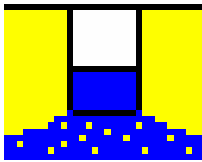


Analysis of infiltration systems according to
DWA-A 138 (April 2005)

GGU-SEEP

VERSION 9



Last revision: April 2012
Copyright: Prof. Dr. Johann Buß
Technical implementation and sales: Civilserve GmbH, Steinfeld

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1 Preface

The **GGU-SEEP** program system allows analysis of systems for the infiltration of precipitation run-off according to the DWA-A 138 standard (*Deutsche Vereinigung für Wasserwirtschaft, Abfall und Abwasser e.V.; Planung, Bau und Betrieb von Anlagen zur Versickerung von Niederschlagswasser, April 2005*). Generally, the basic data and results of an analysis are displayed on the screen. The graphics consist of a total of four elements (also see the "**Output preferences**" menu in Section 7.4):

- legend containing system data;
- system visualisation of the selected infiltration system;
- rainfall intensity table;
- legend containing the analysis results (only if the system has been analysed).

These four elements can be resized and repositioned to suit your requirements. In addition, user-created graphic elements can be added using the integrated Mini-CAD module. Stamp fields (e.g. company logos) can be added in the same manner. The default visualisation format is A4. The sheet format can be modified (e.g. A3) if required.

Data input is in accordance with conventional WINDOWS operations and can therefore be learned almost entirely without the use of a manual. Graphic output supports the true-type fonts supplied with WINDOWS, so that excellent layout is guaranteed. Colour output and any graphics (e.g. files in formats BMP, JPG, PSP, TIF, etc.) are supported. DXF files can also be imported by means of the integrated Mini-CAD module (see the "**Mini-CAD**" manual).

The program has been thoroughly tested. No faults 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 Licence protection and installation

In order to guarantee a high degree of quality, a hardware-based copy protection system is used for the **GGU-SEEP** program.

The GGU software protected by the *CodeMeter* copy protection system is only available in conjunction with the *CodeMeter stick* copy protection component (hardware for connection to the PC, "*CM stick*"). Because of the way the system is configured, the protected software can only be operated with the corresponding CM stick. This creates a fixed link between the software licence and the CM stick copy protection hardware; the licence as such is thus represented by the CM stick. The correct Runtime Kit for the CodeMeter stick must be installed on your PC.

Upon start-up and during running, the **GGU-SEEP** program checks that a CM stick is connected. If it has been removed, the program can no longer be executed.

For installation of GGU software and the CodeMeter software please refer to the information in the *Installation notes for GGU Software International*, which are supplied with the program.

3 Language selection

GGU-SEEP is a bilingual program. The program always starts with the language setting applicable when it was last ended.

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

4 Starting the program

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

- File
- ?

After clicking on the "**File**" menu, a previously calculated system can be loaded by means of the "**Load**" menu item, or a new one created using "**New**".

The program allows simple input procedures by moving directly to the option box after "**New**" is clicked; this box can also be reached by pointing to the "**Edit/Infiltration type**" menu item. Exit the option box by clicking the required type of infiltration; the initial input screen opens. Six **me-nus** are visible in the menu bar:

- File
- Edit
- System
- Output preferences
- Graphics preferences
- ?

After clicking one of these menus, the so-called menu items roll down, allowing 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 **GGU-SEEP** screen is not refreshed after every alteration.

If you would like to refresh the screen contents, press either [F2] or [Esc]. The [Esc] key additionally sets the screen visualisation back to your current zoom, which has the default value 1.0, corresponding to an A4 format sheet.

5 Theoretical principles

The program can be used to analyse a variety of infiltration systems:

- Surface infiltration
- Swale infiltration
- Pipe infiltration
- French drain infiltration
- Shaft infiltration (a variety of shaft types are available)
- Swale-pipe infiltration
- Swale-French drain infiltration
- Paving (surface infiltration) with swale
- Paving (surface infiltration) with French drain
- Paving (surface infiltration) with pipe

A *rainfall event frequency* of $n = 0.2/a$ (= once in 5 years) is described as a generally adopted value for decentralised infiltration systems in the DWA-A 138 standard. For centralised infiltration systems a frequency of $n = 0.1/a$ (= once in 10 years) should generally be adopted. The program therefore allows the frequency to be defined, allowing different events to be investigated.

According to the DWA-A 138 standard, the *thickness of the seepage zone*, i.e. the distance from the base of the infiltration system to the highest groundwater level, should be at least 1 m. This is necessary in order to guarantee a sufficiently long seepage path, e.g. to facilitate time-dependent purification processes. For surface and swale infiltration a seepage zone of < 1 m may be acceptable in substantiated, exceptional cases (see DWA-A 138). Despite this, the distance can be freely defined in the program.

According to DWA-A 138, the *permeability of the in-situ soil* should be between $1 \cdot 10^{-3}$ m/s and $1 \cdot 10^{-6}$ m/s. This demand is made in order to ensure a sufficiently small draining time following a rainfall event, among other things. The program nevertheless accepts permeabilities $< 1 \cdot 10^{-6}$ m/s (but issues an appropriate warning).

According to the old standard the *distance to neighbouring cellars* should not be less than 6 m. The permissible distances are regulated in more detail in the new standard (see Chapter 3.2.2, DWA-A 138, April 2005). Regardless of this, the program queries for the distance of 6 m and issues a warning message where necessary. However, this has no impact on the analysis results.

The program also computes the system's *emptying time* or the *draining time* for certain infiltration types following a rainfall event. The same relationships are employed as assumed by the DWA-A 138 standard for filling. However, both half of the permeability (as in the DWA-A 138 standard to take the lower permeability in the unsaturated zone into consideration) and the full permeability value (once full, the system is generally saturated) may be adopted for analysis.

In the 1990 edition of the standard analysis is performed using **Reinhold's** time coefficient method. More recent investigations by the German meteorological office (*Deutscher Wetterdienst*) have shown that the rainfall intensities after Reinhold can differ considerably from local rain characteristics. In the DWA-A 138 (April 2005) the tables in the KOSTRA Atlas ("*Starkniederschlagshöhen für Deutschland - KOSTRA*") (Storm rainfall levels for Germany), available from the German meteorological office) or, if applicable, location-specific precipitation-storm rainfall evaluations according to ATV-A 121 (available from local authorities) are used to determine **rainfall intensities**. These tables contain precipitation levels and rainfall intensities for various rainfall durations and recurrence intervals (frequencies).

The **GGU-SEEP** program makes its computations using the location-specific rainfall intensities (table), but also allows analysis using Reinhold's rainfall series', e.g. for use in draft design. The program also determines the decisive **rainfall duration after Reinhold**. This time-value function after Reinhold only applies to rainfall durations ≤ 150 minutes. A warning is issued if greater values are determined in the course of analysis. Because the systems are slightly larger for rainfall durations > 150 minutes, the rainfall duration is not reduced for any of the systems, with the exception of shaft infiltration. However, it should still be noted that for rainfall durations > 150 minutes a more detailed consideration is required (e.g. via the rainfall intensity tables in the KOSTRA Atlas).

If the rainfall intensity calculations are performed using the tables in the KOSTRA Atlas, the location-specific tables must be obtained. By default the program contains the tables for the south Hannover region, which are also included in the new standard. If you use the 'KOSTRA-DWD 2000' program published by the *Institut für technisch-wissenschaftliche Hydrologie* (www.itwh.de), the KOSTRA data for the required location within Germany can be imported into **GGU-SEEP** via a file generated by the program or via the Windows clipboard.

The new standard recommends adopting a surcharge factor between 1.1 and 1.2 to determine the required storage volume, in order to avoid under-designing, depending on the measure of risk involved. The surcharge factor is entered in the same dialog box used for selecting the type of infiltration.

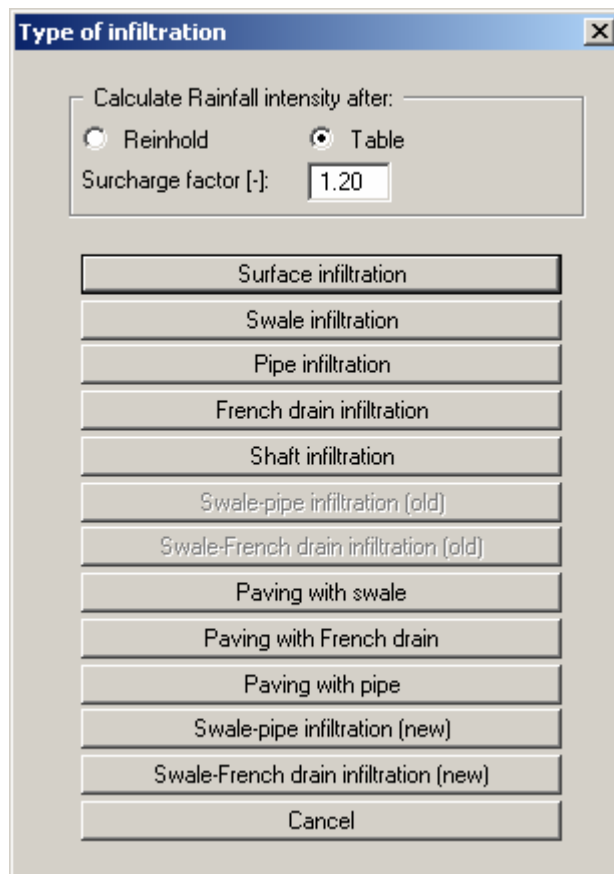
Use of the program will be demonstrated below using worked examples. These examples are provided as files and can be opened using the "**File/Load**" menu item.

6 Worked examples

6.1 Surface infiltration (DWA-A 138, Appendix A.2.1)

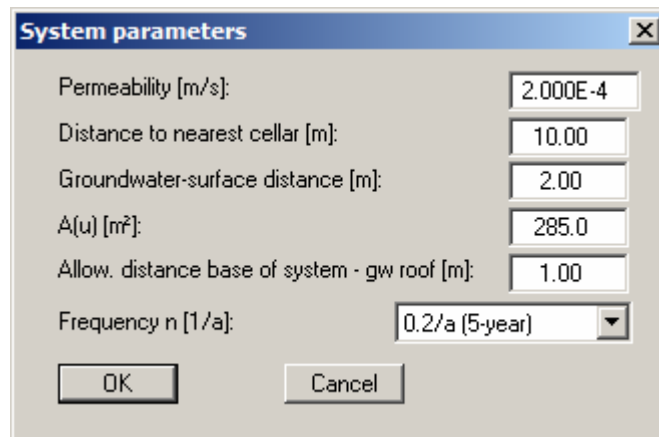
The theoretical principles are contained in the standard (Chapters 3.2.3 and 3.3.1, DWA-A 138, April 2005).

The procedure is demonstrated using the example from the standard (Appendix A.2.1). Go to the menu item "**File/New**" or "**Edit/Infiltration type**". You will see the following dialog box. Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated.



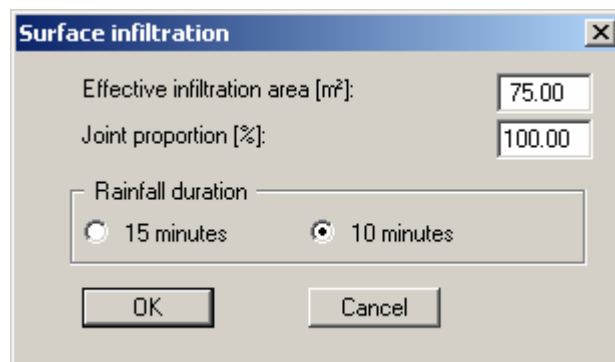
Exit the dialog box by clicking the "**Surface infiltration**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:



Permeability [m/s]:	2.000E-4
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	2.00
A(u) [m²]:	285.0
Allow. distance base of system - gw roof [m]:	1.00
Frequency n [1/a]:	0.2/a (5-year)

Confirm your input with "**OK**". Then select the "**Edit/Surface infiltration**" menu item and enter the data from the following dialog box:



Effective infiltration area [m²]:	75.00
Joint proportion [%]:	100.00
Rainfall duration	
<input type="radio"/> 15 minutes	<input checked="" type="radio"/> 10 minutes

The new standard requires analysis of surface infiltration to be based on a rainfall duration of 10 minutes. Confirm with "**OK**".

