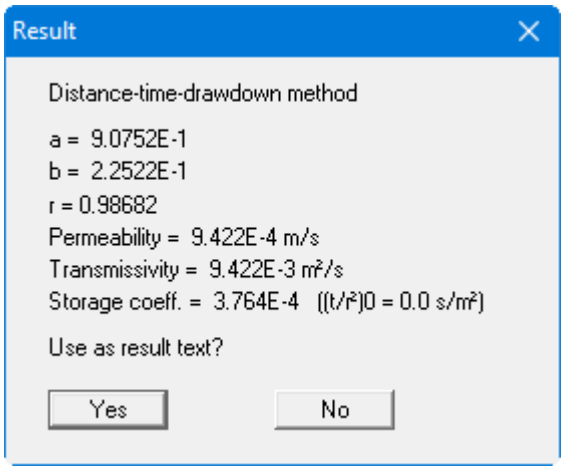
Time [s]	h [m]
17.0	0.300
21.0	0.400
27.0	0.500
35.0	0.700
53.0	0.930
85.0	1.030
168.0	1.200
220.0	1.280
281.0	1.350
330.0	1.400
450.0	1.470
540.0	1.500
720.0	1.560
1080.0	1.640
1440.0	1.710
2100.0	1.790
3000.0	1.860
3900.0	1.900
5400.0	1.990

8300.0	2.070
14600.0	2.180

Go to the "**Evaluation/Distance-time-drawdown method**" menu item.



Enter the values in the dialog box and confirm with "**OK**".



The "**a**" and "**b**" values describe the course of the best-fit curve through the data. The "**r**" value is the correlation coefficient, representing the quality of the best-fit curve. Below this, the permeability, the transmissivity and the storage coefficient are given. The (t/r²)0 value describes the intersection of the best-fit curve with the distance axis.

The solution given in **Langguth/Voigt** is:

- T = 8.9 · 10-3m²/s
- S = 4.6 · 10-4m²/s.

The minor differences are due to the purely visual evaluation employed by **Langguth/Voigt**.

If you adopt the result text, it is entered into the "**Result text**" box in the form .

6.5 GGU-PUMPTEST: Theis recovery method

The theoretical principles are described in **Langguth/Voigt** on pages 171 to 175. The example file "**Theis recovery.pvs**" can be found in the program's example folder.

This method entails a drawdown in a well with a constant pumping rate. Recovery begins after switching off the pump in the extraction well. The recovery course is measured in a nearby monitoring well.

The following data is required for this method:

- the pumping duration until the pump is switched off;
- the constant pumping rate until the pump is switched off;
- the aquifer thickness H;
- the specification of confined or unconfined aquifer;
- the course against time of the recovery h.

After defining the input values they are entered against

(dt + tp)/dt

dt = time difference until 1st measurement
tp = pumping duration

and the best-fit curve for this function determined; from this, the permeability can be calculated.

Example:

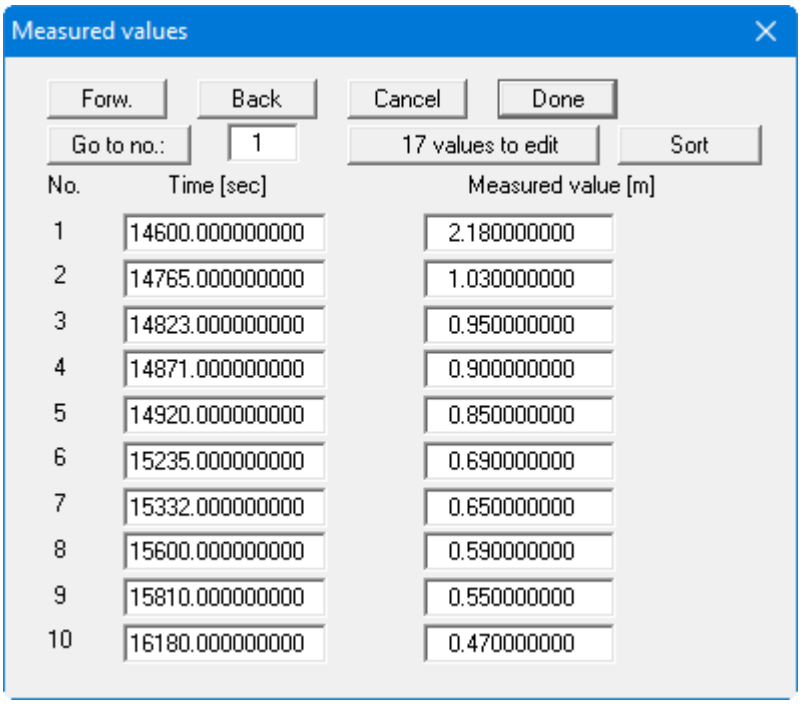
This is the example for Gauge 11b in **Langguth/Voigt**. After switching off the pump the following recovery is measured in Gauge 11b:

Table 5 Recovery values in Gauge 11b

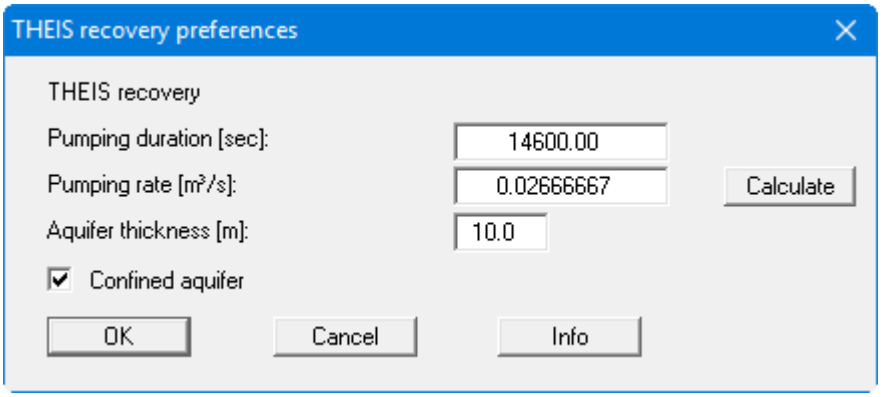
Time [s]	h [m]
14600.0	2.180
14765.0	1.030
14823.0	0.950
14871.0	0.900

14920.0	0.850
15235.0	0.690
15332.0	0.650
15600.0	0.590
15810.0	0.550
16180.0	0.470
16400.0	0.440
17300.0	0.350
17900.0	0.300
18560.0	0.260
19220.0	0.230
20700.0	0.170
23000.0	0.090

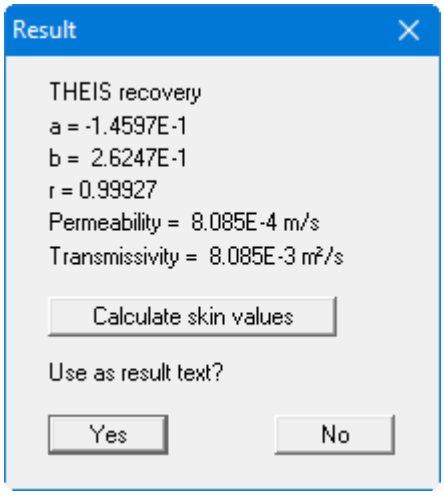
In the menu item "**File/New**", press the "**Theis recovery**" button and then go to the menu item "**Edit/Edit values**". Change the number of values to "**17**" and enter the measured data from the above Table 5.



