Interreg
2 Seas Mers Zeeën
PROWATER
European Regional Development Fund

Restoration of a natural water landscape for climate adaptation

Results of changes implemented to the 'Vloeiweide' site by the Brabantse Delta Water Board and Brabants Landschap

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DISCLAIMER

COLOFON

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AUTHORS

Manschot Anand, Scheele Mattie, Santbergen Leo (editor)
Waterschap Brabantse Delta
Bouvignelaan 5,
4836 AA Breda, Netherlands

Vande Velde Katherine (editor)
Departement Omgeving
Afdeling Strategie, Internationaal Beleid en Dierenwelzijn
Koning Albert II-laan 20 / 8
1000 Brussels, Belgium

PROJECT PARTNERS

COLLABORATERS FOR THE DEMONSTRATION SITE

Restoring the floodplain ‘Vloeiweide’, nature-based where possible

In the Mark basin, along the brook Bijloop, the Brabantse Delta Water Board and Brabants Landschap have developed the demonstration site 'Vloeiweide' for the Interreg 2 Seas project PROWATER. This site helps the region to adapt to the consequences of climate change.

Vloeiweide is a demonstration site for so-called 'Ecosystem-based Adaptation measures'. In this Dutch site, a more natural water landscape is restored. The implemented works are important for climate adaptation and for nature development.

The Brabantse Delta Water Board’s integral mission is to work with partners on sufficient fresh water of good quality and safety against flooding. Brabant Landscape protects and manages nature in Brabant. The water board opts for nature-based solutions where possible ('working with nature') and technical solutions where necessary (due to land and water use). Nature-based solutions for climate adaptation purposes, also known as Ecosystem-based Adaptation (EbA), restore nature with the aim of also restoring the associated Ecosystem Services (ES), such as an adequate freshwater supply, to help counter the impacts of climate change for our society and the environment.

This publication summarizes the climate adaptation measures and results at the site Vloeiweide. These measures contribute to the sponge effect of the catchment area and thus to more running water in the brook Bijloop. As a result, more freshwater will become available for the environment and society during dry periods. In wet periods, there will be fewer peak discharges and, as a result, there will be less flooding downstream of the project area. We create this situation by raising the bed of the brook and excavating the nutrient rich top layer of a number of plots. This allows us to retain the seepage and runoff water in the area for longer. We improve the water quality by adding wood debris to the brook and by restoring a meander. This creates better conditions for aquatic life.

The results are summarised using various steps (chapter 1 to 4) that represent the process for successful planning and implementation of climate change adaptation measures (see Output 1). Presented insights and lessons learnt can help governments (national, provincial and municipal), knowledge institutions, consultancies, managers of nature areas, drinking water companies and landowners in the design of climate change adaptation projects.

Figure 1 – The dot marks the location of the demonstration site for Ecosystem-based Adaptation in the Interreg 2 Seas area.

1 Understanding the catchment

1.1 Geographical & hydrological context

The Vloeiweide (approx. 80 ha) is located on the border of the municipalities of Breda and Zundert. The area is located on two sand ridges, which were formed after the last Ice Age. The difference in height between the sand ridges and the valley of the brook Bijloop, which flows through them, is about 5 meters. De Vloeiweide is a brook valley that offers many opportunities for the development of wet nature, due to its low location in the landscape. Groundwater that comes to the surface (seepage) is an important source of nutrition for the area.

The brook Bijloop flows through the Vloeiweide in a north-easterly direction to Breda (figure 3). The area is bordered along the south-eastern side by the ditch Turfvaart. Bijloop and Turfvaart belong to the catchment area of the Aa or Weerijs (tributary to the Mark river). The Weir "Hellegat" is located where the Bijloop flows into the Vloeiweide. With this weir, the upstream flow of the Bijloop is divided between the Bijloop and the Bijloop diversion channel, an artificially dug watercourse that carries the water directly to the Aa or Weerijs. The weir opens when a certain downstream water level is exceeded. As a result, a large part of the discharge flows via the Bijloop diversion channel to the Aa or Weerijs. Consequently, the downstream part of the Bijloop, including the Vloeiweide, has a limited discharge all year round.