The location-specific table containing the rainfall intensities can now be entered using the menu item "**Edit/Rainfall intensity table**" (see Section 7.2.6). The example uses the "**Hannover-Süd**" rainfall intensity table, included with the **GGU-SEEP** delivery. The data is loaded automatically when the program starts and displayed in the following dialog box:

Rainfall intensity [litres/(sec·ha)]

KOSTRA

Rainfall intensity

Town:

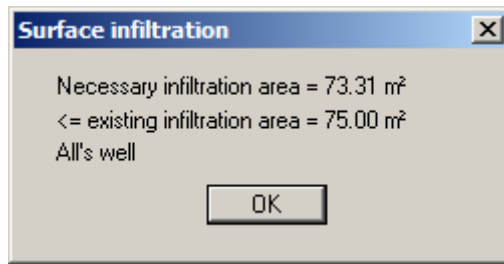
No.	D	rD(1/a)	rD(0.2/a)	rD(0.1/a)	rD(0.05/a)	rD(0.02/a)
1	5 min	201.00	338.90	398.30	458.00	537.70
2	10 min	127.10	204.60	238.00	273.70	321.30
3	15 min	97.20	152.60	176.40	202.90	238.10
4	20 min	80.40	124.00	142.70	164.10	192.60
5	30 min	61.50	92.60	106.00	121.90	143.10
6	45 min	47.00	69.20	78.80	90.60	106.40
7	60 min	38.90	56.40	63.90	73.50	86.30
8	90 min	28.90	42.00	47.70	54.90	64.40
9	2 h	23.40	34.10	38.80	44.60	52.40
10	3 h	17.30	25.40	28.90	33.20	39.00
11	4 h	14.00	20.70	23.50	27.00	31.70
12	6 h	10.40	15.40	17.50	20.10	23.60
13	9 h	7.70	11.50	13.10	15.10	17.70
14	12 h	6.30	9.30	10.60	12.20	14.30
15	18 h	4.60	6.80	7.70	8.90	10.40
16	24 h	3.80	5.50	6.20	7.10	8.40
17	48 h	2.20	3.00	3.40	3.90	4.60
18	72 h	1.70	2.30	2.60	3.00	3.50

If the surface infiltration needs to be computed for a different location, enter the new data in the dialog box or import the data using the "**Import file**" or "**Import clipboard**" buttons in the "**KOSTRA**" group box (see Section 7.2.6). Entered or imported tables can be saved as ".drg" files at the program level and be opened again for later analyses using the "**Load**" button.

The surface infiltration can now be analysed. Go to the "**System/Analyse**" menu item. First, the program shows a note indicating which rainfall intensity table is being used. If required, a different table could be entered or loaded here.

This warning note should not be deactivated in order to avoid mistaken use of the wrong rainfall intensity table.

For surface infiltration a note is also displayed concerning the surcharge factor, which is not taken into consideration for this infiltration type. The analysis results are then displayed:



Following this the analysis results are displayed in the graphics.

Results
 Necessary infiltration area = 73.3 m²
 Governing rainfall duration = 10.0 minutes
 Rainfall per unit area = 204.6 Liter/(sec·ha)

Hannover-Süd	
D	$r_{D(0.2)}$ [l/(s·ha)]
5 min	338.9
10 min	204.6
15 min	152.6
20 min	124.0
30 min	92.6
45 min	69.2
60 min	56.4

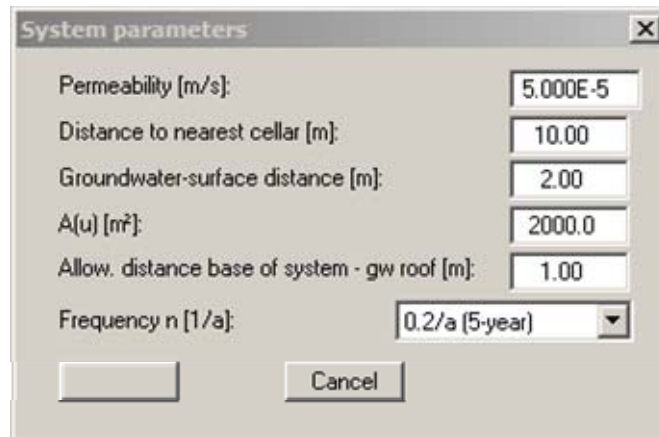
A required infiltration area of 73.3 m² is obtained.

6.2 Swale infiltration (DWA-A 138, Appendix A.2.2)

The theoretical principles are contained in the standard (Chapters 3.2.3 and 3.3.2, DWA-A 138, April 2005).

The procedure is demonstrated using the example from the standard (Appendix A.2.2). Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Enter a surcharge factor of **1.2**, if not already defined. Exit the dialog box by clicking the "**Swale infiltration**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:

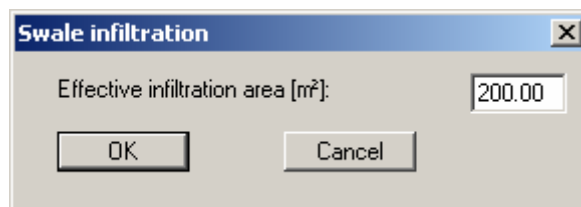


The "System parameters" dialog box contains the following fields and values:

Parameter	Value
Permeability [m/s]:	5.000E-5
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	2.00
A(u) [m²]:	2000.0
Allow. distance base of system - gw roof [m]:	1.00
Frequency n [1/a]:	0.2/a (5-year)

Buttons: [OK], [Cancel]

Confirm your input with "**OK**". Then select the "**Edit/Swale infiltration**" menu item and enter the available infiltration area in the dialog box:



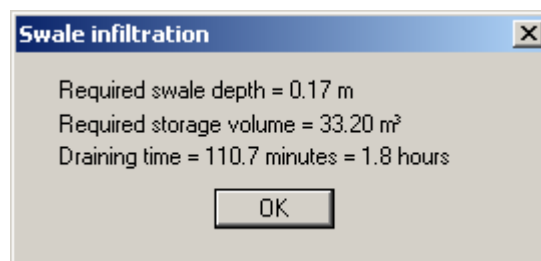
The "Swale infiltration" dialog box contains the following field and value:

Parameter	Value
Effective infiltration area [m²]:	200.00

Buttons: [OK], [Cancel]

Confirm your input with "**OK**". A location-specific table can now be entered with its rainfall intensities. For this example the "**Hannover-Süd**" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "**Edit/Rainfall intensity table**", Section 7.2.6).

The swale infiltration can now be analysed. Go to the "**System/Analyse**" menu item. The results of the analysis are shown:



The "Swale infiltration" dialog box displays the following analysis results:

Required swale depth = 0.17 m
Required storage volume = 33.20 m³
Draining time = 110.7 minutes = 1.8 hours

Button: [OK]

Following this the analysis results are displayed in the graphics.

Results
 Required swale depth = 0.17 m
 Required storage volume = 33.20 m³
 Governing rainfall duration = 30.0 minutes
 Rainfall per unit area = 92.6 Liter/(sec·ha)
 Draining time = 1.8 hours

Hannover-Süd		
D	r _{D(0.2)} [l/(s·ha)]	V [m ³]
10 min	204.6	28.81
15 min	152.6	30.86
20 min	124.0	32.08
30 min	92.6	33.20
45 min	69.2	33.13
60 min	56.4	32.00
90 min	42.0	27.48

A required swale depth of 0.17 m is obtained. In this respect it may be interesting to note that swale design using the table data (KOSTRA Atlas) for Gliesmarode, in Braunschweig, gives a swale depth of 0.27 m. The distance between Hannover-Süd and Braunschweig-Gliesmarode is barely 60 km. A swale depth greater by a factor of 1.59 is required nevertheless.

6.3 French drain infiltration (DWA-A 138, Appendix A.2.4 a)

The theoretical principles are contained in the standard (Chapters 3.2.3 and 3.3.4, DWA-A 138, April 2005).

The procedure is demonstrated using Example a) in Appendix A.2.4. Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Enter a surcharge factor of **1.2**, if not already defined. Exit the dialog box by clicking the "**French drain infiltration**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:

Confirm your input with "**OK**". Then select the "**Edit/French drain infiltration**" menu item and enter the data from the following dialog box:

French drain infiltration [X]

Base width of French drain [m]:

French drain height [m]:

Max. water level in French drain [m]:
 (from ground level)

Eff. height = French drain height - max. water level in French drain

Storage coefficient s [-]:
 For gravel = 0.35; for sand = 0.20

Confirm your input with "OK". A location-specific table can now be entered with its rainfall intensities. For this example the "Hannover-Süd" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "Edit/Rainfall intensity table", Section 7.2.6).

The French drain infiltration can now be analysed. Go to the "System/Analyse" menu item. The results of the analysis are shown:

French drain infiltration [X]

Required French drain length = 35.48 m
 Required storage volume = 31.05 m³
 Draining time = 121.5 minutes = 2.0 hours

Following this the analysis results are displayed in the graphics.

Results
 Required French drain length = 35.48 m
 Required storage volume = 31.05 m³
 Governing rainfall duration = 45.0 minutes
 Rainfall per unit area = 69.2 Liter/(s·ha)
 Draining time = 2.0 hours

Hannover-Süd		
D	$r_{D(0.2)}$ [l/(s·ha)]	L [m]
15 min	152.6	32.81
20 min	124.0	34.08
30 min	92.6	35.27
45 min	69.2	35.48
60 min	56.4	34.97
90 min	42.0	32.94
2 h	34.1	30.82

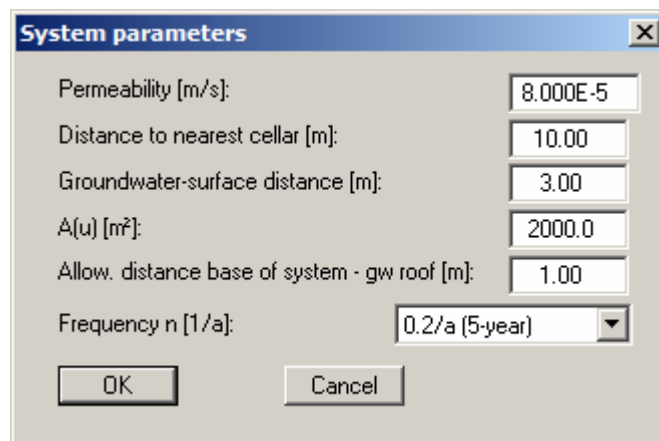
A required French drain length of 35.48 m is obtained.

6.4 Pipe infiltration (DWA-A 138, Appendix A.2.4 b)

The theoretical principles are contained in the standard (Chapters 3.2.3 and 3.3.4, DWA-A 138, April 2005).

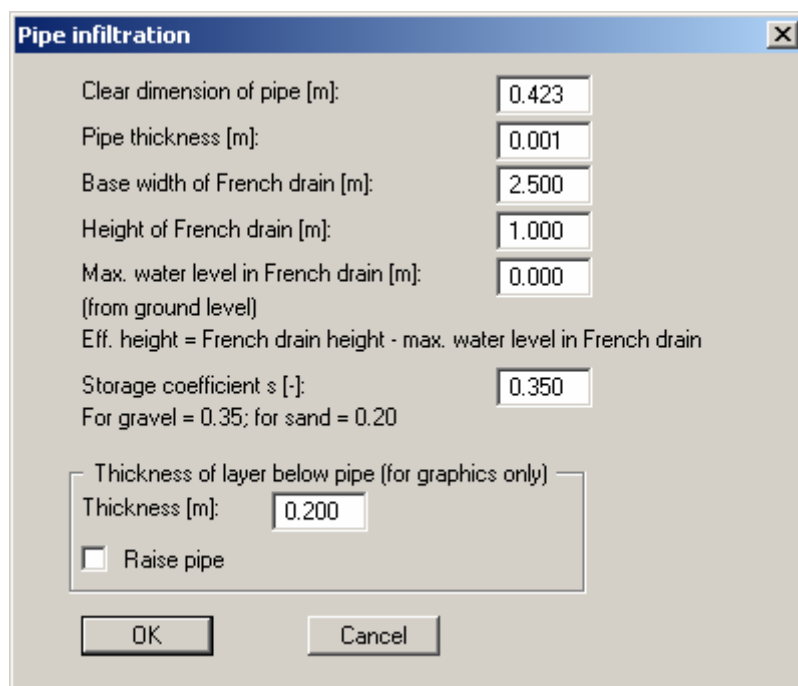
The procedure is demonstrated using Example b) in Appendix A.2.4. Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Enter a surcharge factor of **1.2**, if not already defined. Exit the dialog box by clicking the "**Pipe infiltration**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:



Permeability [m/s]:	8.000E-5
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	3.00
A(u) [m²]:	2000.0
Allow. distance base of system - gw roof [m]:	1.00
Frequency n [1/a]:	0.2/a (5-year)

Confirm your input with "**OK**". Then select the "**Edit/Pipe infiltration**" menu item and enter the data from the following dialog box:



Clear dimension of pipe [m]:	0.423
Pipe thickness [m]:	0.001
Base width of French drain [m]:	2.500
Height of French drain [m]:	1.000
Max. water level in French drain [m]: (from ground level)	0.000
Eff. height = French drain height - max. water level in French drain	
Storage coefficient s [-]: For gravel = 0.35; for sand = 0.20	0.350
Thickness of layer below pipe (for graphics only)	
Thickness [m]:	0.200
<input type="checkbox"/> Raise pipe	

In Example b) (DWA-A 138, Appendix A.2.4) the water supply to, and distribution in, the French drain is by means of two ND 300 pipes. In the **GGU-SEEP** program an equivalent area or a diameter d_{new} is entered for the "**clear dimension of the pipe**", corresponding to the area of the two pipes.

$$A = A_1 + A_2 = 2 \cdot \frac{\pi d^2}{4} \quad \text{and} \quad A_{new} = \frac{\pi d_{new}^2}{4}$$

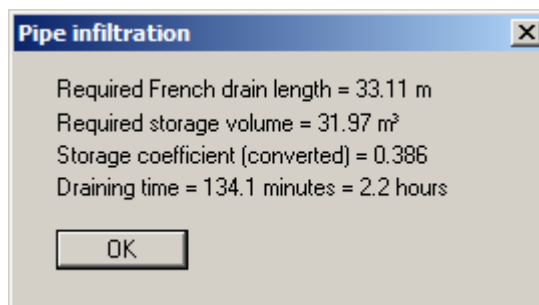
$$\frac{\pi d_{new}^2}{4} = \frac{2\pi d^2}{4} \quad \rightarrow \quad d_{new}^2 = 2d^2 \quad \rightarrow \quad d_{new} = \sqrt{2} d$$

Thus, for the example:

$$d_{new} = 1.41 \cdot 0.3 \text{ m} = 0.423.$$

Confirm your input with "**OK**". A location-specific table can now be entered with its rainfall intensities. For this example the "**Hannover-Süd**" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "**Edit/Rainfall intensity table**", Section 7.2.6).