Navigate through the table using the "**Forw**." button in order to enter further values. Go to the "**Evaluation/Theis recovery**" menu item.



Enter the values in the dialog box and confirm with "**OK**".



The "**a**" and "**b**" values describe the course of the best-fit curve through the data. The "**r**" value is the correlation coefficient, representing the quality of the best-fit curve. Below this, the permeability and the transmissivity are given.

The solution given in **Langguth/Voigt** is:

- T = 8.4 · 10-3m²/s

The minor differences are due to the purely visual evaluation employed by **Langguth/Voigt**.

If you adopt the result text, it is entered into the "**Result text**" box in the form.

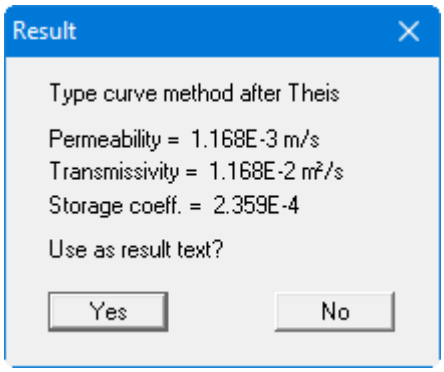
6.6 Theis type curve method

6.6.1 GGU-PUMPTEST: Evaluation using "Hand fit"

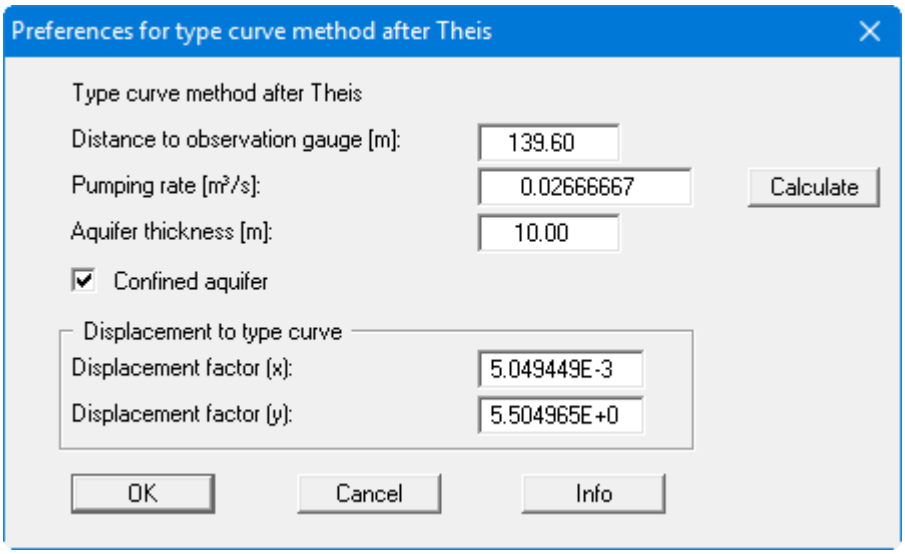
Go to the "**Evaluation/Hand fit**" menu item to select the manually method.

Then click on the curve within the graphic with the left mouse button and hold the button pressed. Now displace the curve until the measured curve and the type curve are congruent.

Now go to the "**Evaluation/Permeability**" menu item.



To check, you can select the menu item "**Evaluation/Theis type curve**" again.

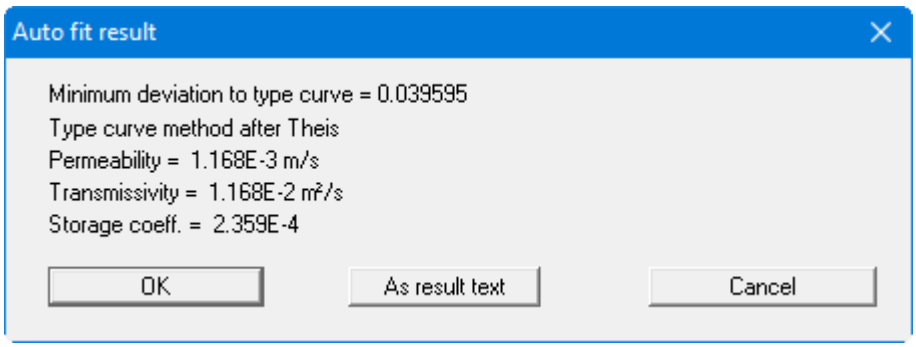


Because of the displacement of the curve, the displacement factors required for determination of permeability have now been determined.

6.6.2 GGU-PUMPTEST: Evaluation using "Auto fit"

Go to the "**Evaluation/Auto fit**" menu item to select the automatic method.

The program only requires a short time to determine the displacement factors.



The solution given in **Langguth/Voigt** is:

- T = 1.1 · 10-3m²/s
- S = 2.4 · 10-4m²/s.

The minor differences are due to the purely visual evaluation employed by **Langguth/Voigt**.

If you adopt the result text, it is entered into the "**Result text**" box in the form.

7 File menu

7.1 GGU-PUMPTEST: "New" menu item

You can evaluate a new pumping test using this menu item.

7.2 GGU-PUMPTEST: "Load" menu item

You can load a file with system data, which was created and saved at a previous sitting, and then edit the system.

7.3 GGU-PUMPTEST: "Save" menu item

You can save data entered or edited during program use to a file, to have them available later, or to archive them. The data is saved without prompting with the name of the current file. The file contains all system information. Loading again later creates the same visualisation as was present at the time of saving.

7.4 GGU-PUMPTEST: "Save as" menu item

You can save data entered during program use to an existing file or to a new file, i.e. using a new file name. For reasons of clarity, it makes sense to use "**.kwr**" as file suffix, as this is the suffix used in the file requester box for the "**File/Load**" menu items. If you choose not to enter an extension when saving, "**.kwr**" will be used automatically.

7.5 GGU-PUMPTEST: "Read datalogger" menu item

W.A.S. (Braunschweig) datalogger files can be imported directly (MDSII).

7.6 GGU-PUMPTEST: "Read ASCII" menu item

ASCII data can be imported using this menu item. Once you have selected the required file you will see the following dialog box, for example:

You move through the file using the arrows adjacent to the currently displayed row of text. Define the column delimiter and assign the required data to the column numbers. For a quick overview, click the "**Read first valid row**" button. If all the information is correct, the result for the row is shown in the box below the column. Otherwise, "**Error**" appears. If necessary, change the column delimiter. If the file contains invalid as well as valid rows, these will simply be skipped during the subsequent import. Finally, press the "**Import data**" button. The test can then be further processed or evaluated.