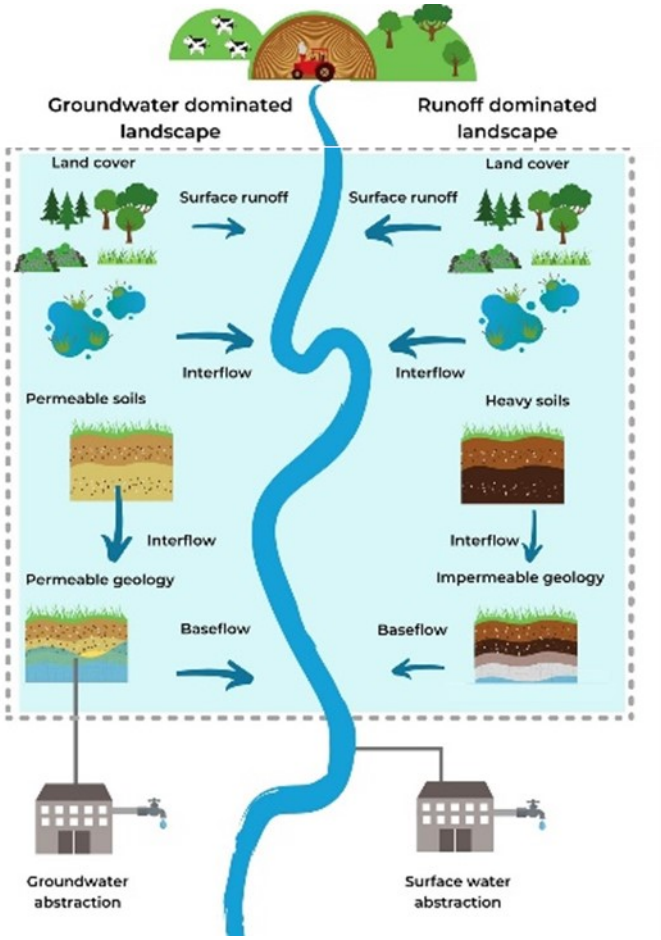


Figure 2 – The site Vloeiweide is located in a groundwater dominated catchment.

In unmodified or sustainably managed groundwater dominated catchments there is little runoff following precipitation as water predominately infiltrates through permeable substrates and moves either laterally or vertically below the surface. However, modification such as surface sealing, soil compaction and land drainage reduce the ability of water to infiltrate and therefore result in greater levels of runoff. Groundwater replenishment depends on the hydrological connectivity to the surface. When connectivity is interrupted by these modifications the resilience of this water supply is reduced.

In unmodified or sustainably managed runoff dominated catchments, water predominantly moves above the surface but interflow and baseflow are still present. As above, when the landscape is modified, surface runoff dramatically increases and interflow and baseflow are further reduced. This leads to an increase in frequency and severity of low river flows during dry periods and an increased risk of flooding following periods of extreme rainfall.

1.2 Human context

Agriculture takes place on 60% of the soil in the Bijloop-Turfvaart sub-basin. 30% is nature reserve and 10% is built-up area. About 75% of agricultural use is regular (not intensive). Most of the land is used as grassland, followed by maize. About 25% concerns intensive agriculture (various crops, including tree and strawberry cultivation). The share of intensive agriculture is highest in the downstream part of the catchment area, as can be seen in the top right corner of Figure 3.