The pipe infiltration can now be analysed. Go to the "**System/Analyse**" menu item. The results of the analysis are shown:



Following this the analysis results are displayed in the graphics.

Results Required pipe length = 33.11 m Required storage volume = 31.97 m ³ Governing rainfall duration = 45.0 minutes Rainfall per unit area = 69.2 Liter/(sec·ha) Draining time = 2.2 hours

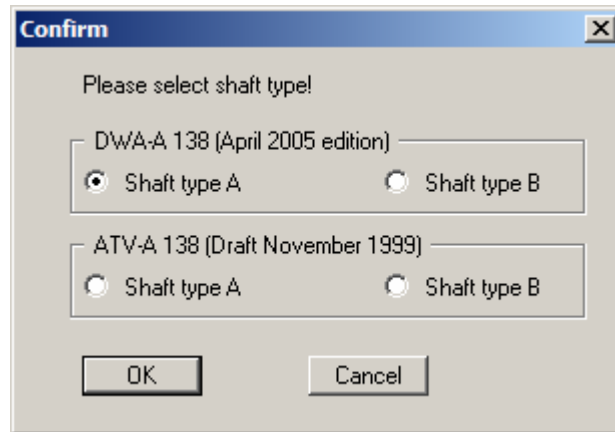
Hannover-Süd		
D	r _{D(0.2)} [l/(s·ha)]	L [m]
15 min	152.6	30.09
20 min	124.0	31.37
30 min	92.6	32.66
45 min	69.2	33.11
60 min	56.4	32.83
90 min	42.0	31.22
2 h	34.1	29.43

A required French drain length of 33.11 m is obtained.

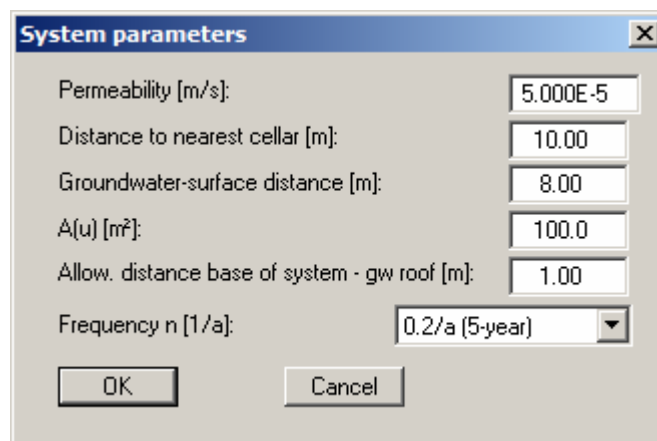
6.5 Shaft infiltration - Type A (DWA-A 138, Appendix A.2.5)

The theoretical principles are contained in the standard (Chapters 3.2.3 and 3.3.5, DWA-A 138, April 2005).

The procedure is demonstrated using the example from the standard (Appendix A.2.5). Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Enter a surcharge factor of **1.2**, if not already defined. Exit the dialog box by clicking the "**Shaft infiltration**" button and selecting shaft type A according to DWA-A 138 (April 2005 edition).



Confirm your input with "**OK**". Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:



Confirm your input with "**OK**". Then select the "**Edit/Shaft infiltration (Type A)**" menu item and enter the data from the following dialog box:

Shaft infiltration [X]

Clear dimension of shaft [m]:

Shaft wall thickness [m]:

Base of inlet [m]:

Filter layer thickness [m]:

Confirm your input with "OK". A location-specific table can now be entered with its rainfall intensities. For this example the "Hannover-Süd" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "Edit/Rainfall intensity table", Section 7.2.6).

The shaft infiltration can now be analysed. Go to the "System/Analyse" menu item. The results of the analysis are shown:

Shaft infiltration (Type A) [X]

Maximum shaft water level $z_{max} = 2.340$ m
 Maximum storage volume $V_{s,max} = 1.838$ m³
 Governing rainfall duration = 60.0 minutes

Following this the analysis results are displayed in the graphics.

Results
 Maximum shaft water level $z_{max} = 2.34$ m
 Maximum storage volume $V_{s,max} = 1.84$ m³
 Governing rainfall duration = 60.0 minutes
 Rainfall per unit area = 56.4 Liter/(sec·ha)

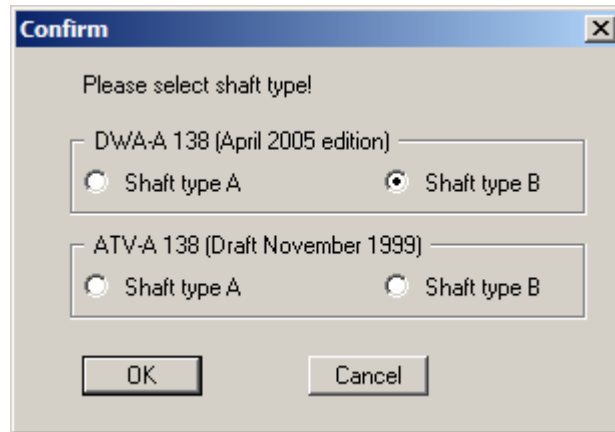
Hannover-Süd		
D	$r_{0(z)}$ [l/(s·ha)]	z [m]
20 min	124.0	2.04
30 min	92.6	2.19
45 min	69.2	2.29
60 min	56.4	2.34
90 min	42.0	2.33
2 h	34.1	2.27
3 h	25.4	2.10

A required shaft depth of 3.84 m is obtained as the sum of the impounding depth z (= 2.34 m), the frost-free depth of the supply pipe (= 1.0 m) and the thickness of the filter (= 0.5 m).

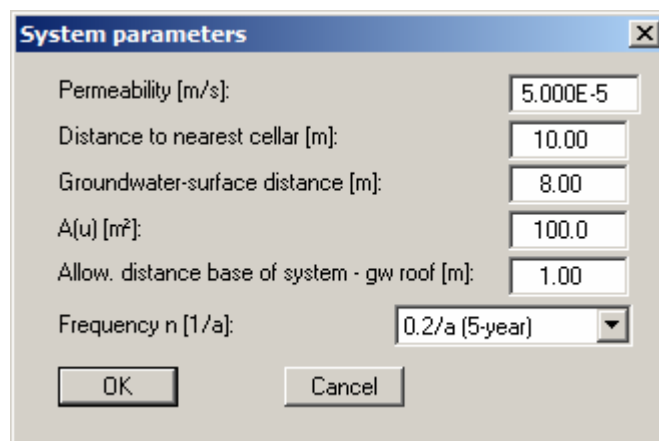
6.6 Shaft infiltration - Type B (DWA-A 138, Appendix A.2.5)

The theoretical principles are contained in the standard (Chapters 3.2.3 and 3.3.5, DWA-A 138, April 2005).

The procedure is demonstrated using the example from the standard (Appendix A.2.5). Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Enter a surcharge factor of **1.2**, if not already defined. Exit the dialog box by clicking the "**Shaft infiltration**" button and selecting shaft type B according to DWA-A 138 (April 2005 edition).



Confirm your input with "**OK**". Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:



Confirm your input with "**OK**". Then select the "**Edit/Shaft infiltration (Type B)**" menu item and enter the data from the following dialog box:

Shaft infiltration [X]

Clear dimension of shaft [m]:

Shaft wall thickness [m]:

Base of inlet [m]:

Filter layer thickness [m]:

Confirm your input with "OK". A location-specific table can now be entered with its rainfall intensities. For this example the "Hannover-Süd" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "Edit/Rainfall intensity table", Section 7.2.6).

The shaft infiltration can now be analysed. Go to the "System/Analyse" menu item. The results of the analysis are shown:

Shaft infiltration (Type B) [X]

Maximum shaft water level $z_{max} = 2.340$ m
 Maximum storage volume $V_{s,max} = 1.838$ m³
 Governing rainfall duration = 60.0 minutes
 Req. permeability (filter layer) $\geq 3.528E-4$ m/s

Following this the analysis results are displayed in the graphics.

Results
 Maximum shaft water level $z_{max} = 2.34$ m
 Maximum storage volume $V_{s,max} = 1.84$ m³
 Req. permeability (filter layer) $\geq 3.53 \cdot 10^{-4}$ m/s
 Governing rainfall duration = 60.0 minutes
 Rainfall per unit area = 56.4 Liter/(sec·ha)

Hannover-Süd		
D	$r_{D(0.2)}$ [l/(s·ha)]	z [m]
20 min	124.0	2.04
30 min	92.6	2.19
45 min	69.2	2.29
60 min	56.4	2.34
90 min	42.0	2.33
2 h	34.1	2.27
3 h	25.4	2.10

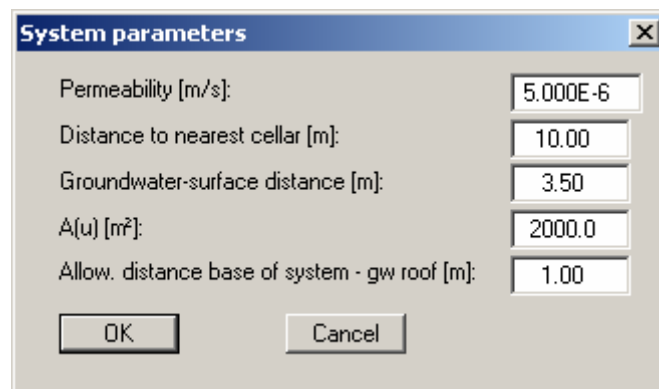
A required shaft depth of 4.34 m is obtained as the sum of the impounding depth z ($= 2.34$ m), the frost-free depth of the supply pipe ($= 1.0$ m), the thickness of the filter ($= 0.5$ m) and the thickness of the sand/fine-gravel layer ($= 0.5$ m).

6.7 Swale-French drain infiltration (DWA-A 138, Appendix A.2.3 a)

The theoretical principles are contained in the standard (Chapters 3.2.3 and 3.3.3, DWA-A 138, April 2005).

The procedure is demonstrated using Example a) in the standard (Appendix A.2.3). Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Enter a surcharge factor of **1.2**, if not already defined. Exit the dialog box by clicking the "**Swale-French drain infiltration (new)**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:



Parameter	Value
Permeability [m/s]:	5.000E-6
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	3.50
A(u) [m²]:	2000.0
Allow. distance base of system - gw roof [m]:	1.00

Confirm your input with "**OK**". Then select the "**Edit/Swale-French drain infiltration**" menu item and enter the data from the following dialog box:

Swale-French drain infiltration

Swale area

Automatic

Swale area (selected) [m]: 200.00

Permeability (swale) [m]: 5.000E-5
(= topsoil permeability)

Frequency (swale) [1/a]: 0.2/a (5-year)

Topsoil thickness [m]: 0.300

Frequency (French drain) [1/a]: 0.2/a (5-year)

Throttled flow [m²/s]: 0.00000

Base width of French drain [m]: 1.500

Height of French drain [m]: 1.000
(from ground level)

Storage coefficient s [-]: 0.350
For gravel = 0.35; for sand = 0.20

OK Cancel

Confirm your input with "**OK**". A location-specific table can now be entered with its rainfall intensities. For this example the "**Hannover-Süd**" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "**Edit/Rainfall intensity table**", Section 7.2.6).

