# GREEN QUAYS

**Generic model for ecological design nature inclusive quays**

O4.1.1

## Urban renewal Breda, nature inclusive

Neighbourhood nature has many positive effects on the living environment in a city. Plants bind particulates, which leads to improved air quality. In addition, plants increase biodiversity by offering shelter and nesting possibilities for fauna. Neighbourhood nature also decreases the effects of extreme circumstances, which are associated with climate change, such as heat stress, flooding and prolonged drought. Research shows that a natural neighbourhood with plenty biodiversity is good for the mental and physical health of citizens.

Nature is no longer exclusive to the countryside; it becomes an ever-increasing part of the city. The city is a specific biotope, in which buildings and natural elements come together. Cities are very compact spaces and make good implementation of nature in the urban environment indispensable. As the city is always under construction, it is only logical to make nature an integral part of the total picture.

But how can this be done in a good way? The Nieuwe Mark project has allowed the project partners to gain useful experience. The Nieuwe Mark stimulates urban biodiversity by realising 'green' quays, making biodiversity part of a bigger plan for urban reconstruction of the river Mark in Breda.

The experiences are shared in four guidebooks that describe the steps of the design process from different angles: 1. Increasing biodiversity, 2. Technical construction of 'green' quay walls, 3. Nature inclusive and participative urban renewal and 4. Generic description of the implementation of the climate-responsice strategy.

This guide focuses on the increasing of biodiversity and answers questions that arose in the design process:

- Which species should take advantage?
- What do they need (establishing conditions)?
- How does that match with other usage conditions?