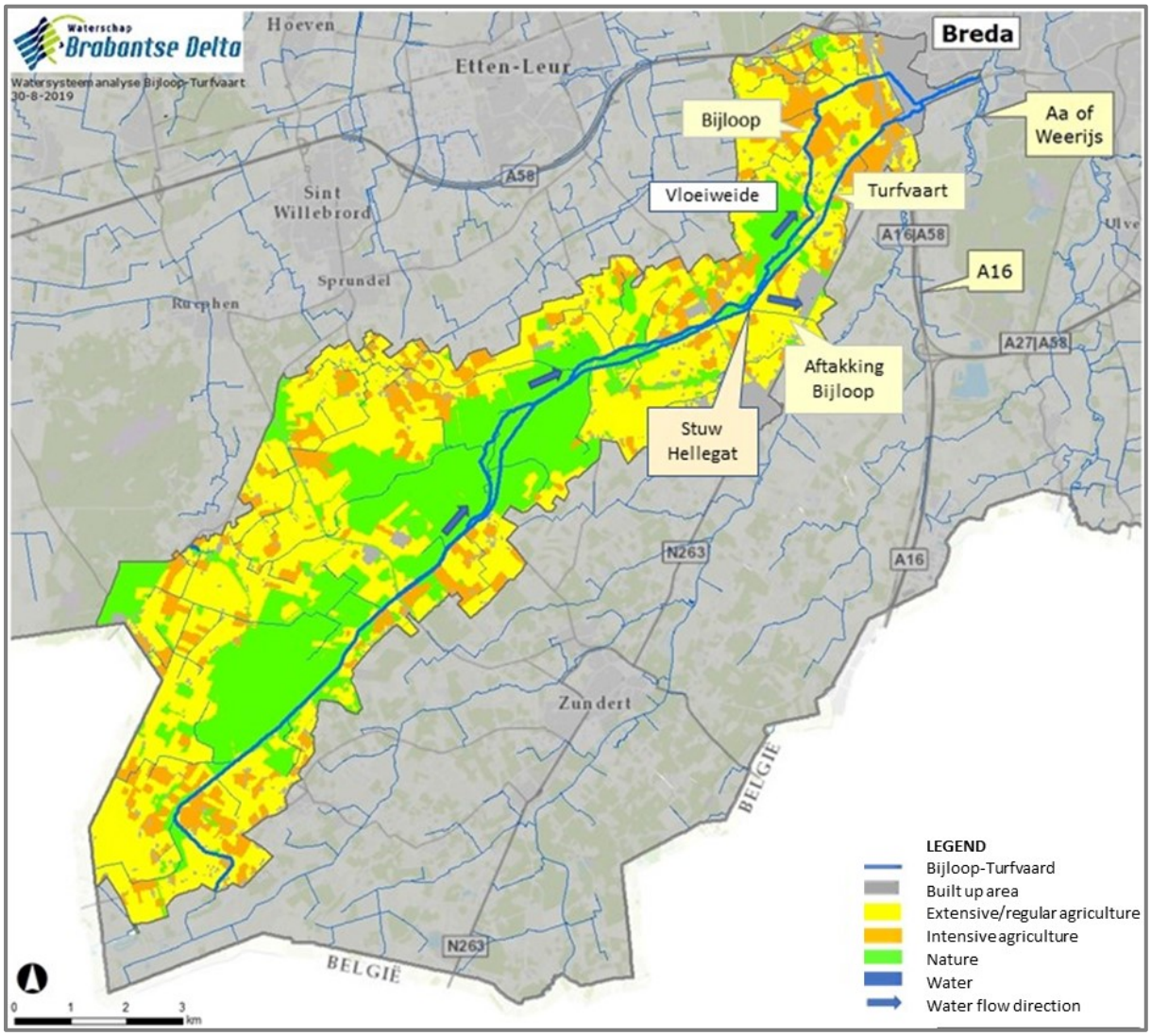


Figure 3 - Land use in the Bijloop-Turfvaart river basin.

The mix of agriculture and nature makes it an attractive area for the inhabitants of the towns and villages (walking, cycling and horseback riding). The nature reserves consist of fens and pools, swamps, dry and wet heathland and forests.