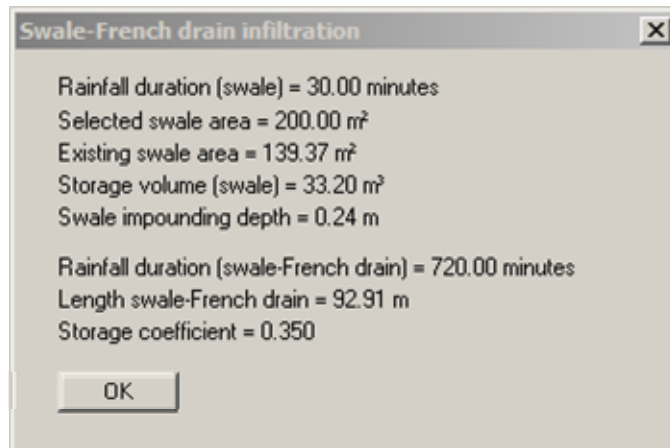
The swale-French drain infiltration can now be analysed. Go to the "**System/Analyse**" menu item. A note is shown first:

Note

Existing swale area (139.37 m²) deviates
by more than 35% from that selected (200.00 m²).
This should be corrected!
How to continue ?

Correct Accept Cancel

Select the "**Accept**" button here to completely copy the example in the new standard. Normally, "**Correct**" should be selected in order to adapt the selected swale area to the in-situ conditions. After pressing "**Accept**" the results of the analysis are shown:



Following this the analysis results are displayed in the graphics.

Results
 Swale depth impounding depth = 0.24 m
 Length swale-French drain = 92.91 m
 Rainfall duration (swale) = 30.00 minutes
 Rainfall duration (swale-French drain) = 720.00 minutes
 Storage volume (swale) = 33.20 m³
 Storage coefficient = 0.350

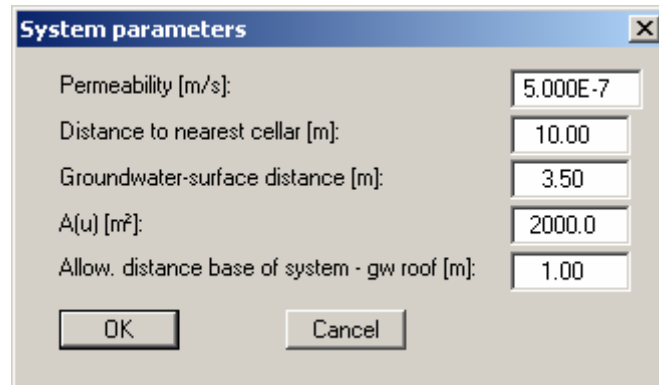
Hanover-Sud				
D	Pos.2 [l/(s*ha)]	L (Fr. drain) [m]	Pos.1 [l/(s*ha)]	V (swale) [m³]
20 min	124.0	11.42	124.0	22.05
30 min	92.6	20.16	92.6	33.20
45 min	69.2	29.79	69.2	33.13
60 min	56.4	37.32	56.4	32.00
90 min	42.0	47.55	42.0	27.45
2 h	34.1	55.64	34.1	21.62
3 h	25.4	66.49	25.4	7.62
4 h	20.7	74.40	20.7	-
6 h	15.4	83.42	15.4	-
9 h	11.5	90.55	11.5	-
12 h	9.3	92.91	9.3	-
15 h	6.5	90.97	6.5	-
24 h	3.5	85.41	3.5	-
48 h	3.0	66.37	3.0	-

A swale depth of 0.24 m and a French drain length of 92,91 m are obtained.

6.8 Swale-pipe infiltration

In order to emphasise the procedure the previous example is modified to a swale-pipe infiltration. Go to the menu item "File/New" or "Edit/Infiltration type". Then press the "Swale-pipe infiltration (new)" button.

Select the "Edit/System parameters" menu item and enter the data from the following dialog box:



The image shows a dialog box titled "System parameters" with a close button (X) in the top right corner. It contains five input fields with the following values:

Parameter	Value
Permeability [m/s]:	5.000E-7
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	3.50
A(u) [m ²):	2000.0
Allow. distance base of system - gw roof [m]:	1.00

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

Confirm your input with "OK". Then select the "Edit/Swale-pipe infiltration" menu item and enter the data from the following dialog box:

Swale-pipe infiltration

Automatic

Swale area (selected) [m]: 100.00

Permeability (swale) [m]: 5.000E-5
(= topsoil permeability)

Frequency (swale) [1/a]: 1/a (1-year)

Topsoil thickness [m]: 0.300

Frequency (French drain) [1/a]: 0.2/a (5-year)

Throttled flow [m²/s]: 0.00100

Base width of French drain [m]: 1.500

Height of French drain [m]: 1.000
(from ground level)

Clear dimension of pipe [m]: 0.200

Pipe thickness [m]: 0.040

Storage coefficient s [-]: 0.350
For gravel = 0.35; for sand = 0.20

Thickness of layer below pipe (for graphics only)

Thickness [m]: 0.200

Raise pipe

OK Cancel

Confirm your input with "OK". A location-specific table can now be entered with its rainfall intensities. For this example the "**Hannover-Süd**" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "**Edit/Rainfall intensity table**", Section 7.2.6).

The swale-pipe infiltration can now be analysed. Go to the "**System/Analyse**" menu item. The results of the analysis are shown:

Swale-pipe infiltration

Rainfall duration (swale) = 60.00 minutes

Selected swale area = 100.00 m²

Existing swale area = 92.59 m²

Storage volume (swale) = 24.49 m³

Swale impounding depth = 0.26 m

Rainfall duration (swale-pipe) = 240.00 minutes

Length swale-pipe = 61.73 m

Storage coefficient (converted) = 0.354

OK

Following this the analysis results are displayed in the graphics.

Hannover-Süd				
D	For. Q [l/(s·ha)]	L (P. drain) [m]	For. q [l/(s·ha)]	V (swale) [m³]
45 min	69.2	38.30	47.0	23.55
60 min	58.4	41.59	35.9	24.49
90 min	42.0	48.98	25.9	23.12
2 h	34.1	52.83	23.4	20.55
3 h	25.4	55.55	17.3	14.85
4 h	20.7	61.73	14.0	7.80
6 h	15.4	61.35	10.4	-
9 h	11.5	55.40	7.7	-
12 h	9.3	44.85	6.3	-

Results
 Swale depth impounding depth = 0.26 m
 Length swale-Pipe = 61.73 m
 Rainfall duration (swale) = 60.00 minutes
 Rainfall duration (swale-Pipe) = 240.00 minutes
 Storage volume (swale) = 24.49 m³
 Storage coefficient (converted) = 0.354

A swale depth of 0.26 m and a French drain length of 61.73 m are obtained.

6.9 Paving with swale infiltration

Notes on the structural design of these systems can be taken from:

- *Merkblatt für wasserdurchlässige Befestigungen von Verkehrsflächen, Forschungsgesellschaft für Straßen- und Verkehrswesen, Ausgabe 1998 (Impervious Paving of Traffic Areas, Fact Sheet German Highways & Traffic Research Association, 1998 edition)*

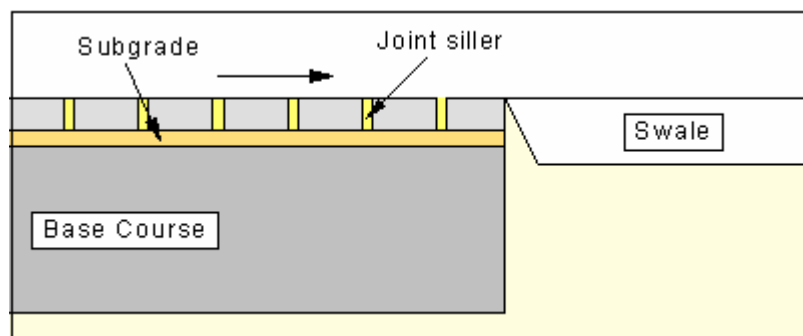


Figure 1 "Paving with swale" designations

The basic design principle is:

The paving is designed as a surface infiltration according to DWA. The surface area supplying the paving $A(u)(paving)$ is obtained from:

- $A(u)(paving) = A(u)(total) \cdot (1.0 - \text{runoff coefficient})$

The decisive permeability for the paving $k_f(paving)$ is obtained from:

- $k_f(paving) = k_f(joints) \cdot \text{proportion of joints}[\%]/100.0$

If this value is greater than the permeability of the subgrade or the subsurface, the smaller value is adopted. The swale is designed as a swale infiltration according to DWA. The surface area supplying the swale $A(u)(swale)$ is obtained from:

- $A(u)(swale) = A(u)(total) \cdot \text{runoff coefficient}$

The decisive permeability for the swale $k_f(swale)$ is obtained from:

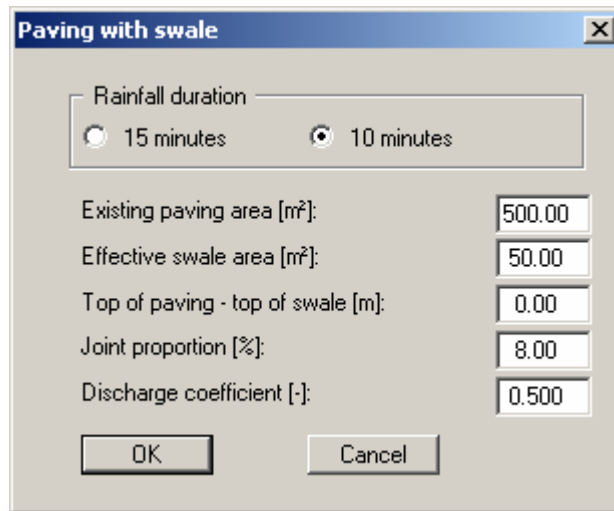
- $k_f(swale) = k_f(subsurface)$

The procedure is demonstrated using a worked example. Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Exit the dialog box by clicking the "**Paving with swale**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:

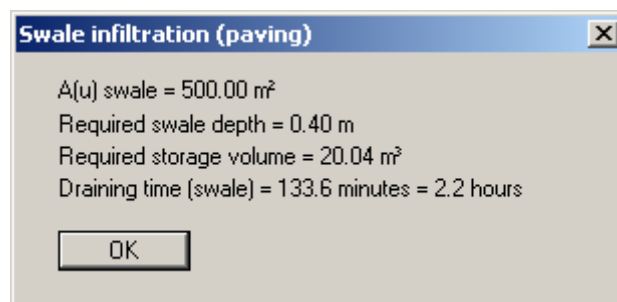
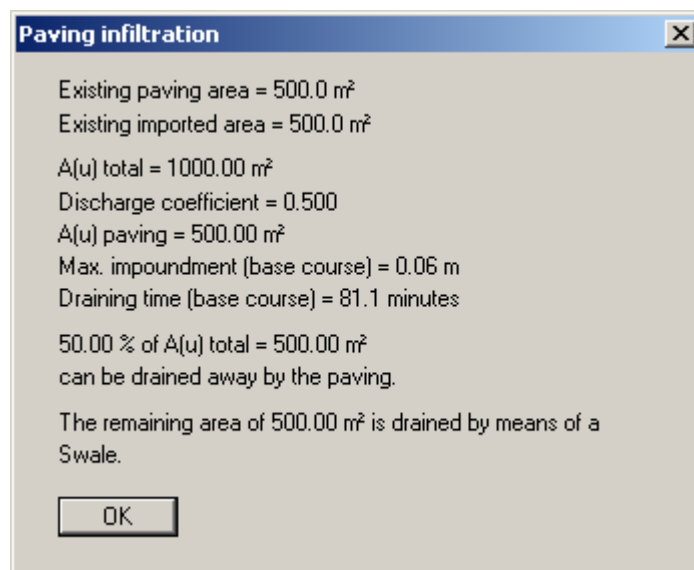
Parameter	Value
Permeability (joints) [m/s]:	1.000E-3
Permeability (subgrade) [m/s]:	1.000E-3
Permeability (base course) [m/s]:	1.000E-4
Thickness (base course) [m]:	0.50
Effective pore space (base course) [-]:	0.20
Permeability (subsurface) [m/s]:	5.000E-6
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	2.00
A(u) [imported area] [m²]: (without paving, e.g. from roof areas)	500.0
Allow. distance base of system - gw roof [m]:	1.00
Frequency n [1/a]:	0.2/a (5-year)

Confirm your input with "**OK**". Then select the "**Edit/Paving with swale**" menu item and enter the data from the following dialog box:



Confirm your input with "OK". A location-specific table can now be entered with its rainfall intensities. For this example the "Hannover-Süd" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "Edit/Rainfall intensity table", Section 7.2.6).