7.7 GGU-PUMPTEST: "Save ASCII" menu item

Values can be saved as ASCII data using this menu item.

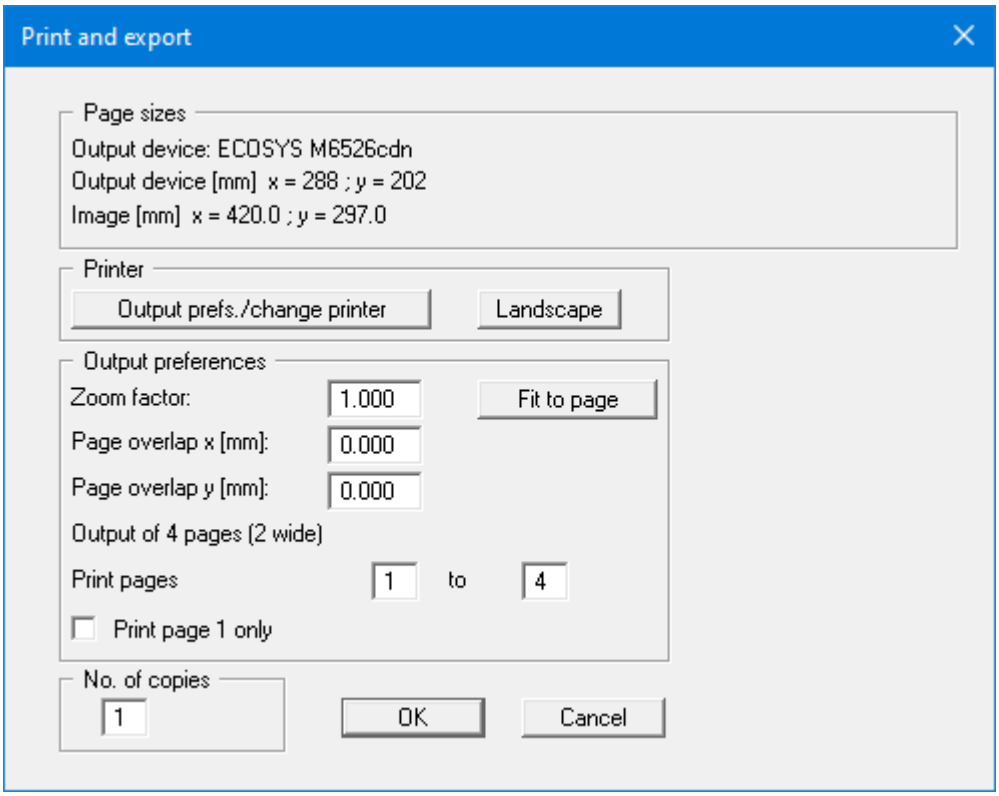
7.8 GGU-PUMPTEST: "Output preferences" menu item

You can edit output preferences (e.g. swap between portrait and landscape) or change the printer in accordance with WINDOWS conventions.

7.9 GGU-PUMPTEST: "Print and export" menu item

You can select your output format in a dialog box. You have the following possibilities:

- "**Printer**"
  allows graphic output of the current screen contents (***graphical representation***) to the WINDOWS standard printer or to any other printer selected using the menu item "**File/Output preferences**". But you may also select a different printer in the following dialog box by pressing the "**Output prefs./change printer**" button.



In the upper group box, the maximum dimensions which the printer can accept are given. Below this, the dimensions of the image to be printed are given. If the image is larger than the output format of the printer, the image will be printed to several pages (in the above example, 4). To facilitate better re-connection of the images, the possibility of entering an overlap for each page, in x and y direction, is given.

Alternatively, you also have the possibility of selecting a smaller zoom factor, ensuring output to one page ("**Fit to page**" button). Following this, you can enlarge to the original format on a copying machine, to ensure true scaling. You can also print only the 1st page with zoom factor = 1.0, in which case the bottom left-hand area is printed. Furthermore, you may enter the number of copies to be printed.

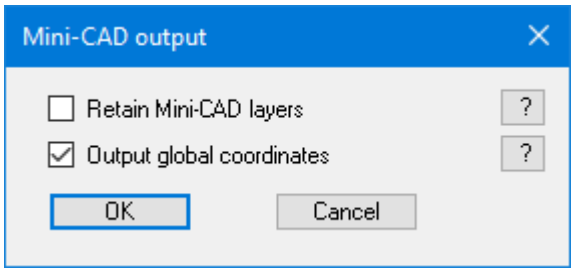
- "**DXF file**"
  allows output of the graphics to a DXF file. DXF is a common file format for transferring graphics between a variety of applications.
- "**GGU-CAD file**"
  allows output of the graphics to a file, in order to enable further processing with the **GGU-CAD** program. Compared to output as a DXF file this has the advantage that no loss of colour quality occurs during export.
- "**Clipboard**"
  The graphics are copied to the WINDOWS clipboard. From there, they can be imported into other WINDOWS programs for further processing, e.g. into a word processor. In order to import into any other WINDOWS program, you must generally use the "*Edit/Paste*" function of the respective application.
- "**Metafile**"
  allows output of the graphics to a file in order to be further processed with third party software. Output is in the standardised EMF format (Enhanced Metafile format). Use of the Metafile format guarantees the best possible quality when transferring graphics.

If you select the "**Copy/print area**" tool

from the toolbar, you can copy parts of the graphics to the clipboard or save them to an EMF file. Alternatively you can send the marked area directly to your printer (see "**Tips and tricks**").

Using the "**Mini-CAD**" program module you can also import EMF files generated using other GGU applications into your graphics (see menu item "**Graphics preferences/Mini-CAD**").

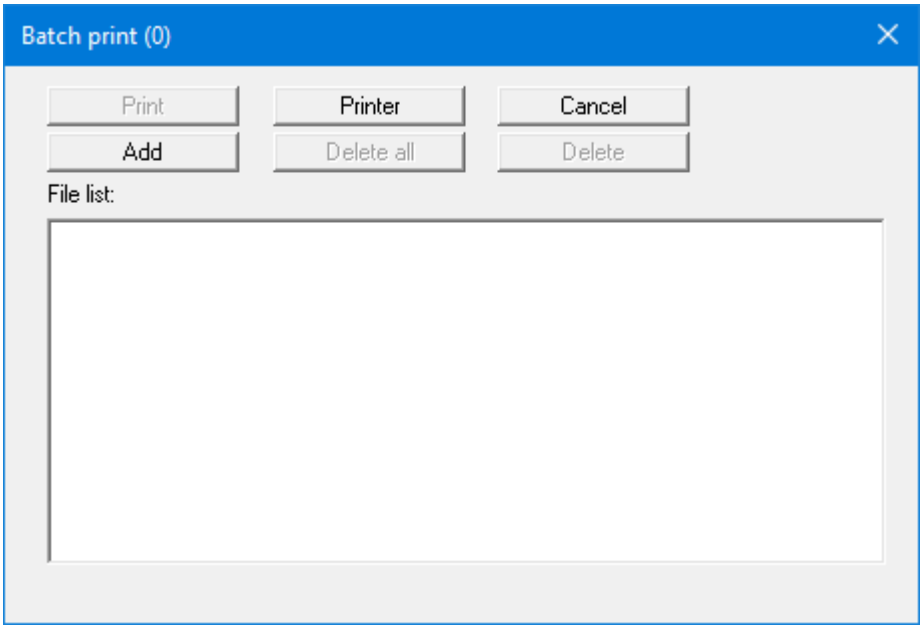
- "**Mini-CAD**"
  allows export of the graphics to a file to enable importing to different GGU applications with the **Mini-CAD** module.



