



## Facts and figures

The inflatable dam consists of three bellows. The following data applies to each bellow:

Lies	4.65 m below NAP
Maximum barrier height	3.55 m above NAP
Height	10 m
Length underneath	60 m, at top 90 m
Sill width	15.4 m
Material length	(24.3 m)
Bellow contents	air 3,500,000 litres, water 3,500,000 litres
Material thickness	1.6 centimetres
Production	Bridgestone, Japan
Material weight	19.3 kg/m <sup>2</sup>
Bellow weight	33 tons
Minimum material life-expectancy	25 years
Dam inflation time	max. 60 min.
Dam deflation time	max. 180 min.
Dam activation water level	+ 0.50 NAP



## Swimming pools and football fields

**Swimming pools and football fields**

It is rather a shame that such an impressive structure spends nearly all year out of sight, hidden under the water. For this reason, we have included here a few statistics. As mentioned above, the three bellows each measure 90 metres in length, comparable with a street of ten houses. The bellows are 10 metres tall, just like a spacious house. Each bellow contains seven million litres when inflated. This would fill roughly fifteen swimming pools. The material from just one bellow weighs as much as thirty cars and would cover half a football field: 25 metres wide, 90 metres long. All the dimensions, and other data, have been placed together in a table at the back of this folder.

**Cooperation**

The Groot Salland Water Authority commissioned the construction of the Ramspol inflatable dam. This water authority managed the budget, bought the land, took care of the necessary permits and is responsible for management and maintenance. The Civil Engineering Division of the Ministry of Transport, Public Works and Water Management acted as project director, assessed the contractor's plans, and monitored the work's technical implementation and quality, and the dam itself was constructed by Hollandsche Beton and Waterbouw bv. Design and implementation was carried out by the contractor, who also conducts maintenance of the structure. Such a 'design & construct' contract allows the contractor to apply all his creativity and expertise to the project. This led the contractor to suggest that the bellows be filled with both water and air. The benefits of this include greater bellow stability and quicker inflation. Part of Reest & Wieden Water Authority's managed area is also protected by the inflatable dam. This water authority is therefore joint principal.



The inflatable dam is located parallel to the Ramspol bridge (N50 road), in the vicinity of Kampen's new Eiland bridge. The information centre is located in one of the control buildings (also adjacent to the N50) on the Kampereiland near the Ramspol bridge (between Kampen and Emmeloord).



Photography: Groot Salland, Freddy Schinkel

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Groot Salland  
Waterschap  
Veelzijdig met water

Balgstuw  
Ramspol  
beschermt West-Overijssel  
tegen hoogwater  
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# Three enormous inflatable bellows protect West Overijssel against the water

In 1995, the water in the Dutch rivers reached record levels. This prompted the authorities to draw up the Major Rivers Delta Plan. According to hastily-passed special emergency legislation, the reinforcement of river dikes was to be accelerated. Everything was to be complete by the end of 1996. One project was allowed greater leeway: the water barrier designed to protect West Overijssel against the threat from the IJsselmeer. Since December 2002, this area has been protected by a unique construction: the Ramspol inflatable dam.



### Automatic safety

Once a year on average, during a strong wind from the north-west, the rising water at Ramspol between the Ketelmeer and the Zwarte Water affords a spectacular show. Three immense bellows slowly rise out of the water and arrest the advance of the IJsselmeer's turbulent waves. These three bellows are each as large as ten terraced houses and are together 240 metres long. When the situation demands it, they can be raised fully automatically. Within just one hour, the water barrier is fully erect and the hinterland is safe.

### Consideration for the countryside

Why not just a 'normal' barrier with vertical lift gates like in Zeeland? Because of the local environment. Thirty-metre tall vertical lift gates would seriously detract from the natural beauty of this stunning and varied water landscape with its panoramic views. Not to mention the twisting dikes, centuries-old 'terp' farms, noble rural estates and characteristic towns and villages located further upstream. The inflatable dam lies out of sight below the water's surface until it is stirred to life automatically by its Monitoring and Operating System.

## Automatic safety

## Unique

### Unique

With a diameter of 10 metres, the Ramspol water barrier is the world's largest inflatable dam. The system itself is not unique. It is often applied in Japan in particular to control water levels under normal weather conditions. Conversely, this dam is designed to activate in abnormal circumstances. Another unique feature of this inflatable dam is that it is filled with both air and water and is employed as storm-surge barrier.



### Funnel

The Ramspol inflatable dam plays a decisive role in protecting West Overijssel against rising water in the IJsselmeer, which results from how the IJsselmeer has been shaped over recent decades. Since the construction of the Afsluitdijk, the creation of the polders and the realisation of the dike between Lelystad and Enkhuizen, the IJsselmeer has been getting steadily smaller, but has also attained an increasingly funnel-like shape, with the Ketelmeer forming the narrowest point. During a north-westerly, the water surges into the Zwarte Meer and the Zwarte Water and heads for Zwolle's urban waterways and the Sallandse watercourses, bringing the danger of flooding to large parts of West Overijssel. This threat has now been reduced significantly.