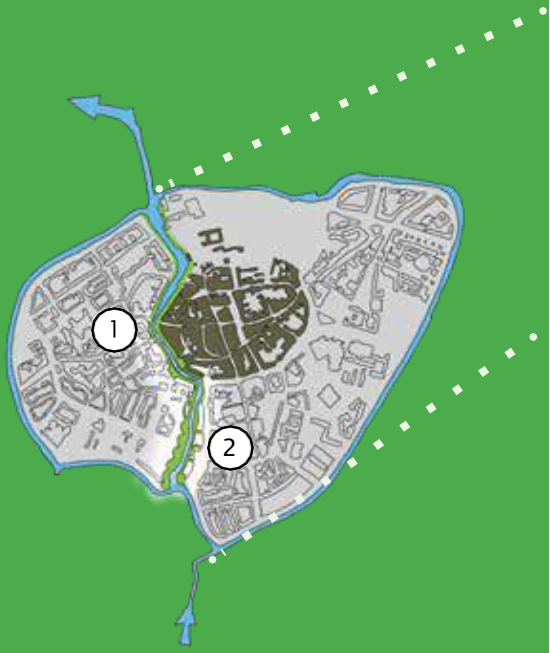
*Ivy-leaved toadflax*

## Which species should take advantage?

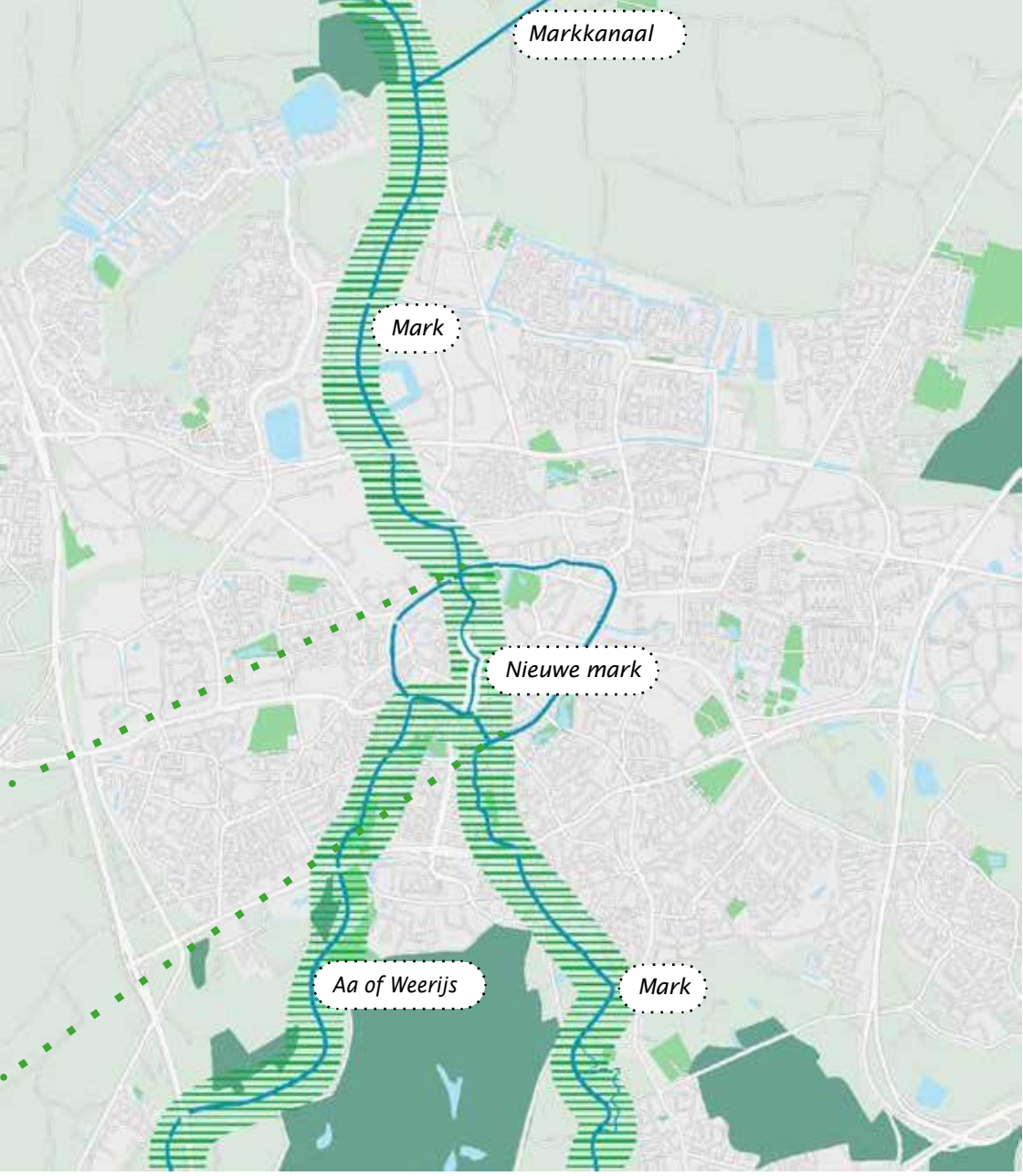
### The ecological context

The design process started with mapping the ecological context. Which (original) landscape types occur in the planning area and surroundings? This will determine which species were found. The most prominent landscape types in the Nieuwe Mark project are: 1. The river Mark and 2. The stony inner city.

1. The river Mark is part of an important ecological corridor connecting nature reserves nearby the Belgian border and the Biesbosch. The Mark and canals around the inner city of Breda have the official status of Ecological Connection Zone (EVZ) within the Nature Network Brabant. With the realisation of the Nieuwe Mark, an old connection route is recovered and with it an extra connection route is added. Species can use the Nieuwe Mark as a stepping stone into the city center, increasing local biodiversity and greenspace.
2. In the inner city, the Mark is embedded between old quay walls. Along the Spanjaardsgat, extraordinary wall plants grow on the old quay walls. A rich assortment of wall plants on the quay walls is what developers had in mind when making plans for the Nieuwe Mark. The landscape architects based their greenspace design for the Nieuwe Mark on the plant growth that occurs naturally along this river.