If the "**Retain Mini-CAD layers**" check box is activated, the layer allocations for any existing **Mini-CAD** elements are saved. Otherwise, all **Mini-CAD** elements are saved on Layer 1 and are also inserted into Layer 1 in other GGU programs via the "**Load**" function in the **Mini-CAD** pop-up menu.
By activating the "**Output global coordinates**" check box, the present graphics are saved in the system coordinates [m]. Otherwise, they are saved in the page coordinates [mm]. If you import the **Mini-CAD** file saved using "**Global coordinates**" into a different GGU program, the coordinates are also transferred. After importing the file and pressing the [**F9**] function key (menu item "**Page size + margins/Auto-resize**") the system coordinates and the scale are corrected according to the transferred world coordinates. - "**GGUMiniCAD**"
allows export of the graphics to a file in order to enable processing in the GGUMiniCAD program. - "**Cancel**"
Printing is cancelled.

7.10 GGU-PUMPTEST: "Batch print" menu item

If you would like to print several appendices at once, select this menu item. You will see the following dialog box:



Create a list of files for printing using "**Add**" and selecting the desired files. The number of files is displayed in the dialog box header. Using "**Delete**" you can mark and delete selected individual files from the list. After selecting the "**Delete all**" button, you can compile a new list. Selection of the desired printer and printer preferences is achieved by pressing the "**Printer**" button.

You then start printing by using the "**Print**" button. In the dialog box which then appears you can select further preferences for printer output such as, e.g., the number of copies. These preferences will be applied to all files in the list.

7.11 GGU-PUMPTEST: "Exit" menu item

After a confirmation prompt, you can quit the program.

7.12 GGU-PUMPTEST: "1, 2, 3, ..." menu items

If you have not stored a working directory for the program icon, the program jumps to the program directory after starting to load or save a file.

Under the menu items of the File menu, the most recently edited files are listed with the respective storage path ("**1, 2, 3, ...**"). Selecting one of these files loads the selected file. The next time the "**File/Load**" or "**File/Save**" menu items are called up in the same program session, the program automatically jumps to the directory of the last file loaded.

8 Edit menu

8.1 GGU-PUMPTEST: "Initial water level" menu item

Normally, the at-rest water level is the reference level and has the value "**0.0**". If you need to enter your data with an at-rest water level <> "**0.0**", enter the at-rest water level here (depth-to-water, measured from top, positive downwards).

8.2 GGU-PUMPTEST: "At-rest groundwater" menu item

If, during a test, the at-rest groundwater level changes for reasons unconnected to the pumping test (e.g. tidal influence), but is superimposed upon it, you can define a polygon course here that describes this change as a function of time, e.g.:

8.3 GGU-PUMPTEST: "Test data" menu item

Using this menu item you can enter further test data.

The data entered here have no influence on the test evaluation! They are descriptive only. Only if entries are made here is anything entered in the table at the bottom of the graphic.

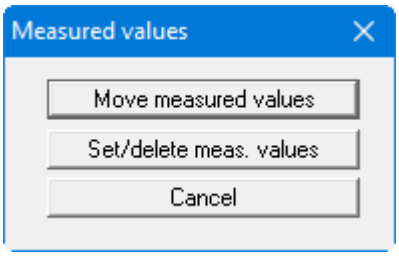
8.4 GGU-PUMPTEST: "Edit values" menu item

This is the central menu item for data input. Depending on the test evaluation method a dialog box opens. The details are more thoroughly described in the examples in Section 3.

8.5 GGU-PUMPTEST: "Graphically" menu item

Using this menu item it is possible to edit values or to add and delete values. To do this, switch to diagnosis mode. Go to the "**Evaluation/Diagnosis**" menu item.

Then go to the menu item "**Edit/Graphically**".



Now select the type of modification needed. You can then move, set or delete the values. Refresh screen with the [**F2**] function key in between.

8.6 GGU-PUMPTEST: "Modify" menu item

You can modify the values in a wide variety of ways using this menu item. You will see the following dialog box:

Using the "**Roughen values**" button, for example, you can roughen simulated values (see "**Test planning**" menu) and thus give them an ***impression of authenticity***.

8.7 GGU-PUMPTEST: Value range "manually" menu item

You can define the representation range for the graphic, and the evaluation range.

The representation range does not influence the test evaluation. Using the figures given for the evaluation range, it is possible to exclude test values at the beginning and end of the test from the evaluation. The evaluation range is marked by two vertical lines in the graphic.

8.8 GGU-PUMPTEST: "All" menu item

After selecting this menu item the graphic is adjusted so that all data points are visible. In addition, the evaluation range is adjusted to include all values in the evaluation.