The infiltration system can now be analysed. Go to the "System/Analyse" menu item. The results of the analysis are shown:



Following this the analysis results are displayed in the graphics.

Results
 Effective permeability (joints) = $8.000 \cdot 10^{-5}$ m/s
 Required swale depth = 0.40 m
 Required storage volume (swale) = 20.04 m³
 Max. impoundment (base course) = 0.06 m
 Rainfall per unit area (paving) = 204.60 Liter/(sec·ha)
 Rainfall duration (paving) = 10 mins
 Rainfall per unit area (swale) = 9.30 Liter/(sec·ha)
 Draining time (swale) = 2.2 hours

Hannover-Süd			
D	r _{0(0,t)} [l/(s·ha)]	r _{0(0,t)} [l/(s·ha)]	V (swale) [m ³]
5 min	338.9	338.9	6.67
10 min	204.6	204.6	8.01
15 min	152.6	152.6	8.93
20 min	124.0	124.0	9.64
30 min	92.6	92.6	10.73
45 min	69.2	69.2	11.93
60 min	56.4	56.4	12.86
90 min	42.0	42.0	14.16
2 h	34.1	34.1	15.12
3 h	25.4	25.4	16.49
4 h	20.7	20.7	17.51
6 h	15.4	15.4	18.71
9 h	11.5	11.5	19.73
12 h	9.3	9.3	20.04
18 h	6.8	6.8	19.36

A swale depth of 0.40 m is obtained.

6.10 Paving with French drain infiltration

Notes on the structural design of these systems can be taken from:

- Merkblatt für wasserdurchlässige Befestigungen von Verkehrsflächen, Forschungsgesellschaft für Straßen- und Verkehrswesen, Ausgabe 1998 (Impervious Paving of Traffic Areas, Fact Sheet German Highways & Traffic Research Association, 1998 edition)*

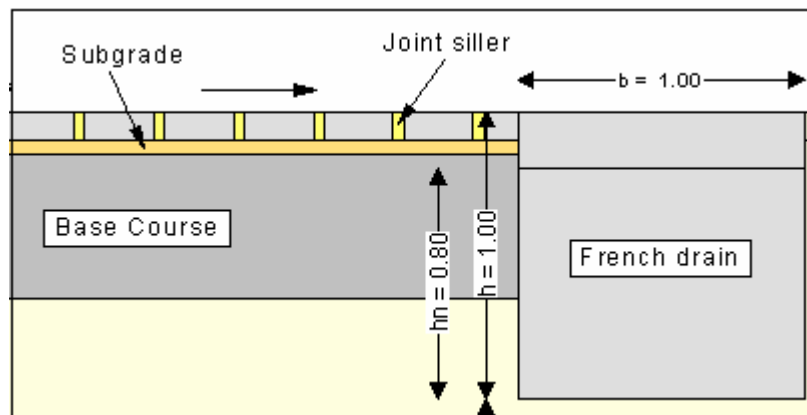


Figure 2 "Paving with French drain" designations

The basic design principle is:

The paving is designed as a surface infiltration according to DWA. The surface area supplying the paving $A(u)(paving)$ is obtained from:

- $A(u)(paving) = A(u)(total) \cdot (1.0 - \text{runoff coefficient}).$

The decisive permeability for the paving $k_f(paving)$ is obtained from:

- $k_f(paving) = k_f(joints) \cdot \text{proportion of joints [\%]}/100.0.$

If this value is greater than the permeability of the subgrade or the subsurface, the smaller value is adopted. The French drain is designed as a French drain infiltration according to DWA. The surface area supplying the French drain $A(u)(\text{French drain})$ is obtained from:

- $A(u)(\text{French drain}) = A(u)(\text{total}) \cdot \text{runoff coefficient}$.

The decisive permeability for the subsurface of the French drain $k_f(\text{French drain})$ is obtained from:

- $k_f(\text{French drain}) = k_f(\text{subsurface})$.

The procedure is demonstrated using a worked example. Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Exit the dialog box by clicking the "**Paving with French drain**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:

Parameter	Value
Permeability (joints) [m/s]:	1.000E-3
Permeability (subgrade) [m/s]:	1.000E-3
Permeability (base course) [m/s]:	1.000E-4
Thickness (base course) [m]:	0.50
Effective pore space (base course) [-]:	0.20
Permeability (subsurface) [m/s]:	5.000E-6
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	2.00
A(u) [imported area] [m²]: (without paving, e.g. from roof areas)	500.0
Allow. distance base of system - gw roof [m]:	1.00
Frequency n [1/a]:	0.2/a (5-year)

Confirm your input with "**OK**". Then select the "**Edit/Paving with French drain**" menu item and enter the data from the following dialog box:

Paving with French drain [X]

Rainfall duration
 15 minutes 10 minutes

Existing paving area [m²]:

Top of paving - top of French drain [m]:

Joint proportion [%]:

Discharge coefficient [-]:

Base width of French drain [m]:

French drain height [m]:

Max. water level in French drain [m]:
 (from ground level)

Eff. height = French drain height - max. water level in French drain

Storage coefficient s [-]:
 For gravel = 0.35; for sand = 0.20

Confirm your input with "OK". A location-specific table can now be entered with its rainfall intensities. For this example the "**Hannover-Süd**" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "**Edit/Rainfall intensity table**", Section 7.2.6).

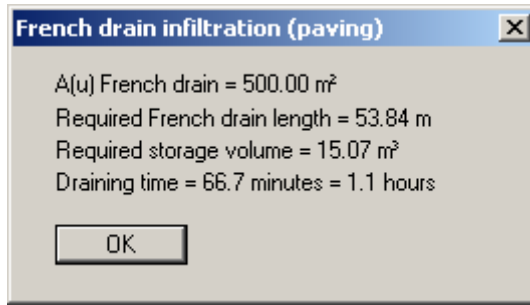
The infiltration system can now be analysed. Go to the "**System/Analyse**" menu item. The results of the analysis are shown:

Paving infiltration [X]

Existing paving area = 500.0 m²
 Existing imported area = 500.0 m²
 A(u) total = 1000.00 m²
 Discharge coefficient = 0.500
 A(u) paving = 500.00 m²
 Max. impoundment (base course) = 0.06 m
 Draining time (base course) = 81.1 minutes

50.00 % of A(u) total = 500.00 m²
 can be drained away by the paving.

The remaining area of 500.00 m² is drained by means of a French drain.



Following this the analysis results are displayed in the graphics.

Results
 Effective permeability (joints) = $8.000 \cdot 10^{-5}$ m/s
 Required French drain length = 53.84 m
 Required storage volume (French drain) = 15.07 m³
 Max. impoundment (base course) = 0.06 m
 Rainfall per unit area (paving) = 204.60 Liter/(sec·ha)
 Rainfall duration (paving) = 10 mins
 Rainfall per unit area (French drain) = 15.40 Liter/(sec·ha)
 Draining time (French drain) = 1.1 hours

Hannover-Süd			
D	$r_{D(0.2)}$ [l/(s·ha)]	$r_{D(0.2)}$ [l/(s·ha)]	L (pipe) [m]
5 min	338.9	338.9	21.69
10 min	204.6	204.6	26.07
15 min	152.6	152.6	29.04
20 min	124.0	124.0	31.32
30 min	92.6	92.6	34.78
45 min	69.2	69.2	38.48
60 min	56.4	56.4	41.28
90 min	42.0	42.0	44.96
2 h	34.1	34.1	47.48
3 h	25.4	25.4	50.59
4 h	20.7	20.7	52.53
6 h	15.4	15.4	53.84
9 h	11.5	11.5	53.73

A French drain length of 53.84 m is obtained.

6.11 Paving with pipe infiltration

Notes on the structural design of these systems can be taken from:

- *Merkblatt für wasserdurchlässige Befestigungen von Verkehrsflächen, Forschungsgesellschaft für Straßen- und Verkehrswesen, Ausgabe 1998 (Impervious Paving of Traffic Areas, Fact Sheet German Highways & Traffic Research Association, 1998 edition)*

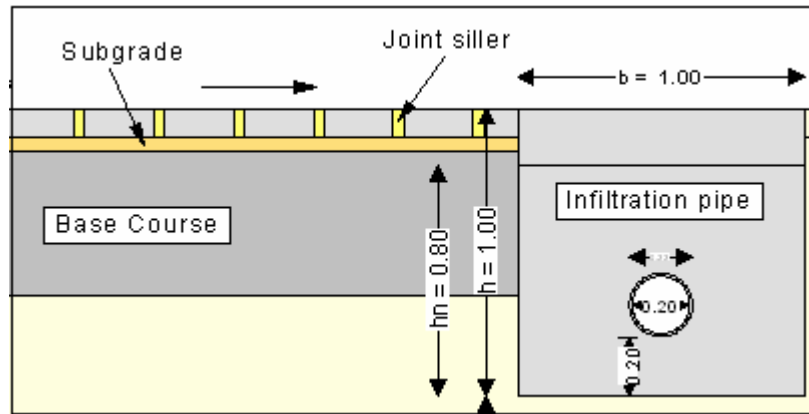


Figure 3 "Paving with pipe" designations

The basic design principle is:

The paving is designed as a surface infiltration according to DWA. The surface area supplying the paving $A(u)(\text{paving})$ is obtained from:

- $A(u)(\text{paving}) = A(u)(\text{total}) \cdot (1.0 - \text{runoff coefficient})$.

The decisive permeability for the paving $k_f(\text{paving})$ is obtained from:

- $k_f(\text{paving}) = k_f(\text{joints}) \cdot \text{proportion of joints [\%]}/100.0$.

If this value is greater than the permeability of the subgrade or the subsurface, the smaller value is adopted. The pipe is designed as an pipe according to DWA. The surface area supplying the pipe $A(u)(\text{pipe})$ is obtained from:

- $A(u)(\text{pipe}) = A(u)(\text{total}) \cdot \text{runoff coefficient}$.

The decisive permeability for the subsurface of the pipe $k_f(\text{pipe})$ is obtained from:

- $k_f(\text{pipe}) = k_f(\text{subsurface})$.

The procedure is demonstrated using a worked example. Go to the menu item "**File/New**" or "**Edit/Infiltration type**". Because analysis is performed according to DWA-A 138 using the rainfall intensity tables in the KOSTRA Atlas, the "**Table**" radio button is activated. Exit the dialog box by clicking the "**Paving with pipe**" button.

Select the "**Edit/System parameters**" menu item and enter the data from the following dialog box:

Permeability (joints) [m/s]:	1.000E-3
Permeability (subgrade) [m/s]:	1.000E-3
Permeability (base course) [m/s]:	1.000E-4
Thickness (base course) [m]:	0.50
Effective pore space (base course) [-]:	0.20
Permeability (subsurface) [m/s]:	5.000E-6
Distance to nearest cellar [m]:	10.00
Groundwater-surface distance [m]:	2.00
A(u) [imported area] [m ²]: (without paving, e.g. from roof areas)	500.0
Allow. distance base of system - gw roof [m]:	1.00
Frequency n [1/a]:	0.2/a (5-year) ▼

OK Cancel

Confirm your input with "**OK**". Then select the "**Edit/Paving with pipe**" menu item and enter the data from the following dialog box:

Paving with pipe [X]

Rainfall duration
 15 minutes 10 minutes

Existing paving area [m²]:

Joint proportion [%]:

Discharge coefficient [-]:

Clear dimension of pipe [m]:

Pipe thickness [m]:

Base width of French drain [m]:

French drain height [m]:

Top of paving - top of French drain [m]:

Max. water level in French drain [m]:
 (from ground level)

Eff. height = French drain height - max. water level in French drain

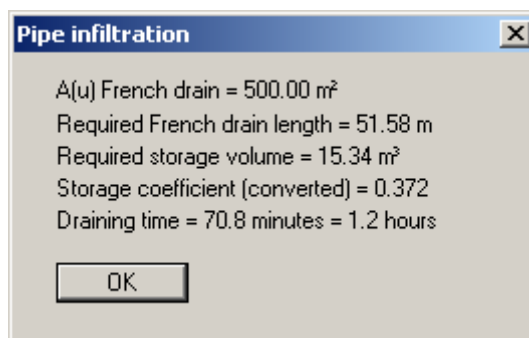
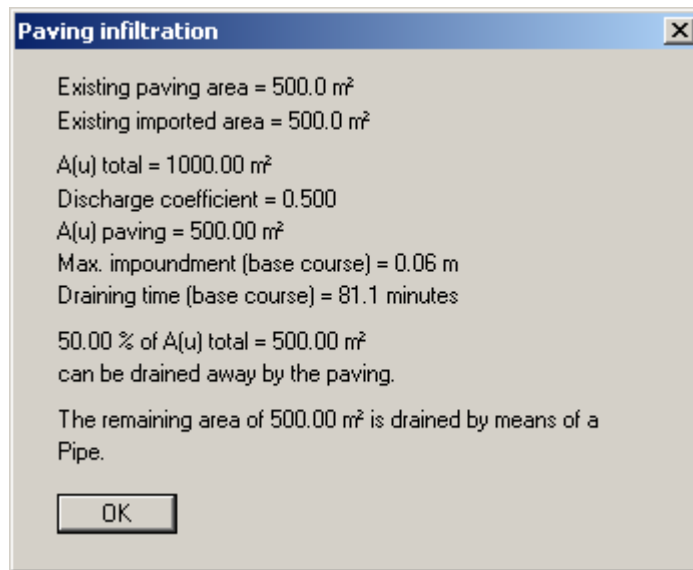
Storage coefficient s [-]:
 For gravel = 0.35; for sand = 0.20

Thickness of layer below pipe (for graphics only)
 Thickness [m]:

Raise pipe

Confirm your input with "**OK**". A location-specific table can now be entered with its rainfall intensities. For this example the "**Hannover-Süd**" rainfall intensity table is used. It is loaded automatically when the program starts (see menu item "**Edit/Rainfall intensity table**", Section 7.2.6).

