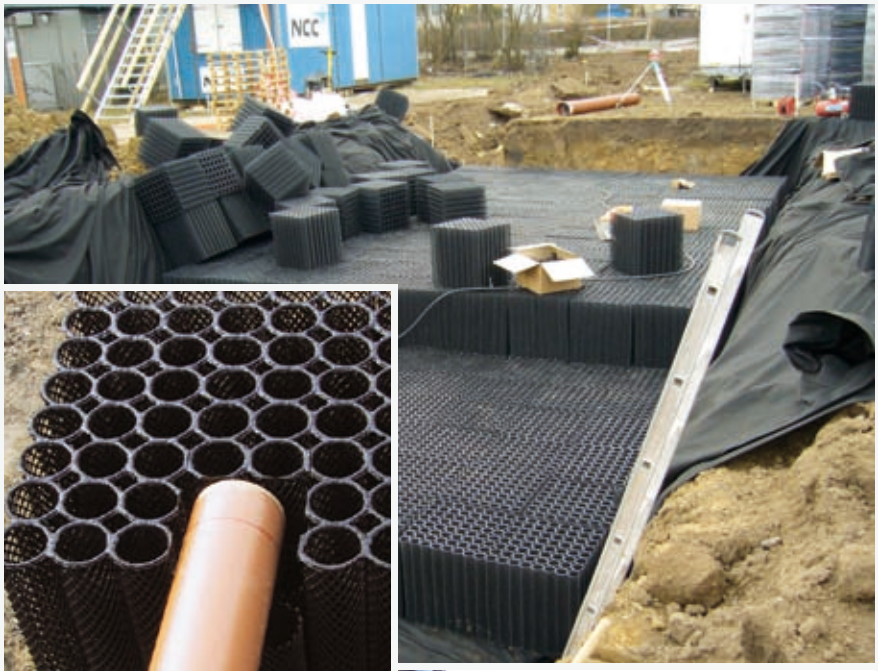
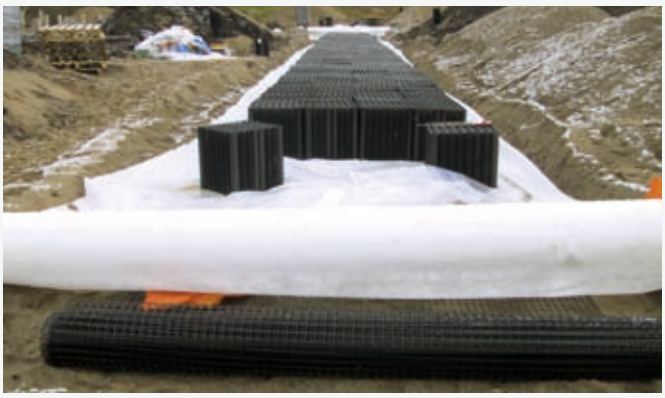
Rainwater drywell

BIO-BLOK® elements with cleaning effect
for the local drainage of rainwater





1. Introduction:

When rainwater is diverted away and cut off from the natural water cycle via storm and wastewater pipes, it takes a heavy toll on groundwater resources.

In many sewer systems, rain and wastewater are mixed and flow through undersized pipe systems, sometimes causing low-lying cellars to flood with foul-smelling wastewater. In heavy rain, the sewer overflows often come into use, with the wastewater load discharged into recipients as a result, and the capacity of the purification plant can be exceeded, whereby the untreated wastewater is discharged directly into watercourses, lakes and the sea.

With the local drainage of rainwater, the overflow of untreated wastewater from wastewater treatment plants and sewer overflow facilities into watercourses or other recipients can be avoided. At the same time, the number of flooded cellars is reduced.

Finally, the drainage of rainwater locally ensures that it is channelled back into the natural water cycle. Rainwater is fresh water and often of a reasonably good quality when it is roof water. It does not, therefore, make sense to mix it with wastewater, which is what happens in the public stormwater system. In areas with separate drainage systems, rainwater is channelled directly into the sea and thus mixed with salt water, with the loss of valuable fresh water as a result. Only in places where the rainwater runoff is of a very poor quality, is its dilution in the sea favourable to seepage into aquifers.

2. Local drainage of rainwater:

Local drainage of rainwater covers many areas from individual roofs to paved areas, individual housing blocks to entire neighbourhoods.