8.9 GGU-PUMPTEST: "Fit in" menu item

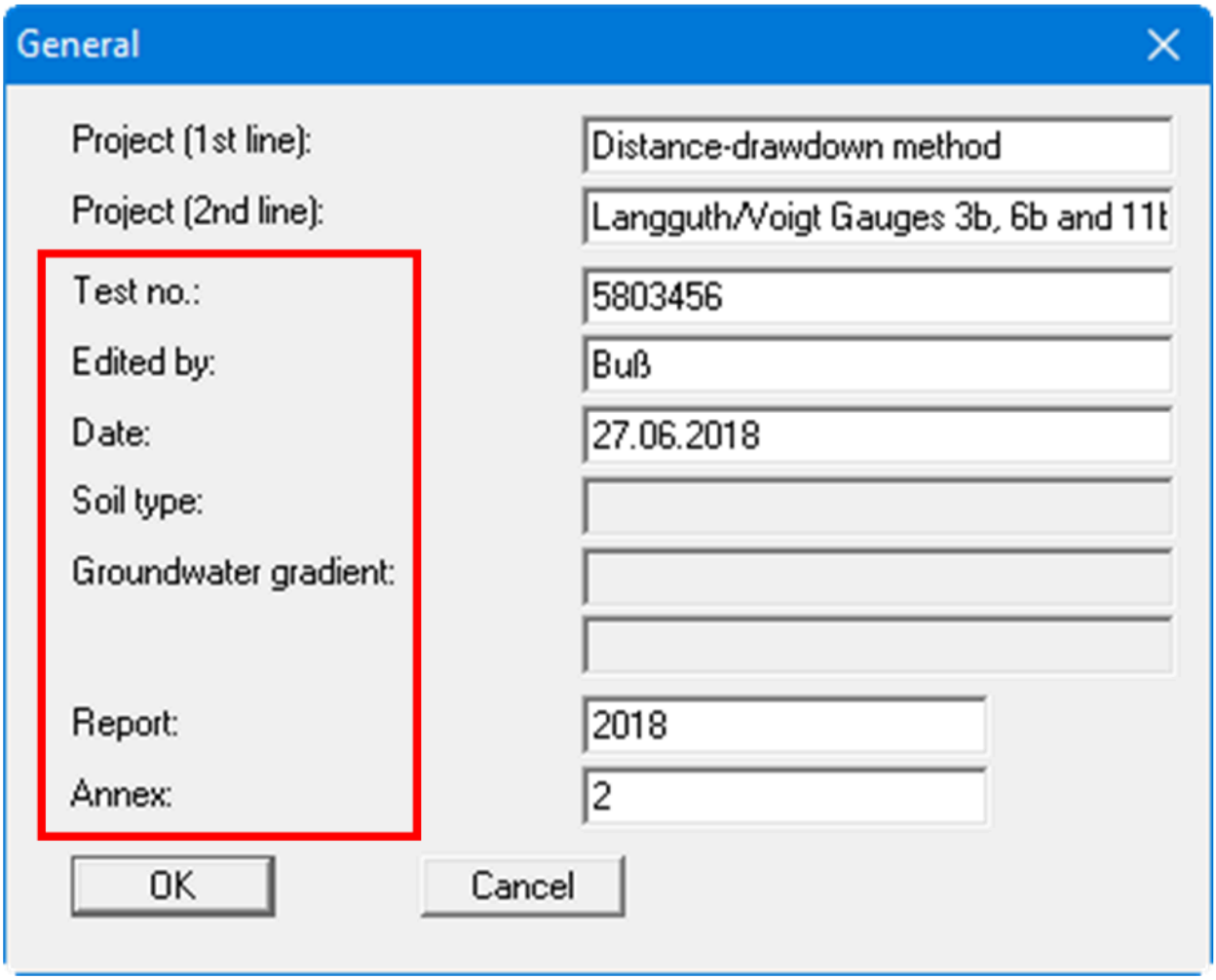
After selecting this menu item the graphic is adjusted so that all data points are visible. The evaluation range is not altered by this.

8.10 GGU-PUMPTEST: "Graphically" menu item

You can define a new evaluation range.

8.11 GGU-PUMPTEST: "General" menu item

Go to this menu item to enter general data such as the project identification, report number, etc. This data is displayed in the correct elements of the output sheet.



The marked texts in the dialog box also appear in the output sheet. Input boxes can be altered or switched off such as "**Soil type:**" as shown in the above dialog box by going to the menu item "**Output preferences/Texts**".

8.12 GGU-PUMPTEST: "Result text" menu item

Once the permeability has been calculated the program proposes a result text to be used in the graphics. You can edit the result text using this menu item. You can also open this dialog box by double-clicking in the corresponding area of the graphic.

8.13 GGU-PUMPTEST: "Company" menu item

You can enter your company address in four lines. These lines will be entered at the top left of the form.

9 Evaluation menu

9.1 GGU-PUMPTEST: "Diagnosis" menu item

You can perform a data diagnosis using this menu item. However, the diagnosis is visual only.

Each axis can be diagnosed using one of four options, independent of the other. A further speciality is the option of including the derivation of the curve in the graphic. Often, irregularities in the measurement data can be better identified on the basis of the derivation curve.

9.2 GGU-PUMPTEST: "Time-drawdown method", "Distance-drawdown method", "Distance-time-drawdown method", "Theis recovery" and "Theis type curve" menu items

The title of this menu item varies according to the selected evaluation method. The details are more thoroughly described in the examples in Sections “Time-drawdown method“ to “Theis type curve method“.

9.3 GGU-PUMPTEST: "Hand fit" menu item

This menu item is only accessible if you are using the "**Theis type curve method**" for evaluation. See Section 0 for details.

9.4 GGU-PUMPTEST: Auto fit

This menu item is only accessible if you are using the "**Theis type curve method**" for evaluation. See Section 0 for details.

9.5 GGU-PUMPTEST: "Permeability" menu item

The program calculates the permeability.

The dialog box for this menu item varies according to the selected evaluation method. The proposed result text can be included in the graphic by clicking "**Yes**". It can be edited at any time using the "**Edit/Result text**" menu item.

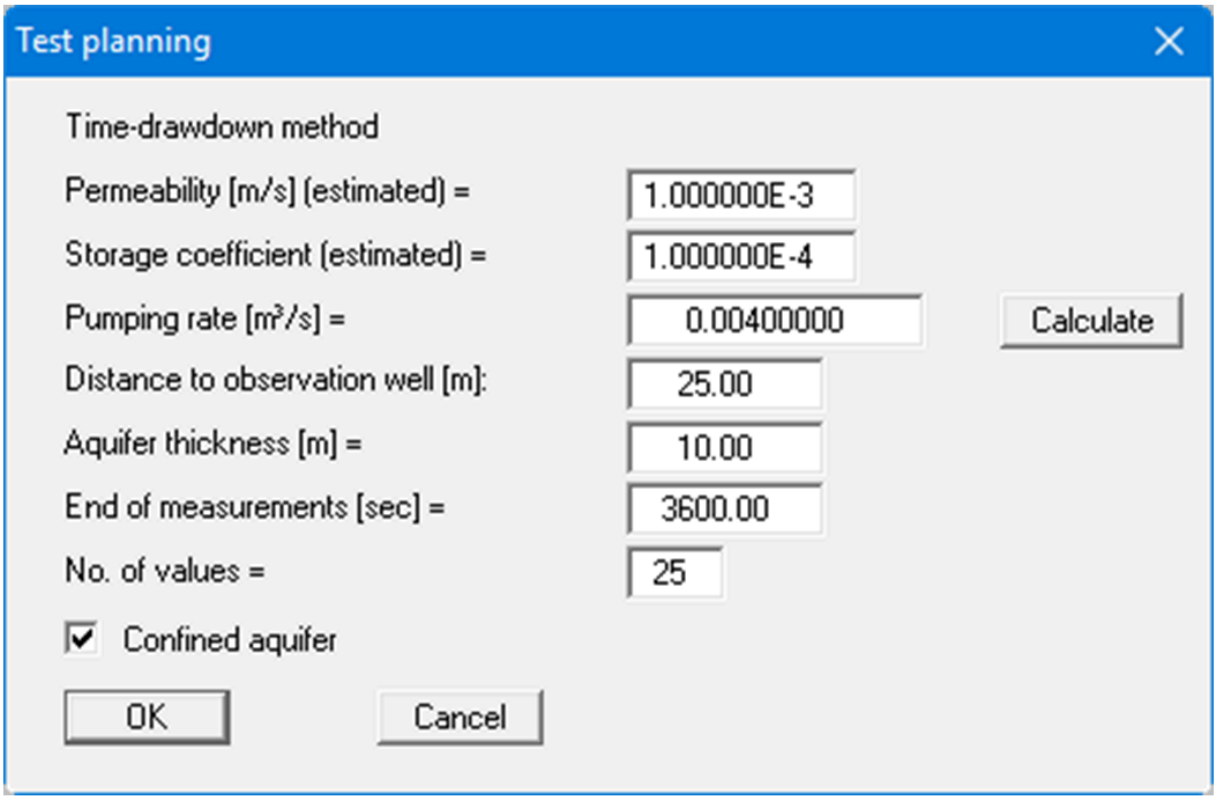
9.6 GGU-PUMPTEST: "Individual values" menu item