The infiltration system can now be analysed. Go to the "**System/Analyse**" menu item. The results of the analysis are shown:



Following this the analysis results are displayed in the graphics.

Results
 Effective permeability (joints) = $8.000 \cdot 10^{-5}$ m/s
 Required pipe length = 51.58 m
 Required storage volume (pipe) = 15.34 m³
 Max. impoundment (base course) = 0.06 m
 Rainfall per unit area (paving) = 204.60 Liter/(sec·ha)
 Rainfall duration (paving) = 10 mins
 Rainfall per unit area (pipe) = 11.50 Liter/(sec·ha)
 Draining time (pipe) = 1.2 hours

Hammer-Sud			
D	F _{0.05} [l/(s·ha)]	F _{0.01} [l/(s·ha)]	L (Fr. drain) [m]
5 min	338.9	338.9	20.43
10 min	204.6	204.6	24.58
15 min	152.6	152.6	27.38
20 min	124.0	124.0	29.52
30 min	92.6	92.6	32.50
45 min	69.2	69.2	36.32
60 min	56.4	56.4	39.99
90 min	42.0	42.0	42.52
2 h	34.1	34.1	44.97
3 h	29.4	29.4	48.03
4 h	26.7	26.7	49.95
6 h	19.4	19.4	51.43
9 h	11.5	11.5	51.58
12 h	9.2	9.2	50.25

A French drain length of 51.58 m is obtained.

6.12 Swale-pipe infiltration (old)

This infiltration type is only supported in order to retain the availability of older records. Design is only possible using Reinhold's rainfall series'. Analyses should therefore no longer be carried out using this type of infiltration!

Details of design and theoretical principles can be taken from the menu item "**Edit/Construction notes + theory**".

6.13 Swale-French drain infiltration (old)

This infiltration type is only supported in order to retain the availability of older records. Design is only possible using Reinhold's rainfall series'. Analyses should therefore no longer be carried out using this type of infiltration!

Details of design and theoretical principles can be taken from the menu item "**Edit/Construction notes + theory**".

7 Description of menu items

7.1 File menu

7.1.1 "New" menu item

A new system design can be entered and analysed. After going to this menu item the option box opens to allow selection of the required type of infiltration (see menu item "**Edit/Infiltration type**", Section 7.2.2).

7.1.2 "Load" menu item

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

7.1.3 "Save" menu item

You can save data entered or edited during program use to a file, in order to have them available at a later date, or to archive them. The data is saved without prompting with the name of the current file.

7.1.4 "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 ".vrs" as file suffix, as this is the suffix used in the file requester box for the menu item "**File/Load**". If you choose not to enter an extension when saving, ".vrs" will be used automatically.

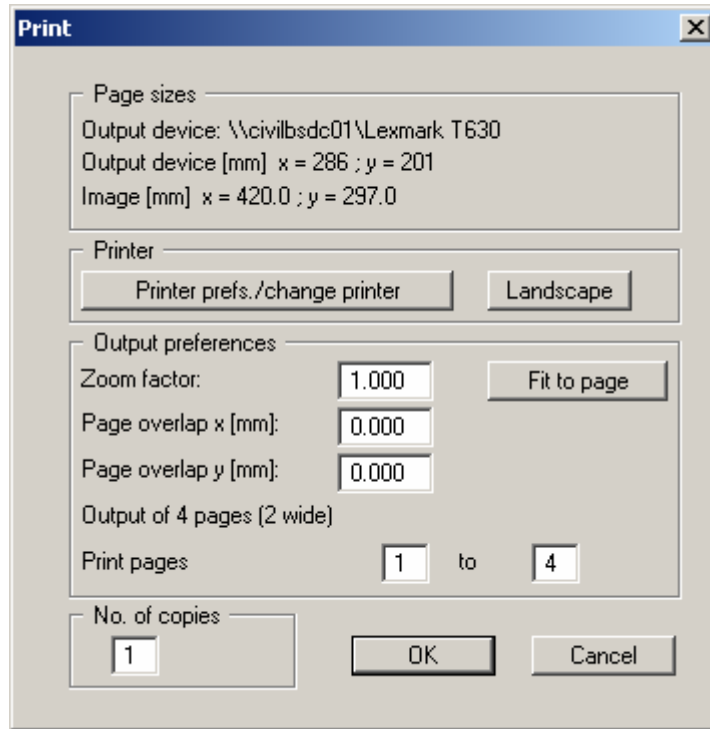
7.1.5 "Printer preferences" menu item

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

7.1.6 "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. to the WINDOWS standard printer or to any other printer selected using the menu item **"File/Printer preferences"**. But you may also select a different printer in the following dialog box by pressing the **"Printer prefs./change printer"** button.



In the upper part of the dialog 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). In order 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. 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.
- **"GGUCAD file"**
allows output of the graphics to a file, in order to enable further processing with the **GGUCAD** 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.

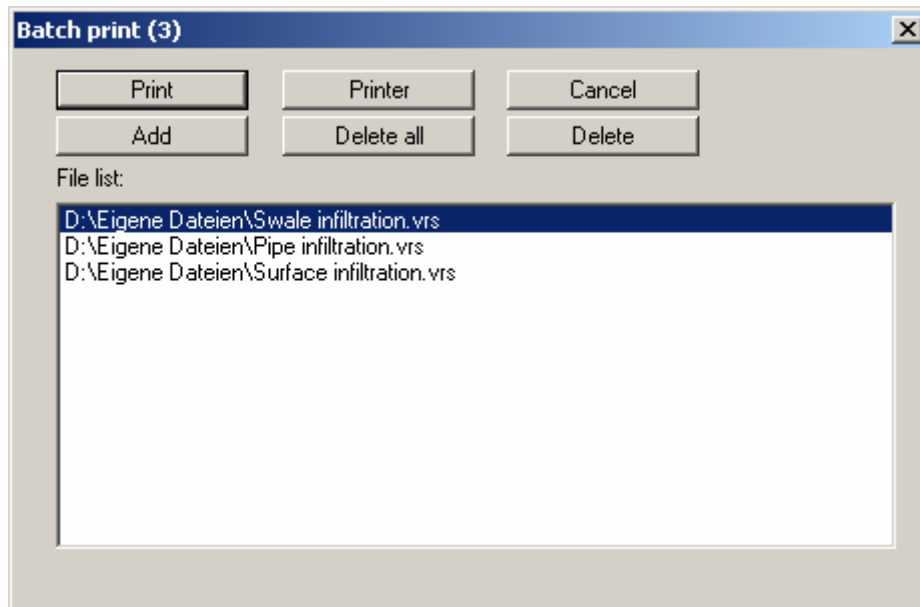
If you select the **"Copy/print area"** tool  from the toolbar, you can copy parts of the graphics to the clipboard or save them to an EMF file. Alternatively you can send the marked area directly to your printer (see "**Tips and tricks**", Section 8.3).

Using the "**Mini-CAD**" program module you can also import EMF files generated using other GGU applications into your graphics.

- **"MiniCAD"**
allows export of the graphics to a file in order to enable importing to different GGU applications with the **Mini-CAD** module.
- **"GGUMiniCAD"**
allows export of the graphics to a file in order to enable processing in the **GGUMiniCAD** program.
- **"Cancel"**
Printing is cancelled.

7.1.7 "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.

7.1.8 "Exit" menu item

After a confirmation prompt, you can quit the program.

7.1.9 "1, 2, 3, 4" menu items

The "**1, 2, 3, 4**" menu items show the last four files worked on. By selecting one of these menu items the listed file will be loaded. If you have saved files in any other folder than the program folder, you can save yourself the occasionally onerous *rummaging* through various sub-folders.

7.2 Edit menu

7.2.1 "Project identification" menu item

A description typifying the system can be entered; it will then be included in the "**System parameters legend**" (see Section 7.4.1).

The infiltration type adopted is entered automatically and does not need to be entered via this menu item.

7.2.2 "Infiltration type" menu item

This menu item is used to select the required type of infiltration. The system is designed according to DWA-A 138 (April 2005), using the rainfall intensity tables from the KOSTRA Atlas. The "**Table**" radio button is activated in the following dialog box; in addition, a surcharge factor can be entered. According to the standard, this may be between 1.1 and 1.2. If the "**Reinhold**" button is activated, design uses the old method with the Reinhold's rainfall series'.

The dialog box titled "Type of infiltration" contains the following elements:

- Calculate Rainfall intensity after:
 - Reinhold
 - Table
- Surcharge factor [-]:
- Buttons for infiltration types:
 - Surface infiltration
 - Swale infiltration
 - Pipe infiltration
 - French drain infiltration
 - Shaft infiltration
 - Swale-pipe infiltration (old)
 - Swale-French drain infiltration (old)
 - Paving with swale
 - Paving with French drain
 - Paving with pipe
 - Swale-pipe infiltration (new)
 - Swale-French drain infiltration (new)
- Cancel

After selecting an infiltration type the screen graphics are refreshed accordingly.

7.2.3 "System parameters" menu item

The primary system boundary conditions are entered using this menu item. The dialog box has a different appearance depending on the infiltration type selected, see the examples given in Section 6.

All data entered using this menu item are displayed in the "**System parameters legend**" on the output sheet (see Section 7.4.1).

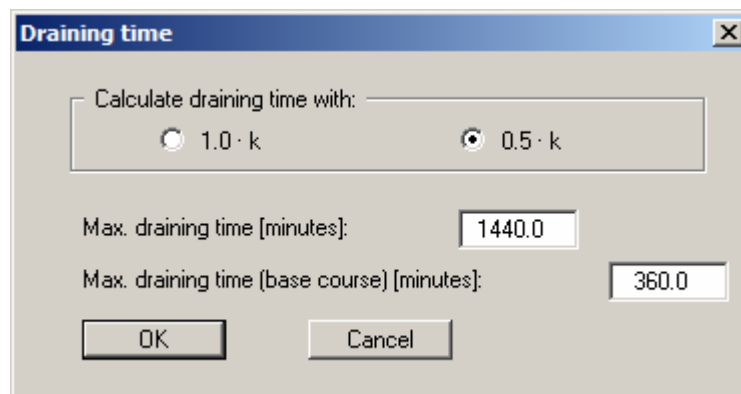
7.2.4 "Swale infiltration, Pipe infiltration ..." menu items

The boundary conditions typifying the individual infiltration types are defined using this menu item. Depending on the infiltration type selected the dialog box has a different design, see the examples given in Section 6.

All data entered using this menu item are displayed in the "**System parameters legend**" on the output sheet (see Section 7.4.1).

7.2.5 "Draining time" menu item

The permeability used to compute the draining time of the infiltration system is defined using this menu item. The DWA-A 138 standard proposes $0.5 \cdot k$ for analysis. Activate the required value in the dialog box.



The maximum draining time is given in the lower half of the box (displayed for paving with French drain). The program will issue a warning if this value is exceeded during infiltration system analysis.