Wherever the favourable physical framework and geological conditions exist, the removal of rainwater via drywells is an economically attractive option, whilst major environmental benefits are achieved.

If the diversion of rainwater from larger areas is not expedient due to poor seepage from the drywell to the soil, the solution may be to establish an emergency overflow from the drywell to a stormwater or wastewater pipe system. This would reduce the overloading of the seepage system considerably as the pipe system receives a smaller quantity of water.

With the seepage of roof and surface water, the volume of groundwater will be increased. By virtue of the then Danish Ministry of the Environment and Energy's executive order on payment regulations for wastewater treatment plants, the municipalities have been given more flexible rules for promoting the drainage of rainwater locally.

The municipalities have been given the authority to refund part of the drain connection charge to landowners willing to manage roof and surface water on their own property, thereby offering them partial withdrawal from the obligation to pay tax for the municipal stormwater and sewer system.

The local percolation of rainwater reduces the municipalities' costs for the treatment of wastewater and improves the stability of the treatment processes at treatment plants, so that the costs associated with pumps, environmental taxes and the extension of the capacity in the existing sewer systems are radically reduced.

3. What is a drywell?

A drywell is in principle a hole in the ground, filled with a medium that provides an air cavity for receiving the inflow of rainwater. The rainwater then seeps from the medium into the surrounding soil.

4. What is an efficient drywell?

An efficient drywell is characterised by the following:

- The medium used has a high porosity, so that the drywell can hold as much water as possible.
- The medium used has the largest possible vertical contact surface per volume unit, so that seepage from the medium into the soil is as high as possible, i.e. the drywell's vertical lateral surfaces against the soil are the greatest possible.

5. Why choose a drywell constructed from BIO-BLOK® elements?

The following benefits are achieved with BIO-BLOK® elements:

- Biological cleaning of organic substances in the rainwater
- Flexible construction – the element can be easily divided to increase the vertical seepage surface
- Large vertical seepage surface per unit
- Also efficient in clayey soils
- Robust product that can withstand knocks, bumps and inadvertent handling
- Vertical load capacity of up to 15 tonnes/m²
- Fast and easy installation
- High porosity
- Flexible and simple pipe connection options
- Possibility of increasing the element's load capacity
- Elements with high chemical resistance
- Made from eco-friendly polyethylene
- Made in Denmark

6. Application:

Rainwater drywells are typically used for the drainage of rainwater

from roofs, car parks and other paved areas.

7. Dimensioning:

In DS 440:1983, "The Society of Danish Engineer's norm for small drainage systems with seepage'', a single guideline is given with regard to the dimensioning of small drywells.

The guideline does not take into account the soil's hydraulic conductivity, as the drywell simply has to have a certain porosity. This porosity is determined by a rainwater quantity of 140 l/sec. X hectares for a period of 10 minutes.

This guideline should not be used in areas with clayey or silty soil, as the drywell will be severely under dimensioned.

In the following, a single dimensioning formula is shown for BIO-BLOK® drywells for small-scale seepage projects. This dimensioning is based on SBI-185 "Drainage installations, 2nd Edition" and DS 432:2000 "Norm for drainage installations".

If clayey soil (with poor seepage properties) is involved, the BIO-BLOK® element should be divided into two in order to obtain the largest possible vertical seepage surface, i.e. giving the drywell a width of approx. 27cm. The drywell should always be installed as a longitudinal drywell, see example C on page 6.

Guideline dimensioning rule for clayey soil:
A BIO-BLOK® element can drain a vertical surface area of approx. 10 m^2 depending on the quality of the soil.

In the case of sandy soil (good seepage properties), the drywell should always be installed as a longitudinal drywell. The BIO-BLOK® element can be divided into two. Dividing it into two produces a better drywell as, this way, a larger vertical seepage surface per volume unit is achieved.

Guideline dimensioning rule for sandy soil:
A BIO-BLOK® element can drain a vertical surface area of approx. 25 m^2 depending on the quality of the soil.

The recommended dimensioning rules mentioned above are uncertain and should therefore only be used for small drywells.

EXPO-NET Danmark A/S therefore recommends that all rainwater drywells be dimensioned on the basis of the "IDA Spildevandskomitéens (IDA Wastewater Committee's) Publication no. 25" from 1994. If Publication no. 25 is used for dimensioning, it is possible to determine the size of the drywell on the basis of precipitation knowledge, the soil's hydraulic conductivity based on local measurements and chosen repetition periods for the exceeding of the drywell's capacity.