You can specify information on individual measured values by clicking the individual points. A message box opens showing the results for that point:

10 GGU-PUMPTEST: "Test planning" menu

Here, you can simulate a pumping test using estimated values for permeability, etc. It is then possible, based on the simulation results, to estimate the measurement precision required and the time required for the pumping test.

The dialog box for this menu item varies according to the selected evaluation method, e.g. the time-drawdown method:



After confirming with "**OK**" the simulated values are displayed.

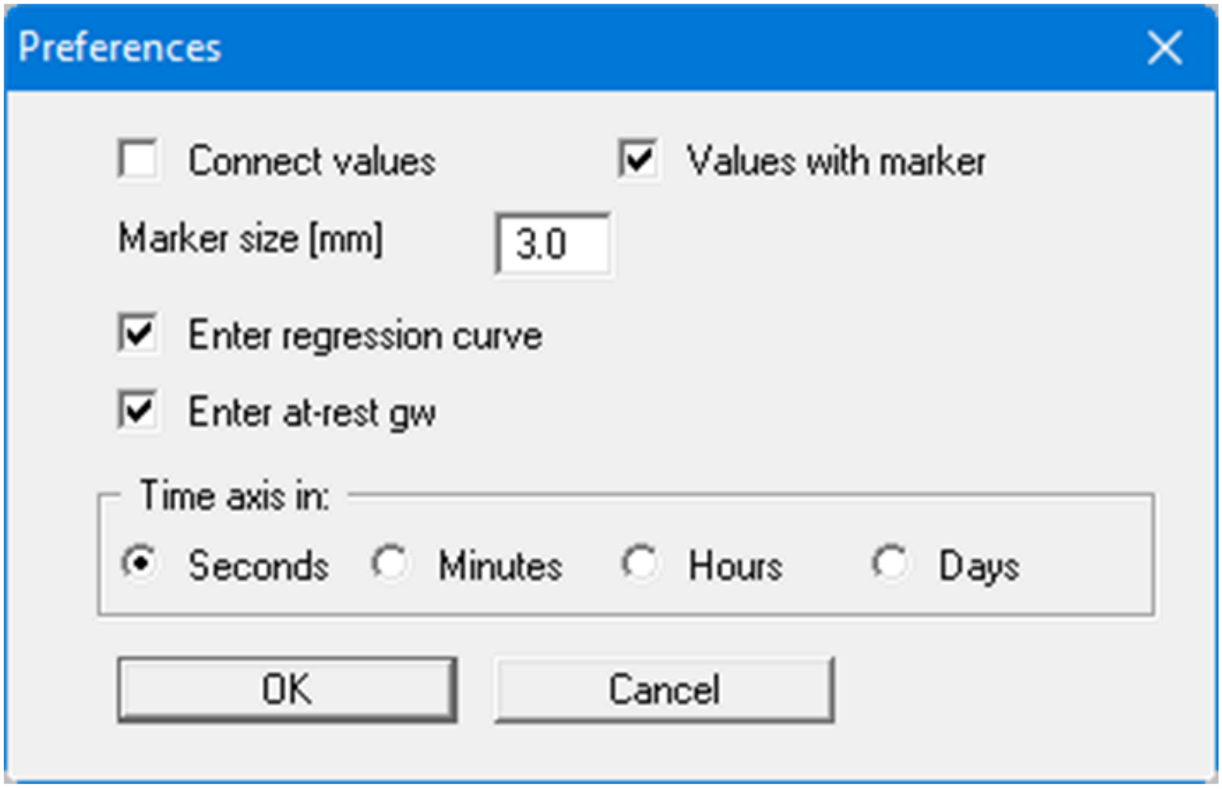
If you are using the ***Distance-drawdown method***, you must enter at least two well distances before being able to use the "Test planning" menu item. These are specified using the "**Edit values**" menu item, by creating two new data pairs there via the "**Edit x values**" button.

When using the ***Distance-time-drawdown*** method, input of at least one well is required prior to test planning. To do this, go to the menu item "**Edit values**" again and create a well by clicking "**New**". No additional measured data is needed.

11 Graphics preferences menu

11.1 GGU-PUMPTEST: "Preferences" menu item

The dialog box for this menu item varies according to the selected evaluation method. You can define preferences for the graphical representation of the measured values.

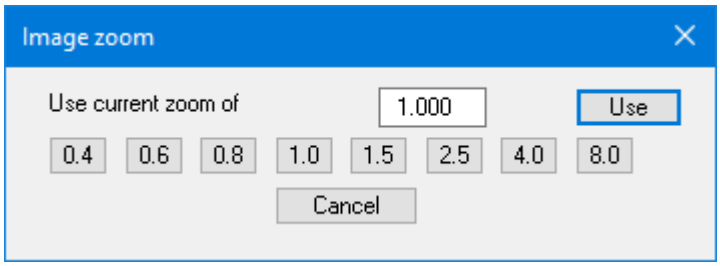


If the at-rest groundwater level changes during the test, the level can be represented against time together with the values. If the test evaluation includes a regression calculation, the regression curve can also be represented. In addition, you can specify the units for the time axis (hours, minutes, etc.).

11.2 GGU-PUMPTEST: "Refresh and zoom" menu item

The program works on the principle of ***What you see is what you get***. This means that the screen presentation represents, overall, what you will see on your printer. In the last consequence, this would mean that the screen presentation would have to be refreshed after every alteration you make. For reasons of efficiency and as this can take several seconds for complex screen contents, the screen is not refreshed after every alteration.

If, e.g., after using the zoom function (see below), only part of the image is visible, you can achieve a complete view using this menu item.



A zoom factor between 0.4 and 8.0 can be entered in the input box. By then clicking on "**Use**" to exit the box the current factor is accepted. By clicking on the "0.4", "0.6", etc. buttons, the selected factor is used directly, and the dialog box closed.