7.2.6 "Rainfall intensity table" menu item

If the analysis is performed using the data from the KOSTRA Atlas tables, location-specific data must be used. The "**Hannover-Süd**" rainfall intensity table is included with the **GGU-SEEP** delivery. The data is loaded automatically when the program starts and displayed in the following dialog box:

No.	D	rD(1/a)	rD(0.2/a)	rD(0.1/a)	rD(0.05/a)	rD(0.02/a)
1	5 min	201.00	338.90	398.30	458.00	537.70
2	10 min	127.10	204.60	238.00	273.70	321.30
3	15 min	97.20	152.60	176.40	202.90	238.10
4	20 min	80.40	124.00	142.70	164.10	192.60
5	30 min	61.50	92.60	106.00	121.90	143.10
6	45 min	47.00	69.20	78.80	90.60	106.40
7	60 min	38.90	56.40	63.90	73.50	86.30
8	90 min	28.90	42.00	47.70	54.90	64.40
9	2 h	23.40	34.10	38.80	44.60	52.40
10	3 h	17.30	25.40	28.90	33.20	39.00
11	4 h	14.00	20.70	23.50	27.00	31.70
12	6 h	10.40	15.40	17.50	20.10	23.60
13	9 h	7.70	11.50	13.10	15.10	17.70
14	12 h	6.30	9.30	10.60	12.20	14.30
15	18 h	4.60	6.80	7.70	8.90	10.40
16	24 h	3.80	5.50	6.20	7.10	8.40
17	48 h	2.20	3.00	3.40	3.90	4.60
18	72 h	1.70	2.30	2.60	3.00	3.50

- **"OK"**
Closes the dialog box. The changes made are accepted.
- **"Load"**
Any previously entered and saved rainfall intensity tables can be opened as ".drg" files and the data used to analyse the planning zone.
- **"Save"**
User-define rainfall intensities or those imported from the KOSTRA Atlas can be saved in the ".drg" format and the data for the respective site thus utilised for subsequent analyses.
- **"Cancel"**
Closes the dialog box. Any changes made are not accepted.

- **"Convert"**
If the rainfall intensity data is available in [mm] instead of [litres/(second · ha)], enter the values into the table in [mm]. Then click the **"Convert"** button and confirm this in the following message box by clicking **"Yes"**.

However, only do this if the data has been entered in [mm] and then only once, otherwise the data will be rendered useless.

- **"Convert back"**
The "Convert back" button is intended for *emergencies*. It allows erroneously converted data to be reconverted to its original condition.

"KOSTRA" group box

- **"Import file"**
If the required rainfall intensity table is not available as a file, the data can be imported from the KOSTRA Atlas using this button.

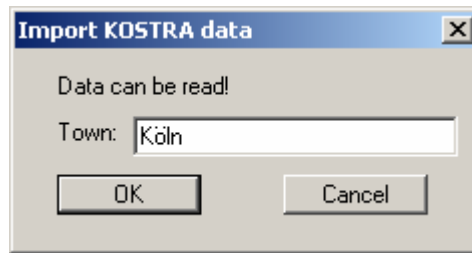
The *printed edition of the KOSTRA Atlas* includes a DOS program for generating rainfall intensity tables. If the DOS program is started, you are asked for the values for various rainfall durations and frequencies for the respective location, which must be picked off the maps provided. After entering the required data the DOS program is automatically closed and the determined values stored in a **"table"** file. Open the file in a text editor and save it with the name of the location as a text file (*.txt), otherwise the program will overwrite the old data. If the open the **"table"** file using an editor it will look similar to that in the figure below.

Niederschlagshoehen und -spenden fuer das ausgewaehlte Rasterfeld																	
=====																	
T	I	.5	1.	2.	5.	10.	20.	50.	100.								
D	I	hN	RN	hN	RN	hN	RN	hN	RN	hN	RN	hN	RN	hN	RN		
5 min	I	5.3	176.0	6.6	220.5	7.9	264.9	9.7	323.7	11.0	368.2	12.4	412.6	14.1	471.4	15.5	515.8
10 min	I	6.5	108.2	8.3	138.5	10.1	168.9	12.5	209.0	14.4	239.3	16.2	269.6	18.6	309.7	20.4	340.0
15 min	I	7.3	81.3	9.5	105.6	11.7	129.8	14.6	161.9	16.8	186.1	18.9	210.4	21.8	242.4	24.0	266.7
20 min	I	8.0	66.3	10.4	87.0	12.9	107.7	16.2	135.1	18.7	155.8	21.2	176.5	24.5	203.8	26.9	224.5
30 min	I	9.0	49.8	11.9	66.3	14.9	82.9	18.9	104.7	21.8	121.3	24.8	137.9	28.7	159.7	31.7	176.2
45 min	I	10.1	37.3	13.6	50.5	17.2	63.8	21.9	81.3	25.5	94.5	29.1	107.7	33.8	125.2	37.4	138.4
60 min	I	10.9	30.4	15.0	41.7	19.1	53.0	24.4	67.9	28.3	79.2	32.6	90.5	37.9	105.4	42.0	116.7
90 min	I	12.0	22.2	16.4	30.4	20.8	38.5	26.6	49.3	31.0	57.5	35.4	65.6	41.2	76.4	45.6	84.5
2 h	I	12.8	17.8	17.5	24.3	22.1	30.8	28.3	39.3	33.0	45.8	37.6	52.2	43.8	60.8	48.4	67.3
3 h	I	14.1	13.0	19.1	17.7	24.2	22.4	30.8	28.6	35.9	33.2	40.9	37.9	47.6	44.1	52.6	48.7
4 h	I	15.1	10.5	20.4	14.2	25.7	17.9	32.8	22.8	38.1	26.5	43.5	30.2	50.5	35.1	55.8	38.8
6 h	I	16.5	7.6	22.3	10.3	28.1	13.0	35.7	16.5	41.5	19.2	47.3	21.9	54.9	25.4	60.7	28.1
9 h	I	18.1	5.6	24.4	7.5	30.7	9.5	38.9	12.0	45.2	13.9	51.4	15.9	59.7	18.4	66.0	20.4
12 h	I	19.4	4.5	26.0	6.0	32.6	7.6	41.4	9.6	48.0	11.1	54.6	12.6	63.4	14.7	70.0	16.2
18 h	I	20.9	3.2	28.0	4.3	35.1	5.4	44.4	6.9	51.5	7.9	58.6	9.0	67.9	10.5	75.0	11.6
24 h	I	22.5	2.6	30.0	3.5	37.5	4.3	47.5	5.5	55.0	6.4	62.5	7.2	72.5	8.4	80.0	9.3
48 h	I	26.7	1.5	35.0	2.0	43.3	2.5	54.2	3.1	62.5	3.6	70.8	4.1	81.7	4.7	90.0	5.2
72 h	I	31.0	1.2	40.0	1.5	49.0	1.9	61.0	2.4	70.0	2.7	79.0	3.0	91.0	3.5	100.0	3.9

T - Wiederkehrzeit (in a): mittlere Zeitspanne in der ein Ereignis einen wert einmal erreicht oder ueberschreitet
D - Niederschlagsdauer einschliesslich Unterbrechungen (in mm, h)
hN - Niederschlagshoehe (in mm)
RN - Niederschlagsspende (in l/(s*ha))

The **GGU-SEEP** program automatically uses the rainfall intensities RN in [litres/(sec·ha)] (marked columns in the figure above) generated by the DOS program.

Click the **"Import file"** button to transfer the data to **GGU-SEEP** and open the previously created **"table"** file or the corresponding text file. Enter the location name for which the rainfall intensities have been determined in the following dialog box, if it is not already imported from the TXT file.



After confirmation using "OK" the location name is used in the "Rainfall intensity table" dialog box.

In order to allow reuse of the KOSTRA data once imported, save them using the location name via the "Save" button (see above).

- "Import clipboard"
If you use the *KOSTRA-DWD 2000 (digital database)* program in order to determine the rainfall intensities for the required location, enter the result from the KOSTRA-DWD 2000 program via "Send to clipboard". Then open any text editor and paste the generated rainfall intensity table from the clipboard. It is best to save the file as a text file using the location name.
- "Info"
The discussed KOSTRA data import types are described here.

7.2.7 "Construction notes + theory"

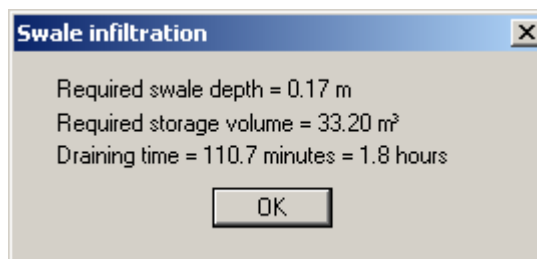
Explanations of designs taken from the DWA-A 138 standard are displayed depending on the selected type of infiltration. You are referred to the DWA-A 138 for some infiltration types.

7.3 System menu

7.3.1 "Analyse" menu item

This menu item starts the analysis of the infiltration system. Alternatively, press the [F5] function key or click the *calculator* in the tool bar. First, the input data are checked. A warning message is produced if errors are identified.

Once the analysis is complete information on the analysis is displayed, as shown in the following box.

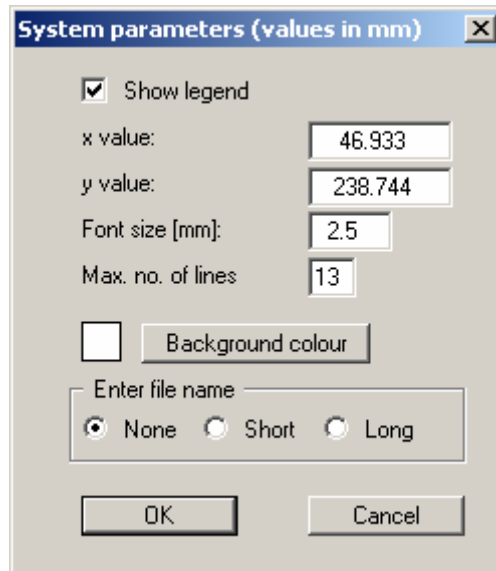


After confirming the input with "OK", the analysed system is displayed on the screen. In addition, the principle result data are displayed in a legend on the screen.

7.4 Output preferences menu

7.4.1 "System parameters legend" menu item

After selecting this menu item a dialog box opens allowing graphics preferences to be selected for displaying a legend containing system data. The legend is activated by the "**Show legend**" check box. In addition to data in the dialog box the legend also contains the project identification, if it was entered using the corresponding menu item 7.2.1.



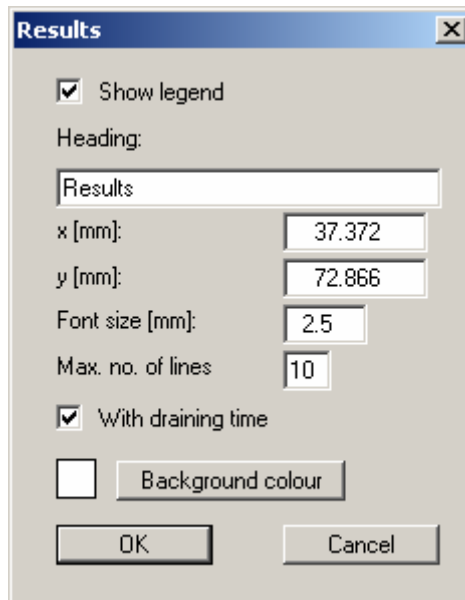
You can define and edit the position of the legend using the values "**x**" and "**y**". You control the size of the legend using "**Font size**" and "**Max. no. of lines**"; where necessary, several columns are used. The legend background can also be given a colour fill.

The fastest way to modify the position of the legend is to press the **[F11]** function key and then to pull the legend to the new position with the left mouse button pressed.

By activating the "**Short**" or "**Long**" option buttons the current file name can be shown in the legend, either with or without the path.

7.4.2 "Results legend" menu item

Once the system has been analysed the results can be displayed in a legend on the output sheet. If the "**Show legend**" check box is activated in the dialog box below, the shape and appearance of the result graphics can be individually defined.



A text can be specified under "**Heading:**", at the top of the dialog box; this will be entered in the legend.

You can define and edit the position of the legend using the values "**x**" and "**y**". You control the size of the legend using "**Font size**" and "**Max. no. of lines**"; where necessary, several columns are used. The legend background can also be given a colour fill.

The fastest way to modify the position of the legend is to press the **[F11]** function key and then to pull the legend to the new position with the left mouse button pressed.

The "**With draining time**" check box activates display of this value in the legend.

7.4.3 "System visualisation" menu item

A graphical visualisation of the current infiltration system is displayed on the output sheet. The shape and appearance of this system visualisation can be modified by activating the "**Show system**" check box in this menu item.

- "**Show system**"

The Visualisation is activated and uses the x and y coordinates defined in "**x value:**", "**y value:**", "**Width:**" and "**Height:**". The "**Font size**" for labelling is also defined here.

The fastest way to modify the position or size of the system visualisation is to press the [F11] function key and then to either pull the system visualisation to the new position or to move the sides of the system visualisation to their new size with the left mouse button pressed.