EXPO-NET Danmark A/S has, in collaboration with COWI A/S, developed a spreadsheet for the simple dimensioning of BIO-BLOK® rainwater drywells. The spreadsheet is based on selected typical K and average K values (K = hydraulic conductivity) from a number of standard types of soil. The spreadsheet with appurtenant instructions is available at www.expo-net.com.

8. Installation and accessories:

It is both simple and fast to install large and small drywells using BIO-BLOK® elements. The hole is dug and the floor of the hole is levelled.

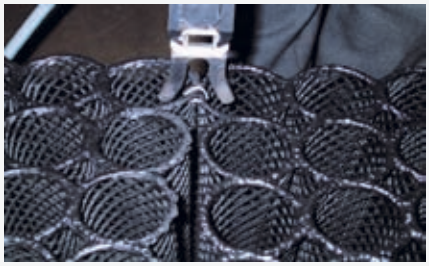
Geotextile (fibre membrane) is then laid and the elements are put in place. The inflow to and outflow from the drywell are established, after which the fibre membrane is pulled up over the top and around the sides of the drywell.

Once the drywell has been installed (incl. fibre membrane), it is covered with approx. 10cm of clean sand to protect the fibre cloth from sharp stones, etc. In areas where the elements will be subjected to heavy loads or poor soil, we recommend that the construction is reinforced with a plastic reinforcement net such as EXPO-1211 Std. Lay this netting out over the top of the sand layer. This ensures that the fibre membrane will remain intact and that a more uniform and evenly distributed load is achieved. See schematic diagrams at www.expo-net.com.

Drywell being installed

All BIO-BLOK® elements should be assembled using stainless steel staples. EXPO-NET Danmark A/S is happy to lend out staple guns on request for the assembling of individual elements and can supply stainless steel staples.

Staple gun and staples

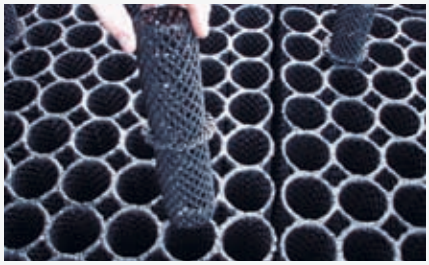


The elements fixed together

If the drywell is to be built up in several layers, a stacking pipe should be used to hold the layers in place. Depending on the soil load, BIO-BLOK® drywells can be built up in several layers. See under “technical specifications” on the last page.

BIO-BLOK® stacking pipe

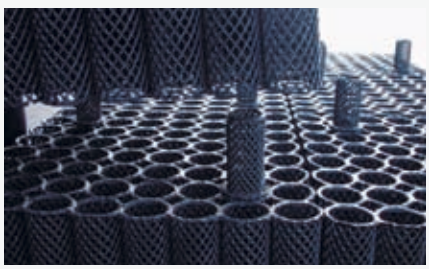
BIO-BLOK® stacking pipes are rounded at the ends in a conical shape, making the fixing of the elements on top fast and simple. The conical ends of the stacking pipes “catch” the ends of the tubes in the element placed on top.



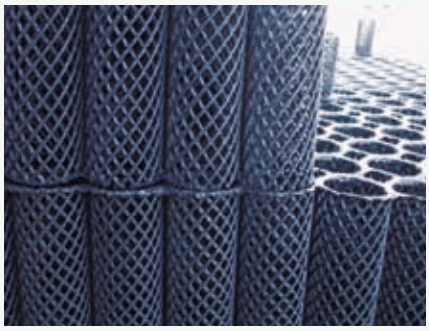
Installation of stacking pipes

The use of stacking pipes in drywells with elements in several layers means that the elements function as a whole, locked unit, which is a contributory factor to the easy installation of the drywells.

All horizontal joins between the elements must be locked together with stainless steel clips. In this way, a strong and flexible construction is achieved that will be able to withstand the varying loads of surrounding layers of soil, without breaks occurring in the net tube construction of the elements.