It is much simpler, however, to get a complete overview using [**Esc**]. Pressing [**Esc**] allows a complete screen presentation using the zoom factor specified in this menu item. The [**F2**] key allows screen refreshing without altering the coordinates and zoom factor.

11.3 GGU-PUMPTEST: "Zoom info" menu item

An info box informs you about the activation and options of the zoom function.

The quickest way to enlarge a specific section of the screen is to open a zoom window by holding down the [**Ctrl**] key and the mouse button.

11.4 GGU-PUMPTEST: "Pen colour and width" menu item

In order to enhance the clarity of the graphics you can preset the pen settings for various graphic elements in the GGU programs

You can change the pen widths for the elements listed in the dialog box and adjust the pen and/or fill colours by clicking on the button with the element name. In some GGU programs you can also define a line colour for selected elements.

For the graphic output of colours on ***monochrome printers*** (e.g. laser printers), colours are replaced by an equivalent shade of grey. In the case of very light colours, the corresponding graphic elements are then barely visible on the printer. In such cases, it makes sense to change the colour setting to darker colours.

11.5 GGU-PUMPTEST: "Legend font selection" menu item

With this menu item you can switch to a different true-type font. All available true-type fonts are displayed in the dialog box.

11.6 GGU-PUMPTEST: "Font size selection" menu item

You can edit font sizes for various text elements of your graphic.

11.7 GGU-PUMPTEST: "Mini-CAD toolbar" menu item

Using this menu item you can add free text, lines, circles, polygons and images (e.g. files in formats BMP, JPG, PSP, TIF, etc.) to the main program graphics. PDF files can also be imported as images. A pop-up menu opens, the icons and functions used are described in more detail in the **Mini-CAD** manual saved in the "**C:\Program Files (x86)\GGU-Software\ Manuals**" folder during installation.

Drawing objects that you create with this **Mini-CAD** system refer to the page format (in mm). They therefore always remain in the same page position. You should select this menu item if you want to enter general information on the drawing (e.g. company logo, report number, system number, stamp).

If you transfer this so-called ***header data*** to a file via the icon

in the pop-up menu, you can save this header data in a "**.kpf**" file for a completely different system (with different system coordinates) and also load it again in other GGU programs using the icon

in the pop-up menu. The saved header data will then be in the same position again. This simplifies the creation of general page information considerably.

11.8 GGU-PUMPTEST: "Toolbar preferences" menu item

After starting the program, a horizontal toolbar for menu items appears below the program menu bar. If you would rather work with a popup window with several columns, you can specify your preferences using this menu item. The smart icons can also be switched off.

At the bottom of the program window, you find a status bar with further information. You can also activate or switch off the status bar here. The preferences will be saved in the "**GGU-BORELOG.alg**" file (see menu item "**Graphics preferences/Save graphics preferences**") and will be active at the next time the program is started.

By clicking on the tools (smart icons) for the menu items you can directly reach most of the program functions. The meaning of the smart icons appears as a text box if you hover with the mouse pointer over the tools. Some of the tool functions cannot be called up via normal menu titles and menu entries.

Not all of the icons described below are available in all GGU programs.

"**Next page**"/"**Previous page**"
You can use these icons to scroll forwards and backwards between individual pages. In many GGU programs, you can use this in the ***output table representation***.

"**Select page**" or "**Diagram/Output table**"
If you are in the ***output table representation***, you can use this symbol to jump to a specific page or switch back to the normal display, i.e. your graphic display.

"**Zoom out**"
If you have previously zoomed in, this tool returns to a full screen display.

"**Zoom (-)**"/"**Zoom (+)**"
With the zoom functions you can zoom in or out of parts of the image, by clicking the left mouse button.

"**Copy/print area**"
Use this tool to copy only parts of the graphics in order to paste them, e.g. to a report. You will see information on this function and can then mark an area, which is copied to the clipboard or can be saved in a file. Alternatively, you can send the marked area directly to your printer (see "**Tips and tricks**").

"**Colour on/off**" or "**Colour/hatching**"
If you want to remove the colour from the system display, e.g. to create a black and white printout, you can do this using this on/off switch.
In several GGU programs, 4 colour and hatching settings are possible via this icon, which you can click through in sequence. A colour filled representation is the default setting, the next click shows the hatching, then coloured and hatched. The fourth click shows a representation with neither colour nor hatching. The next click starts again.

"**Move object**"
Use this icon to position legends and diagrams at the desired position on the output sheet.

"**Undo move object**"
By clicking this icon the last performed movement of graphical elements made using the [F11] function key or the menu item "**Output preferences/Move objects**" can be undone.

"**Restore move object**"
By clicking this symbol, the last object movement undo carried out using "Undo move object" can be restored.

“Construction phase back”/”Construction phase forward”
If you are in the display of construction phases, you can use these icons to scroll back and forth between the individual construction phases.

11.9 GGU-PUMPTEST: "Save graphics preferences" menu item

Some of the preferences you made with the menu items of the "**Graphics preferences**" menu as well as the inputs using the "**Edit/Company**" menu item can be saved to a file. If you select "**GGU-PUMPTEST.alg**" as file name, and save the file on the same level as the program, the data will be automatically loaded the next time the program is started and need not be entered again.

If you do not go to "**File/New**" upon starting the program, but open a previously saved file instead, the preferences used at the time of saving are shown. If subsequent changes in the general preferences are to be used for existing files, these preferences must be imported using the menu item "**Graphics preferences/Load graphics preferences**".

11.10 GGU-PUMPTEST: "Loadgraphics preferences" menu item

You can reload a graphics preferences file into the program, which was saved using the "**Graphics preferences/Save graphics preferences**" menu item. Only the corresponding data will be refreshed.

12 Output preferences menu

12.1 GGU-PUMPTEST: "Page size and margins" menu item

The default page set-up is A4 (landscape) when the program is started. You can edit the page format in the dialog box.

12.2 GGU-PUMPTEST: "Margins" menu item

In the default program preferences the form is shown with cutting borders. For output to an A4 printer, a reduction of the printer output is generally necessary, as proprietary printers cannot fully cover an A4 page. The margin preferences can be defined in the following dialog box.

By deactivating the "**With borders**" check box and with an appropriate choice of left and lower margins, it is generally possible to create a non-reduced printer output. It is necessary to also adapt the page height and width.

12.3 GGU-PUMPTEST: "Texts" menu item

The default labelling of some output sheet elements can be edited in this menu item's dialog box. Among other things, the name of the output sheet can be specified here.

Your input in lines 1 to 6 in the "**Test no., etc.**" group box of the above dialog box, as well as the input for "**Report**:" and "**Annex**:" also represent the designations for the input boxes in the "**Edit/General**" menu item dialog box. If lines are deactivated in the above dialog box, the corresponding input boxes in the "**Edit/General**" menu item dialog box are also deactivated.