*The Nieuwe Mark becomes a navigable river. (1) is where the river will be embedded between quay walls made of brick, and (2) is the intended location of the natural bank*



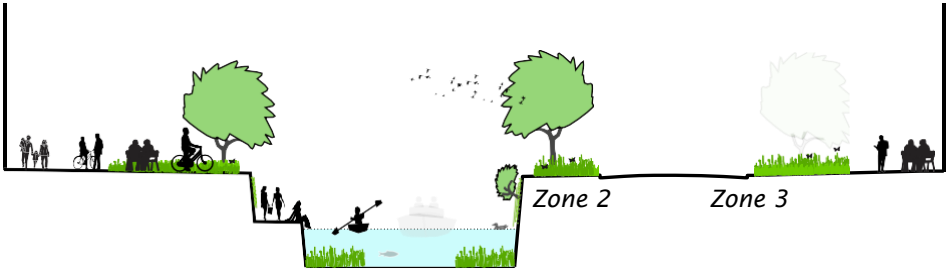

*The Mark and Aa of Weerijs are important ecological connections between nature reserves near the Belgian border and the Biesbosch. The canals around the inner city of Breda form an essential link in this. The realisation of the Nieuwe Mark adds an extra connection through the inner city.*

## The selection of target species

Based on the ecological context, it was assessed how the Nieuwe Mark can improve the inner city's biodiversity. The planning area was divided in three zones. A selection of target species or target groups was made, that symbolise the project's desired direction. Here, the two landscape types that meet within the Nieuwe Mark, form the basis of the plan:

1. The Mark as an ecological connection between nature at the north and south side of (the inner city of) Breda and
2. The stony inner city.

The list of target species was determined in consultation with local nature associations, of which the members have profound knowledge of both present nature values and bottlenecks that obstruct further development.




The planning area is devided into three zones for the list of target species:

| Zone 1 | Zone 2 | Zone 3 |
|---|---|---|
| *Water and bottom of the Mark, that are under water at some time* | *Banks and quays (from the level that is always above waterl) and below bridges* | *Establishing zone from the quay till the facades* |

Target species and groups are chosen for each zone:

| | | |
|---|---|---|
| **Fish**<br>*european eel, bullhead and juvenile fish from common species like ide* | **Insects**<br>*yellow-loosestrife bee and loosestrife melitta* | **Insects**<br>*no specific species* |
| **Birds**<br>*mallard, common coot and great crested grebe* | **Birds**<br>*common moorhen, kingfisher, grey wagtail, barn swallow and sand martin* | **Birds**<br>*house sparrow, dunnock, black redstart, common swift and common starling* |
| | **Wall plants**<br>*wall-rue, maidenhair spleenwort, hart's-tonge fern, yellow corydalis, pellitory-of-the-wall and ivy-leaved toadflax* | **Bats**<br>*no specific species* |
| | **Bank plants**<br>*no specific species* | |
| | **Bats**<br>*no specific species* | |

## Establishing conditions

For each target species or group the establishing conditions were determined. These include, for example, underwater hiding places, nesting and breeding opportunities in shrubs or below bridges, food supply for birds and bees and suitable places on quay walls for wall plants to grow. The list of target species and their establishing conditions have been added to the programme of requirements for the design of the Nieuwe Mark. In addition to stimulating the biodiversity, this programme of demands consists of the other preconditions and design targets for the area, such as recreation, water disposal and coolness (climate adaptation).

*More information:*

*Report D.4.1.2 (Randvoorwaarden voor ontwikkeling muurplanten)*

*Report D.4.1.3 (Randvoorwaarden voor ontwikkeling fauna)*

## Additional research

By formulating the programme of requirements, the following technical questions arose:

- What do wall plants need in order to grow on the new quay walls?
- Is it possible to let trees grow out of the quay walls without causing damage to the walls in the future?
- What are the possibilities for creating underwater shelter for fish?

To answer these questions, research was conducted with several small test setups to determine the best technical solutions.