The drywell is locked by stacking pipes



BIO-BLOK® fitted with stacking pipes

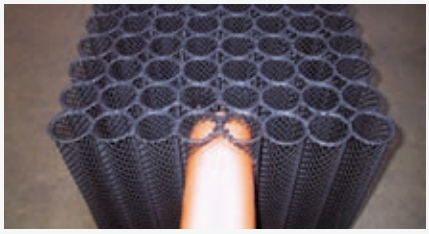
9. Pipe connections:

Pipe connections can be made in the side or the top of the drywell. If a connection is made in the side of the element, the use of a hole saw is recommended for cutting away the material in the element, so that the pipe can be inserted to an appropriate depth. This keeps the pipe from shifting.

Hole saw for side connection

For pipe connections in the side of the drywell, the fibre membrane is cut to fit the pipe connection by cutting out a small cross in the membrane and fastening the “flaps” this is fixed to the connecting pipe with plastic strips or similar material.

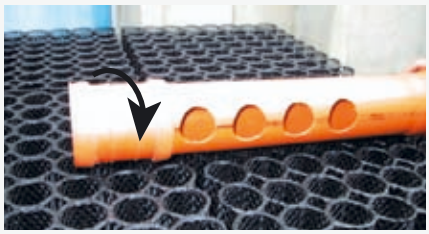
The joint can be further protected against soil ingress by wrapping the pipe bushing with an extra piece of fibre membrane.



Example of pipe connection in the side

It is recommended that pipe connections of Ø200mm or larger are connected in the top of the drywell. The inlet pipe should run an appropriate length across the drywell, and end in a 90 degree bend leading into the top of the drywell, or be plugged or capped following the boring out of an appropriate number of holes in the underside of the pipe, which faces downwards across the top of the drywell so that the conducted water flows freely into the drywell.

Example of pipe connection in the top with bore holes



Example of the pipe installed so that the holes face downwards

10. Product information:

The Danish-produced BIO-BLOK® elements are made of plastic net tubes with a large hollow space for storing rainwater.

From here, the rainwater can seep through the soil surrounding the rainwater drywell into the groundwater, safeguarding the supply of drinking water.

There are two types of BIO-BLOK® elements for rainwater drywells.

BIO-BLOK® 80 HD G is used in areas where the pressure load from soil and traffic above the drywell is up to 2.5 tons per m^2 vertical load, making the element suitable for use in most areas without notable traffic.

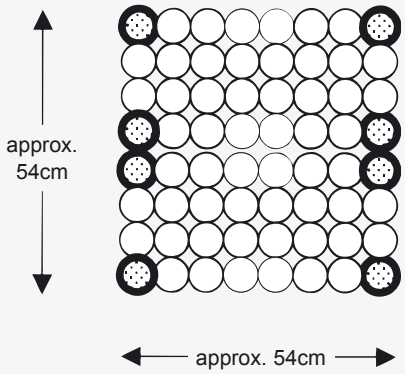
BIO-BLOK® 80 HD GF is a reinforced element that can withstand a vertical load of up to 15 tons per m^2, making this element suitable for use in most areas subject to heavy traffic, and the element can also withstand the weight of a substantial layer of soil.

Both types of elements are made of the imperishable and eco-friendly material polyethylene, which is also highly resistant to chemicals. Both types of elements have a square shape, making them ideal both with regard to weight and exterior dimensions, when installing drywells.

The elements are also highly robust and can withstand inadvertent handling and heavy-handed treatment in the form of bumps and knocks.

The extruded net tube construction of the elements gives each element porosity and makes them highly resistant to loads to which they may be subjected during installation in drywells.

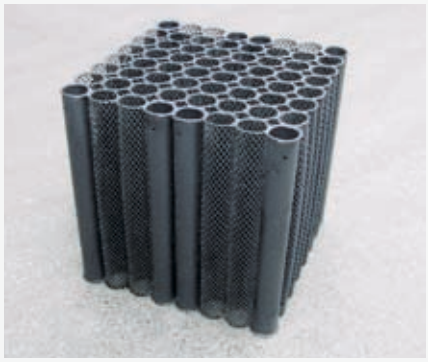
BIO-BLOK® 80 HD GF is suitable for the installation of drywells in areas subject to high loads and high traffic, or for installation in areas where the drywell is to be installed at greater depths with higher soil loads as a result.



Horizontal section of BIO-BLOK® 80 HD GF

The reinforcement of the BIO-BLOK® elements is constructed by the welding of polyethylene pipes in the corners of the elements in such a way that the reinforced element can be divided into two to achieve greater seepage efficiency, such as for clayey soil.