Using the input in lines 1 to 5 in the "**Test data**" group box in the above dialog box, you define the input box designations in the "**Edit/Test data**" menu item dialog box and thus the representation in the table on the output sheet. Use "**Reset**" to restore the default labelling settings.

12.4 GGU-PUMPTEST: "Position info" menu item

The positions and layout of the individual elements on the output sheet can be altered using the following menu items. This menu item provides information on the options for altering the position and layout more quickly using the mouse.

12.5 GGU-PUMPTEST: "Measured values" menu item

You can edit the position, size and layout of the element in the graphical visualisation of the test results using this menu item.

The position of the element on the output sheet and its size can be defined or edited by means of the variables "***x***" and "***y***", "**dx**" and "**dy**". The element can be provided with a frame and a background colour to suit your personal requirements. If the element needs to be returned to its original condition, this can be done using the "**Reset**" button. Alternatively, you can alter the size and shape of the element using the mouse (see menu item "**Output preferences/Move objects**", Section 0).

12.6 GGU-PUMPTEST: "Title" menu item

The position and layout of the title element can be altered via the dialog box for this menu item, if the "**Title display**" check box is activated.

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item . Simply proceed as described there to edit the "**Title**" element.

The heading "**Pumping test**" shown in the title element can be edited in the menu item "**Output preferences/Texts**". The texts "**Project (1st line)**" and "**Project (2nd line)**" are entered immediately after double-clicking the element or using the menu item "**Edit/General**".

12.7 GGU-PUMPTEST: "Company" menu item

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured value**s" menu item . Simply proceed as described there to edit the "**Company**" element.

The input for this element can be edited immediately after double-clicking on the element or via the menu item "**Edit/Company**".

12.8 GGU-PUMPTEST: "Test no., etc." menu item

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item . To edit the "**Test no. etc.**" element, simply proceed as described there.

The input for this element can be edited immediately after double-clicking on the element or via the menu item "**Edit/General**". For this element you also have the option of adapting the texts in front of the input boxes to suit your needs. Go to the menu item "**Output preferences/Texts**".

12.9 GGU-PUMPTEST: "Annex and report" menu item

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item . To edit the "**Annex and report**" element, simply proceed as described there.

The input for this element can be edited directly by double-clicking the element or by going to the menu items "**Edit/General**". For this element you also have the option of adapting the texts in front of the input boxes to suit your needs. Go to the menu item "**Output preferences/Texts**".

In addition, the report and annex numbers can be rotated by 90° in the diagram view, if the "**Annex and report**" element is opened directly by double-clicking.

12.10 GGU-PUMPTEST: "Test data" menu item

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item. Simply proceed as described there to edit the "**Test data**" element.

The input for this element can be edited immediately after double-clicking on the element or via the menu item "**Edit/Test data**". For this element you also have the option of adapting the texts in front of the input boxes to suit your needs. Go to the menu item "**Output preferences/Texts**" .

12.11 GGU-PUMPTEST: "Result text" menu item

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item. Simply proceed as described there to edit the "**Result text**" element.

Input for this element can be carried out automatically by the program after evaluation. However, you can also edit the input manually directly after double-clicking the element or using the menu item "**Edit/Result texts**".

12.12 GGU-PUMPTEST: "Evaluation range" menu item

If you have activated the "**Evaluation range display**" button in this menu item, a legend with the minimum and maximum measured data in the evaluation range is displayed on the output sheet.

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item. Simply proceed as described there to edit the "**Evaluation range**" element.

12.13 GGU-PUMPTEST: "System" menu item

A sketch of the system including the test boundary conditions is shown on the output sheet if the "**System display**" check box is activated. The position and layout of the system presentation can be altered via the dialog box for this menu item.

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item. Simply proceed as described there to edit the "**System**" element. You can also adapt the colours of the various visualisation elements.

12.14 GGU-PUMPTEST: "Gauge" menu item

This menu item is only active in conjunction with the "**Distance-time-drawdown method**". A legend is displayed on the output sheet showing the names of the gauges and associated markers, as well as information on the number of measured values and the distance to the wells.

Almost exactly the same dialog box opens with the same preference options as that described in the "**Output preferences/Measured values**" menu item. Simply proceed as described there to edit the "**Gauge**" element.

12.15 GGU-PUMPTEST: "Reset all" menu item

With this button, all preferences for the aforementioned elements, which may have been edited with the previous menu item, will be reset to the program defaults.

12.16 GGU-PUMPTEST: "Move objects" menu item

When you go to this item you can move the various objects with the aid of the mouse. Move the mouse over the object to be moved. When you are located above a moveable object the mouse pointer appears in the shape of a cross. You can now press and hold the left mouse button and drag the object to the required position.

After going to this menu item only one object at a time can be moved using the mouse or its size be altered.

In order to move or edit several objects, this function can be more quickly activated by pressing [**F11**] or the

icon.

The size of an object can also be altered using this menu item or the [**F11**] key. If you move over the frame of a changeable object after activating this function the mouse assumed the shape of a double-headed arrow. Hold the left mouse button and move the frame until the object has reached the required size. To retain the ratio of the sides, pull at one corner only. If on one side only is pulled the object will become higher or wider.

The last change made in the position or size of an object can be undone using [**Back**] or by clicking the

icon.

13 Info menu

13.1 GGU-PUMPTEST: "Copyright" menu item

You will see a copyright message and information on the program version number.

The "**System**" button shows information on your computer configuration and the folders used by the GGU program.

13.2 GGU-PUMPTEST: "Maxima" menu item

You will see information on the default program maxima.

13.3 GGU-PUMPTEST: "Help" menu item

The manual is opened as a PDF document. The help function can also be accessed using the [**F1**] function key.

13.4 GGU-PUMPTEST: "GGU on the web" menu item

Using this menu item, you can access the **GGU Software website**.

Check the page of your program module at regular intervals for information about updates and changes. On the "**Changelogs**" subpage, you can also subscribe to an e-mail notification that informs you of all changes on a monthly basis.

13.5 GGU-PUMPTEST: "GGU support" menu item

This menu takes you directly to the **GGU Software Support Portal**.

Here you can enter your support request directly and upload your edited GGU program file.

13.6 GGU-PUMPTEST: "What's new?" menu item

You will see information on program improvements in comparison to older versions.

13.7 GGU-PUMPTEST: "Simple analyses" menu item

Here, the program offers two equations for confined and unconfined groundwater, which allow the permeability to be approximately determined.

13.8 GGU-PUMPTEST: "Language preferences" menu item

This menu item allows you to switch the menus and the graphics from German to English and vice versa. To work in German, deactivate the two check boxes "**Dialoge + Menüs übersetzen (translate dialogues, menus)**" und "**Graphiktexte übersetzen (translate graphics)**".

Alternatively, you can work bilingually, e.g. with German dialog boxes but with graphic output in English. The program always starts with the language setting applicable when it was last ended.