The importance of healthy water, biodiversity and nature is firmly anchored in the policy of the province of Noord-Brabant (Figure 3). The Bijloop-Turfvaart is part of the Brabant Nature Network, which focuses on the restoration of ecological connecting zones and 'Wet Natural Pearls'. In addition, the Bijloop-Turfvaart has been designated as a water body for the Water Framework Directive. The water quality must be categorised as ‘good’ according to the WFD, by 2027 at the latest.

1.3 Water resource risks & challenges

Important water usage in the Bijloop-Turfvaart catchment is linked to 'drinking water production' (deep groundwater), agriculture and nature (both shallow groundwater and surface water). Current water management is strongly geared to preventing flooding for agriculture and residential areas. The changing climate requires more attention for policy in relation to increasing drought. At present, the fresh seepage water disappears too fast from the catchment area.

When more water flows through the brook Bijloop, to the point where current management considers it a risk of flooding downstream of the Hellegat weir, the water is drained via the Bijloop diversion channel to the Aa or Weerijs. However, so much water is diverted via this diversion channel, that only groundwater goes to the (too) deeply incised Bijloop. As a result, the water in the brook Bijloop flows too slowly. This has a negative effect on water quality and biodiversity. The nitrogen and phosphorus load on the brook is still too high, with negative consequences for aquatic plants, aquatic insects and fish. High concentrations of heavy metals (cobalt and zinc) pose a risk to aquatic life.

The climate adaptation measures in the Vloeiweide increase the sponge effect and ensure more (capacity for) running water in the Bijloop. As a result, more freshwater will become available for nature and humans all year round.

To promote wetland conservation and restoration, the most beautiful wetlands have recently been labelled as “Natural Pearls” in the landscape (‘*natte natuurparel’ in Dutch*) – that should be allowed to shine and glitter. This is a clear example of the PROWATER philosophy of naturally retaining water and allowing it to flow through the landscape. Such a system provides natural fertilization of the soil for specific flora and fauna. The landscape acts like a sponge. When it is dry it absorbs water. When the sponge is saturated, it gradually releases the water. In this way a robust water system is created that can better cope with the consequences of climate change and that is good for nature and good for agriculture.

2 Identifying and engaging buyers, sellers and brokers

The basic idea behind the PES (Payment for Ecosystem Services) financing model is that investments made by 'buyers' in climate change adaptation measures result in the targeted provision of ecosystem services provided by the 'sellers' (see Output 2). The financing of the Vloeiweide took place in the more traditional Dutch way, by water board levies as well as European and regional subsidies, including the European Regional Development Fund (ERDF) and the Brabant Green Development Fund. The targeted ecosystem services that buyers (tax-payers) receive in return are a more stable supply and division of freshwater over the area (alleviating pressure in the rivers Aa and Weerijs during heavy rainfall events; allowing water to slowly release to the environment in times of drought) and restored healthy nature.

In the demonstration site Vloeiweide, the inhabitants of the province of Noord-Brabant are in fact the interested 'buyers' of the ecosystem services. By paying taxes, including the water board levies, they finance the climate adaptation measures in the demonstration site (and many other water board projects and water management activities in North Brabant). The intended ecosystem services that those buyers will receive are biodiversity, more healthy nature in which recreation can take place and a better freshwater supply.

The 'sellers' are the owners of the land on which the measures are implemented. Sale may mean that land is actually sold. Another form is that the water board and Brabants Landschap exchange land with the landowners. In addition, the sellers may be compensated for the loss of income (financial,