If maximum seepage from the drywell's elements to the surrounding soil type is required, (most usually required when the drywell is installed in soil types with low hydraulic conductivity, such as clayey soil), it is possible to increase the capacity of single elements by making a quick and easy division of the elements.



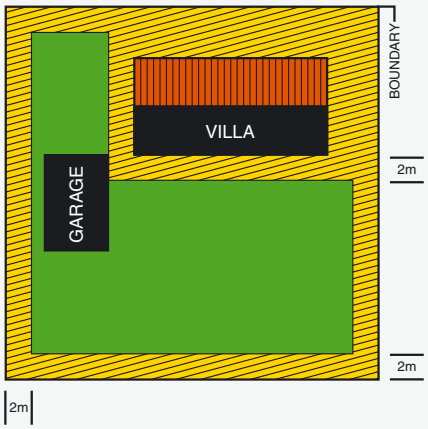
BIO-BLOK® 80 HD GF

Divided BIO-BLOK® element

Division of BIO-BLOK® element to obtain greater seepage area

11. Positioning:

The drywell can be positioned almost anywhere. For example in Denmark the general distance requirements are 2m from property lines and building foundations (does not apply to garages and carports), though 5m from the building if there is a cellar. The depth of the drywell should be given careful consideration as the soil load may be critical if the drywell is positioned too deeply in the soil. **Always contact the technical department of the local authority before beginning any work, as local regulations may apply.**



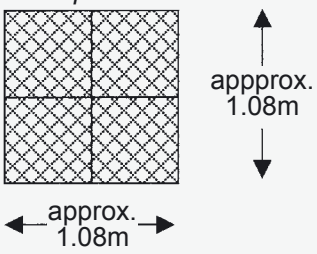
The diagram shows a plot with a house and garage. In this case, the drywell may only be installed in the green area.

12. Examples of geometric configurations and their implications:

The capacity of a drywell is dependent upon the ratio between its volume and its vertical seepage area. The greater the vertical seepage area per volume unit, the greater the capacity of the drywell. When planning the geometric configuration of a drywell, an attempt should be made to achieve the greatest possible vertical seepage of a given drywell's volume.

The following examples of geometric configurations used show the significance of the different configurations to achieving an efficient drywell.

Example A:

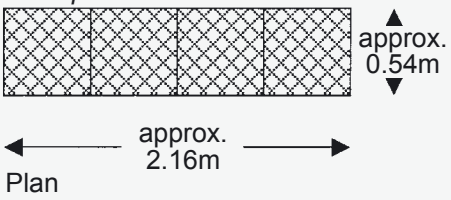


Plan

A drywell that is constructed with equal-sized sides has the least vertical area of contact with the soil. This configuration is rarely used.

Area of 4 BIO-BLOK® elements, approx. 54 x 54 x 55cm
$A_{Vertical}$ = 4 x 0.55 x 1.08 = 2.37m²

Example B:

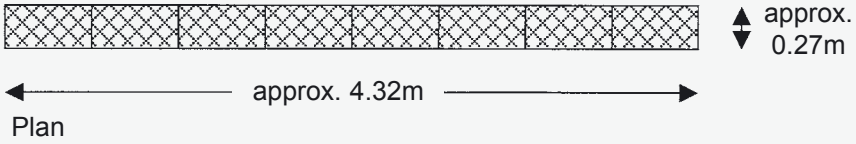


Plan

A drywell normally has a rectangular construction as this shape has a higher vertical area of contact to the soil.

Area of 4 BIO-BLOK® elements, approx. 54 x 54 x 55cm
$A_{Vertical}$ = 2 x 0.55 x 2.16 + 2 x 0.55 x 0.54 = 2,97m²

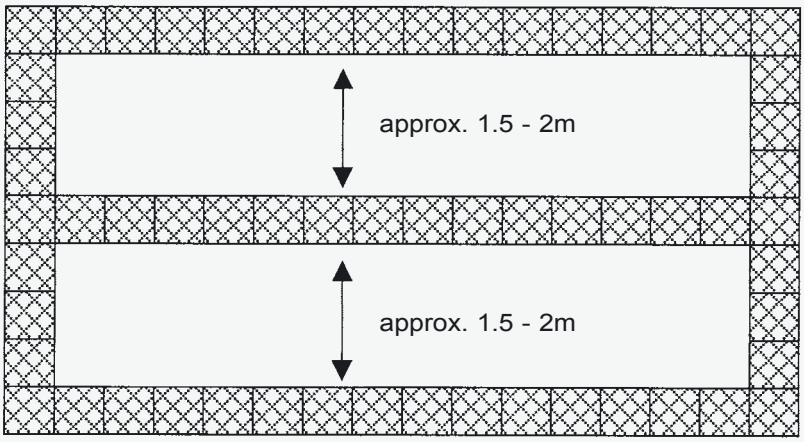
Example C:



Plan

Area of 4 BIO-BLOK® elements, approx. 54 x 54 x 55cm, which is divided in two.
$A_{Vertical}$ = 2 x 0.55 x 4.32 + 2 x 0.55 x 0.27 = 5.05m²

Example D:



Example of the construction of a compact BIO-BLOK® drywell with the greatest possible vertical seepage surface.

13. Environment:

Surface water from roofs, car parks and streets is not clean. When you choose BIO-BLOK® elements for the construction of drywells, you are choosing an element that will biologically break down a number of the impurities in the water and hence improve the quality.

Through the use of BIO-BLOK® elements for drywells, the rainwater that is diverted through it is biologically cleaned before seeping into the groundwater.

The reason for this is that the BIO-BLOK® element is constructed of net tubing, the total surface area of which forms the ideal habitat for micro-organisms. When these micro-organisms come into contact with the diverted water, they begin to break down the organic pollution, etc. that exists in the surface water.

The breaking down of pollutants requires oxygen that can be found in the diverted rainwater. The element therefore has the effect of a submerged filter and a trickling filter combined, thereby helping to clean the water and improve the quality of the groundwater.

Drywells made from BIO-BLOK® elements are therefore the optimal and eco-friendly choice.

Fast installation

14. Tender text:

The volume of the drywell must be constructed using BIO-BLOK® elements or similar net tubing elements with a cleaning effect.

The elements must be made of welded vertical net tubing made from polyethylene with a modular size of (W x L x H) approx. 54 x 54 x 55cm.

For further information please visit our website.

15. Technical assistance:

Our engineers are on hand with advice regarding the dimensioning and installation of rainwater drywells. The advice is free and non-binding.

Enquiries can be made to:

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Georg Jensens Vej 5
DK-9800 Hjørring

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Fax: +45 98 92 41 89
Email: plast@expo-net.dk
www.expo-net.com

Technical specifications:

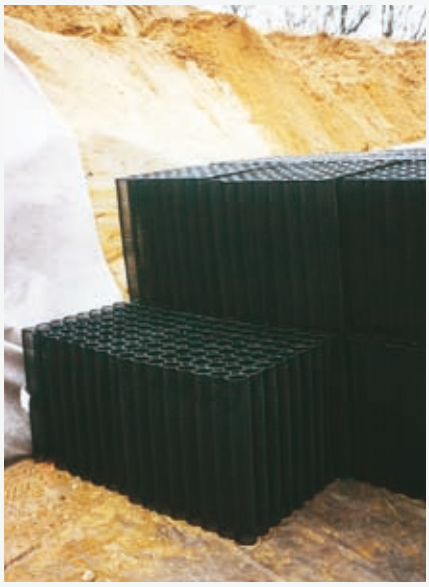
Type	BIO-BLOK® 80 HD G	BIO-BLOK® 80 HD GF	Stacking pipes
Dimension (W x L x H)	54 x 54 x 55cm	54 x 54 x 55cm	Ø54 x 220mm
No. of elements per m³	6.23	6.23	-
Volume	0.160m³	0.160m³	-
Percentage of hollow space	95%	95%	-
Water volume	0.152m³	0.152m³	-
Weight	8 kilos	9 kilos	-
Density	0.95	0.95	-
Max. vertical pressure load	≤ 2.5 tons per m²	≤ 15 tons per m²	
Max. horizontal pressure load	≤ 1.0 tons per m²	≤ 1.0 tons per m²	-
Article number	871080-55	871085-55B	871099-

All measurements are approximate. The pressure loads are measured as maximum values with side support (compacted soil).

16. Examples of drywells with BIO-BLOK® elements:

Efficient transportation

Fast offloading



Drywell, Bramminge, Denmark

Site development

Longitudinal drywell, industrial area

Longitudinal drywell, residential area

Fast installation

Longitudinal drywell

Large drywell, Flensborg, Germany

EXPO-NET® DANMARK A/S

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