- "**Shaft thickness factor**"

The graphical visualisation of the shaft wall for shaft infiltration employs a factor to make details of the wall clear.

- "**With inlet**"

The inlet to a shaft infiltration system can also be displayed in the graphics.

- "**With groundwater**"

If the groundwater is very deep the system graphics are compressed. The infiltration system itself is barely recognisable. In such cases, deactivate the "**With groundwater**" check box. The graphics are then generally restricted to the zone around the system. The groundwater level no longer influences the scaling of the graphics.

- **"With water"**
The water-filled system can be visualised for swale and shaft infiltration. Activate the **"With water"** check box to enable this option.
- **"Background colour"**
The remaining background of the system visualisation can be given a colour fill.

7.4.4 "Simple header data" menu item

The graphics can be modified to suit requirements using the Mini-CAD system integrated in the program. Among other things it is possible to create a user-designed company header, which can also include a company logo, etc. (see Section 7.5.6). If this appears to be too much work this menu item allows a simplified type of header data to be used.

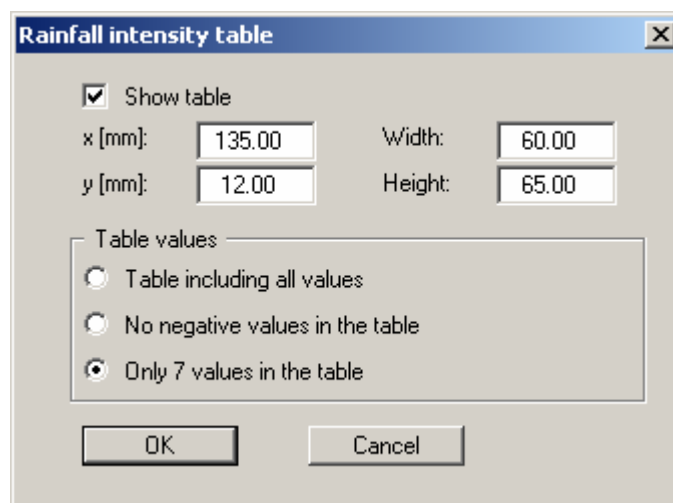
Activate the **"Show header data"** check box and enter the required text. The position on the output sheet is defined by **"x [mm]:"** and **"y [mm]:"**. If required, a coloured background can be defined using the **"Background colour"** button.

7.4.5 "Rainfall intensity" menu item

The rainfall intensities must be available as table data for an analysis using the KOSTRA Atlas table data. As long as the user-defined system has not been analysed, the selected table is displayed with all its data on the output sheet.

After going to this menu item the position and size of the table can be modified in the subsequent dialog box or, if required, be switched off by deactivating the "**Show table**" check box. The font sizes used in the table are adjusted to suit the defined preferences.

The fastest way to modify the position or size of the rainfall intensity table is to press the [F11] function key and then to either pull the table to the new position or to move the sides of the table to their new size with the left mouse button pressed.



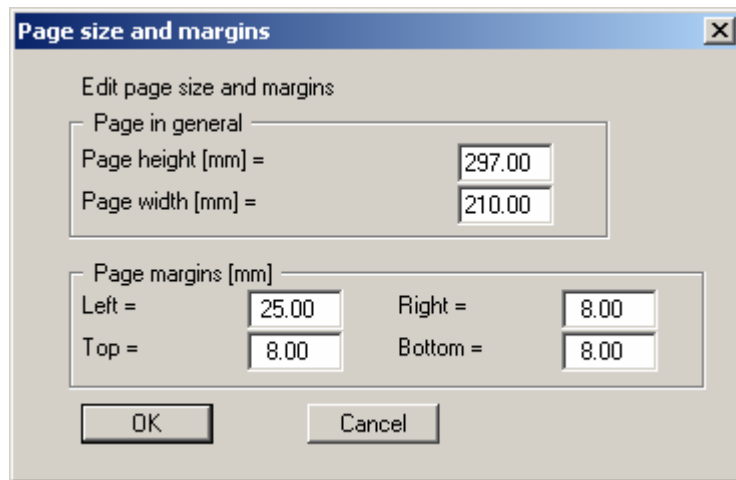
In order to display only the decisive table data after system analysis, the data required for display can be defined using the radio buttons in the lower group box. If "**Only 7 values in the table**" is selected it should be noted that the program automatically display one row above and one row below the decisive values, i.e. more than 7 rows may be displayed.

7.4.6 "Reset all" menu item

All changes made in the preferences for the legends can be reset to the defaults applied when the program starts using this menu item.

7.4.7 "Page size and margins" menu item

The program uses A4 format as default. You can edit the page format in the following dialog box.




Enter the values to be adopted for "**Page height**" and "**Page width**". The program automatically draws thin borders around the page, which are required when using paper rolls on a plotter. "**Page margin**" defines the position of a thickly drawn frame as a distance to these borders.

In order to achieve 1:1 output on an A4 printer the borders must be switched off (see menu item "**Graphics preferences/With borders**", Section 7.5.4) and the page height and page margins be adapted to the printable area of the printer.

7.4.8 "Move objects" menu item

When you go to this item you can move the various legends and diagrams 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.

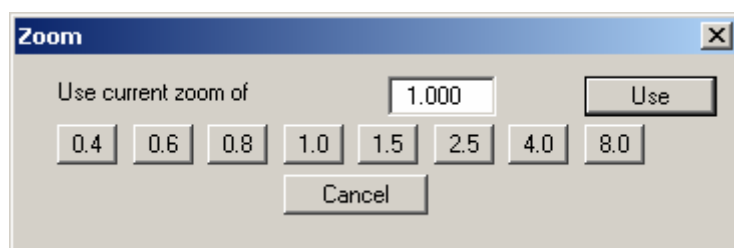
The size of an object can also be altered using this menu item or the [F11] key. If you move over the frame of a changeable object after activating this function the mouse assumed the shape of a double-headed arrow. Hold the left mouse button and move the frame until the object has reached the required 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.

7.5 Graphics preferences menu

7.5.1 "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.

7.5.2 "Zoom info" menu item

By clicking two diametrically opposed points you can enlarge a section of the screen in order to view details better. An information box provides information on activating the zoom function and on available options.

7.5.3 "Legend font selection" menu item

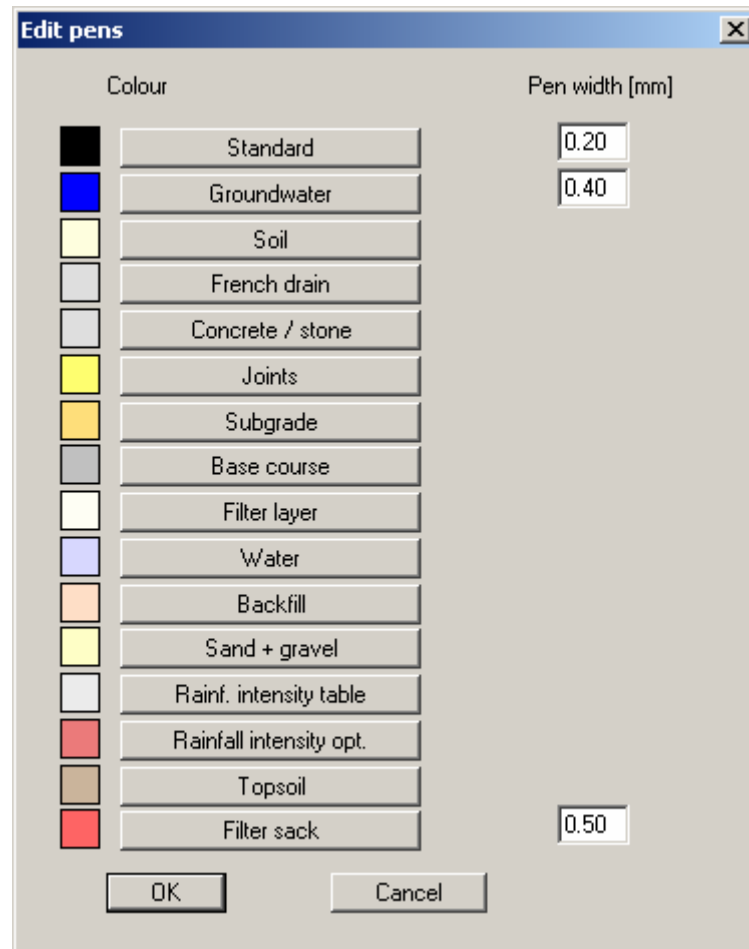
With this menu item you can switch to a different true-type font. All available true-type fonts are displayed in the dialog box.

7.5.4 "With borders" menu item

The program automatically draws thin cutting borders around the page, which are required when using a plotter on paper rolls. You can switch off the lines by deactivating this menu item.

7.5.5 "Pen colour and width" menu item

In order to enhance the clarity of the graphics you can edit the pen settings for various graphic elements.



You can edit the pen widths for the elements shown in the dialog box; by clicking on the button with the element designation you can also edit the pen or fill colours.

7.5.6 "Mini-CAD toolbar" menu item

Using this menu item you can add free text to the graphics and add lines, circles, polygons and images (e.g. files in formats BMP, JPG, PSP, TIF, etc.). A pop-up menu opens, the icons and functions used are described in more detail in the **Mini-CAD** manual provided.

Objects created with the Mini-CAD module are based on the page format (in mm). This makes you independent of the coordinate system and keeps you in the same position on the page. You should select the "**Header toolbar**" if you wish to place general information on the drawing (company logo, report numbers, plan numbers, stamp etc.). Once you have saved the header information to disk (see **Mini-CAD** user manual), you can load it into completely different systems (with different system coordinates). The saved header information will appear in exactly the same position on the page, which greatly simplifies the creation of general page information.

7.5.7 "Toolbar preferences" menu item

After starting the program a horizontal toolbar for the 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-SEEP.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 activated from the normal menu items.



"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.



"Next infiltration type"

This tool allows you to jump to the next infiltration type without using the menu.



"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**", Section 8.3).



"Colour on/off"

If you prefer to do without colour in the system visualisation, e.g. to create a black and white printout, use this on/off switch.



"Undo move object"

If you have previously moved a legend ([F11] or used "**Output preferences/Move objects**"), you can undo the last movement with this tool.



'Restore move object'

If you have previously undone a movement, you can restore with this tool.

7.5.8 "Load graphics 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.

7.5.9 "Save graphics preferences" menu item

Some of the preferences you made with the menu items of the "**Graphics preferences**" menu can be saved to a file. If you select "**GGU-SEEP.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**".

7.6 ? menu

7.6.1 "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 **GGU-SEEP**.

7.6.2 "Help" menu item

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

7.6.3 "GGU on the web" menu item

Using this menu item you can access the GGU Software website: www.ggu-software.com. Keep in touch with new program versions and the regular *download* offers.

If you would like to be automatically notified about program innovations, please register for the Newsletter in our Knowledge Base. Go to the following website: <http://kbase.civilserve.com>.

7.6.4 "GGU support" menu item

This menu item takes to the GGU-Software [Support area](#) at www.ggu-software.com.

7.6.5 "What's new?" menu item

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

7.6.6 "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.

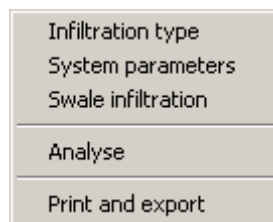
8 Tips and tricks

8.1 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.




The "**Swale infiltration**" entry always corresponds to the selected infiltration type (surface infiltration, shaft infiltration, etc.). By double-clicking the left mouse button on legends, diagrams or **Mini-CAD** objects, you will immediately move to the editor for the selected object and can then edit it.

8.2 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 contents and sets the screen back to the given format. This is useful if, for example, you have used the zoom function to display parts of the screen and would like to quickly return to a complete overview.
- [**F1**] opens the manual file.
- [**F2**] refreshes the screen without altering the current magnification.
- [**F5**] opens the menu item "**System/Analyse**".
- [**F11**] activates the menu item "**Output preferences/Move objects**".

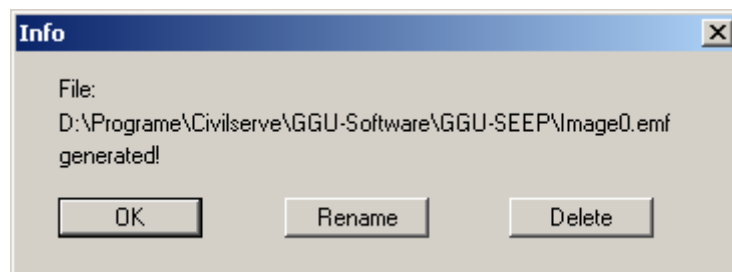
8.3 "Copy/print area" icon

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 opens once the area has been defined:



The default location of the file is the folder from which the program is started 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.

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