## Dike reinforcement

## Safety within the hour

### Dike reinforcement

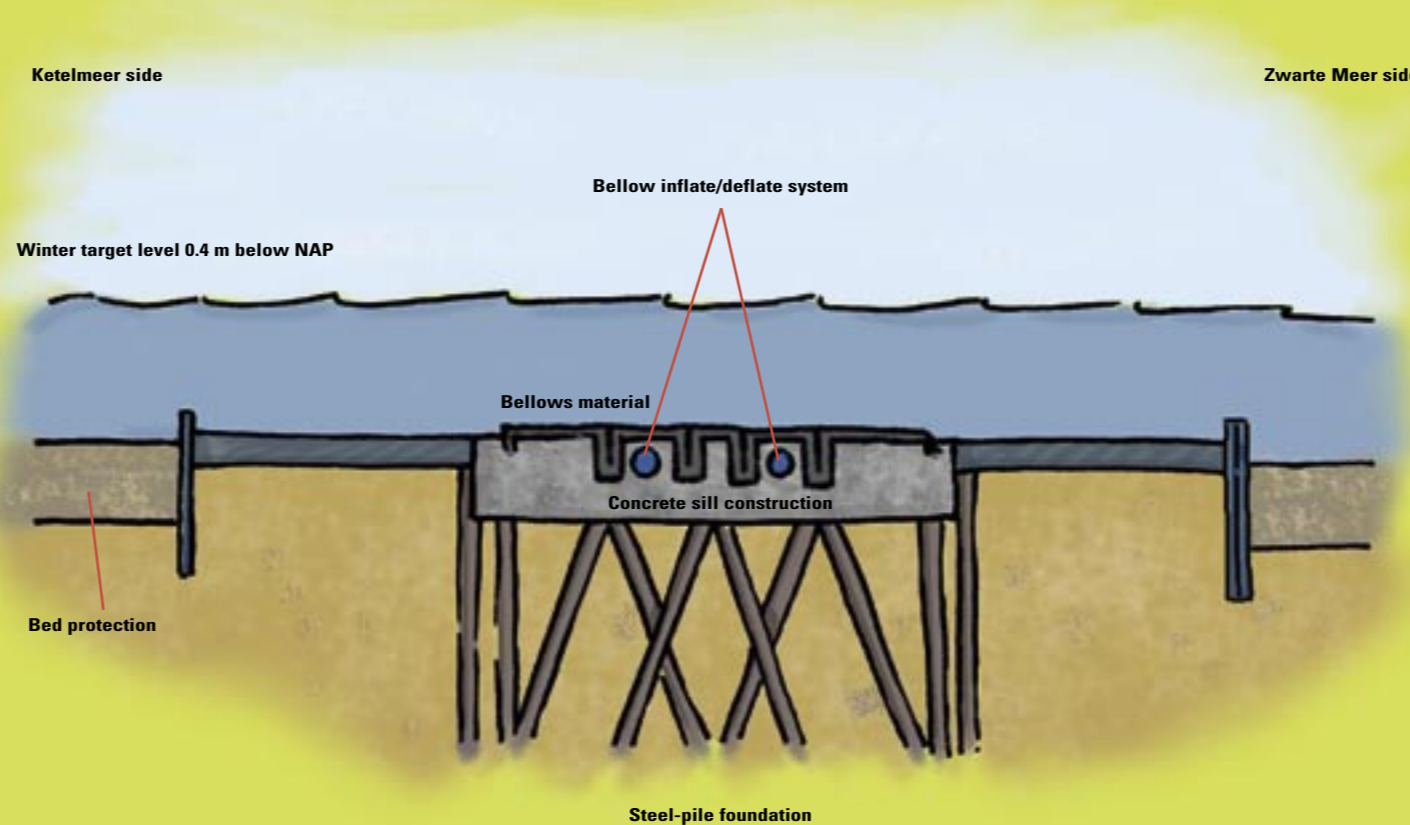
One of the advantages of the inflatable dam is that it avoids having to invest in large-scale dike modifications along the Zwarte Water and Vecht rivers. Though the benefits are not just monetary. Major dike reinforcements often entail an assault on important conservational and cultural-historical values. Once the decision had been made to construct the Ramspol inflatable dam, then only the minimum reinforcement of the dikes was necessary.

### Safety within the hour

But how does the inflatable dam actually work? Well, below the water, completely out of sight, lie three immense bellows, each ninety metres long and made of a flexible material consisting of rubber and nylon fibre. The bellows lie neatly folded on guide rollers. If flooding is likely, then the bellows are filled with air and water, causing them to inflate until they top out at as much as four metres above the water level. It takes about an hour to fully inflate them. As long as the inflatable dam is fully activated, shipping can moor at Schokkerhaven and Zwartsluis, among other places. Once water levels on the Ketelmeer and the Zwarte Meer reach their normal equilibrium, the bellows are deflated and disappear once again below the water, only reappearing to dam the next storm-surge and torrent. The fact that the system is operated completely automatically is especially striking. Using the water-level data in the IJsselmeer and the Ketelmeer, the system decides when to activate the barrier. Shipping is alerted and the bellow-inflation mechanism is triggered. When the threat abates, the system automatically deflates the barrier and annuls the shipping alert.



### Inflatable dam at rest



### Inflatable dam in action