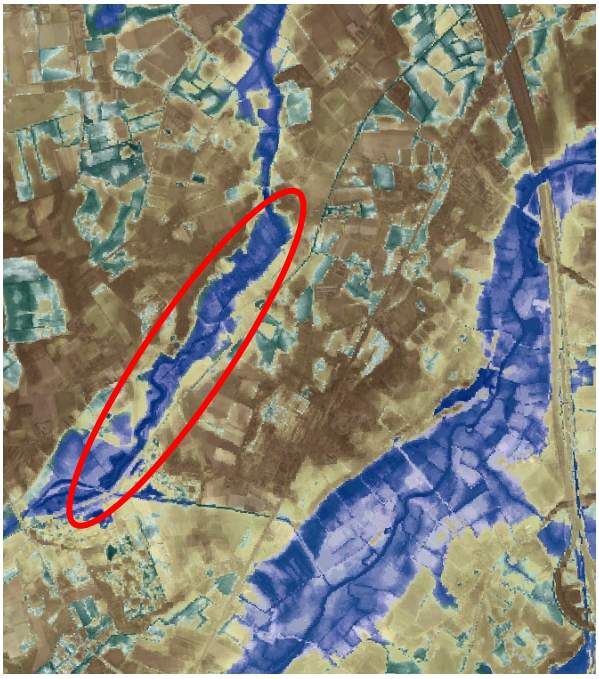
material). This concerns, for example, the raising of plots where rewetting damage is expected. The sellers (private individuals and farmers) must give permission for this. The water board and the Brabant Landscape together have a mediating role in the Vloeiweide project. They have the expertise for the necessary planning procedures and the design and implementation of the brook and nature restoration and compensating measures.

Within the existing Dutch agreements on soil and water use, the brook and nature restoration options for the Vloeiweide area are limited. For example, less water can flow through the brook Bijloop due to agricultural plots located downstream. They should not get too wet and are therefore partly raised. The Bijloop also has little room for recovery measures downstream, because the stream is wedged between agricultural plots. A payment for ecosystem services approach can offer prospects in the future for further brook and nature restoration with increased earning potential for agriculture (see Output 2). The increased share of private financing through PES revenue models would make it possible to compensate for more than just the loss of income. This more convincing revenue model, aimed at increased infiltration and retention of rainwater for freshwater supply, can convince more sellers (landowners and managers/farmers) in the area to also invest in climate adaptation measures voluntarily (in addition to what is requested through regulation).

3 Prioritising locations for climate adaptation measures

3.1 Prioritisation by means of the water systems map

For the project PROWATER, the University of Antwerp applied the water system map to the Interreg 2 Seas area (including catchments in Flanders, the Netherlands and South England) (Output 3). This map helps prioritise where to best apply EbA measures to infiltrate and retain water, based on hydrological characteristics, soil typology and topographical information. The map identifies 'natural places' in the landscape for seepage (groundwater coming back to the surface) and infiltration.



Groundwater dominated catchment

Hill top / Plateau – infiltration area, where water can infiltrate to groundwater bodies (indicated in brown)

Valley height – infiltration area, where water can infiltrate to groundwater bodies (indicated in yellow). Water that infiltrates here will have less residence time before it emerges in streams. However, flood attenuation can be achieved by infiltration.

Hill depression / Valley depression – Temporarily wet area, where runoff can be retained and slowly infiltrate. (indicated in green)

Floodplain – Temporarily wet area, where runoff and seepage can be retained and slowly infiltrate. (indicated in blue)

Figure 4 - The red oval indicates the part of the Bijloop along which several measures will be implemented.. The water system map confirms the potential to restore permanent and temporary wetlands (with potential for permanently wet areas and temporary wet areas indicated in blue and green).

The water system map indicates that the site Vloeiweide is suitable for the development of permanently and temporarily wet nature (figure 4), with the abundance of special plants due to the presence of the seepage. The challenge here is a more stable distribution of water over the whole area and across the seasons. The water must remain available in the catchment area for longer.

This is possible in the Vloeiweide through a combination of climate adaptation measures: 2.6 km of brook restoration (raising the soil, introducing woody debris and allowing more water to pass through the brook), hydrological restoration of 45 ha of nature reserve (soil restoration, restoration of natural depressions, smart water distribution). Smart, adapted control of the weirs and distribution system Hellegat allows as much water as possible to flow through the nature reserve via the Bijloop. An important precondition is that flooding downstream of the Vloeiweide (agricultural and urban area of Breda) does not increase. This is possible due to the increased water storage capacity created in the Vloeiweide. Consequently, less water is diverted to the Aa and Weerijs, also lowering the pressure during rainfall events in the Aa and Weerijs (tributaries to the river Mark). Figure 5 shows the measures in more detail.

Figure 5 – Restoration measures PROWATER project Vloeiweide.

3.2 Refining spatial prioritisation & EbA opportunities

The location choice for the restoration measures on the basis of the water system map supports the provincial function allocation in the Brabant Nature Network, which focuses on the restoration of ecological connecting zones and 'Wet Natural Pearls' (Figure 3) (see § 1.2). The province of North-Brabant had based the locations for water and nature functions on (desired) hydrological,

morphological and ecological characteristics and processes (in line with the PROWATER philosophy). These functions had already been assigned before the start of the PROWATER project in consultation with Brabants Landschap and the Brabantse Delta Water Board. Brabants Landschap already owns the present nature plots within the Natte Natuurparel Vloeiweide, which facilitates the implementation of measures.

The Brabantse Delta Water Board is working on brook restoration (Bijloop) as part of the Water Framework Directive and, together with Brabants Landschap, on the restoration of wet natural spots (such as the Vloeiweide).

3.3 The expected impact

Ecosystem services are the contributions of ecosystems to human benefits that contribute to the economy, public health and a healthy living environment. These benefits also include the intrinsic (subsistence) value of nature and biodiversity.

Due to the implemented climate adaptation measures at the Vloeiweide, the landscape acts like a sponge. With rain and irrigation of the Vloeiweide, the area can retain more water for a longer period of time (an estimated 45,000 m^3 extra storage is realised). This means that downstream areas of the brook Bijloop can be protected from flooding for longer, so that water has to be diverted less quickly to the Aa or Weerijs. This could relieve the Aa or Weerijs, which in turn must also be able to handle high flows to protect Breda (further downstream) from flooding. During prolonged dry periods, the wetter area of the Vloeiweide gradually releases the water to the wider environment. In this way, a robust water system is created that makes a better contribution to freshwater supplies, (downstream) agriculture and nature. The measures also contribute to better water quality with more life and biodiversity in the water and adjacent nature reserves.

4 Monitoring and evaluation

4.1 Monitoring and evaluating the impact of EbA on ecosystem services

A monitoring plan is implemented to develop a more accurate understanding of the water balance of the project area and the hydrological effects of the restoration measures. This plan has been drawn up in consultation with Brabants Landschap (nature manager). Groundwater levels are measured at a number of places. On the basis of the results, water and nature management can be adjusted in the future where desirable.

4.2 Evaluating the participatory planning and implementation process

Participation in PROWATER has provided Dutch organisations with the following insights:

- There is no blueprint for ‘participatory area development’, because every area is different. Governments, water and nature managers and private initiators need time to properly organize such a participatory process. A clear division of roles, clear rules and time-out moments are important here.
- Land is needed to give space to nature which in turns facilitates more sustainable land use. This is a critical factor that requires the cooperation of landowners.
- Making compromises asks for a weighing of interests. Support and cooperation of interested agricultural entrepreneurs is crucial. This was a major challenge in the Vloeiweide project. It would be more optimal for nature if more water could flow through the brook Bijloop and the

Vloeiweide. However, this would make agricultural plots downstream too wet. There is no room downstream to drain more water.

- Experiences in restoration projects as Vloeiweide has taught us that coordination of the wishes of the nature manager and the water manager requires special attention. Monitoring together is then important for forming a shared picture of the possibilities and impossibilities and of the coherence among policy and management goals for water and nature.
- The PROWATER water system map is an important tool for determining where in a river basin you can best take measures to infiltrate, retain, store and discharge fresh water at a natural rate.
- The cross-border groundwater bodies and river basins offer a starting point for further development of cross-border Flemish-Dutch water landscapes.