*More information:*

*Report D.4.2.1 (Generic model of the nature inclusive quay construction)*

*Wall plants are tough species that require very little. The most important establishing conditions are a sufficient water supply and a place to root. The goal of one of the test setups was to determine how to realise the optimum conditions.*

*The presence of underwater hiding opportunities is of vital importance for fishes. If the recreational purpose of the Nieuwe Mark prohibits natural bank and underwater vegetation growth, would it be possible to create artificial hiding places for young fish instead? To answer this question, gabions were filled with different volumes of timber, positioned underwater and surveyed. The developers chose timber, with the knowledge that stone is a rare occurrence in the river Mark and unwanted exotic gudgeons swimming there flourish on stony substrates.. On the other hand, the desired target species (young ide, bullhead and European eel) use timber for shelter. More fish were caught near the gabions than along the quay walls where no gabions were positioned.*

*A test setup conducted research into the possibilities of growing trees in the new quay wall without causing damage to its stone coating. For this research, native tree and shrub species that naturally occur along the Mark, such as European white elm and Common sallow, were chosen. These trees offer nesting and hiding opportunities for birds. Also, common sallow flowers in early spring and is often visited by bumblebees. Situation June 2020 (L) and June 2022 (R). Despite several exceptionally warm and dry summers, the trees have established themselves very well.*

## The design

In the design stage, the formulated preconditions for the target species and the results of the test setups were translated into design criteria, which the city council developers used in their design.

**Participation**

To help local residents engage in the philosoph y of nature inclusive design, several physical and online sessions were organised. Firstly, this sessions explained what measures were incorporated in the Nieuwe Mark design to increase biodiversity. And secondly, participants were inspired with examples of how to increase biodiversity in their own house and garden. These sessions helped to increase the support base for the renewal of the Nieuwe Mark and allowed local residents to discover what difference increased biodiversity can make in their surroundings.

*More information:*

*Report D7.2.3 (Action plan to nature* inclusive and participative urban developmentl)

*As part of the open doors day at the start of the project, visitors received an appealing native plant to increase the biodiversity of their own (facade) garden – a nice sight and good for insects*

## Where are the target species?

During the design phase, volunteers started surveying the dispersion of the determined target species and groups. Not only within the project area, but also in the surrounding areas . Potential source areas, from which the target species might colonise the Nieuwe Mark, were also mapped. This kind of data collection is called citizes science. The collected data are used as a reference point to monitor developments and control targets over time. Have all target species been able to find and colonise the Nieuwe Mark?


*The results of the research. The map shows the source areas from which target species maidenhair spleenwort can spread to the project area.*

*In order to determine which bank and wall plants could establish themselves along the Nieuwe Mark, volunteers from Natuurplein de Baronie surveyed the dispersion of these species upstream along the Mark and Weerijs (L) and on the old quay walls along the Spanjaardsgat (R).*

## Making choices

Choices had to be made in the design of the Nieuwe Mark, in which ecological demands were not always compatible with other demands (appearance, recreational purposes) could technically not be realised. Several of these choices are described below.

**Spontaneity versus quick results**

For the Nieuwe Mark project, it was decided that target species had to reach the project area on their own. With mobile species like insects, birds and fishes, this is obvious. It is far less obvious for wall and bank plants, which are usually planted. In this case, we chose not to plant species but to create a suitable establishing environment. This means that patience is necessary in order to develop a well-grown quay wall. The plants need to be carried to the project area by wind (ferns), water (bank plants) or ants (yellow corydalis and ivy-leaved toadflax). This process might take several years.


*During the construction of the Breda harbour in 2006, developers did not take the establishment of wall plants into account. Despite this, in 2020 there were already wall plants growing on the quay walls. They had settled in the settlement joints. Keeping these settlement joints empty in the design of the new quay walls is expected to speed up the colonisation process of the target wall plants.*

## The eye wants something too

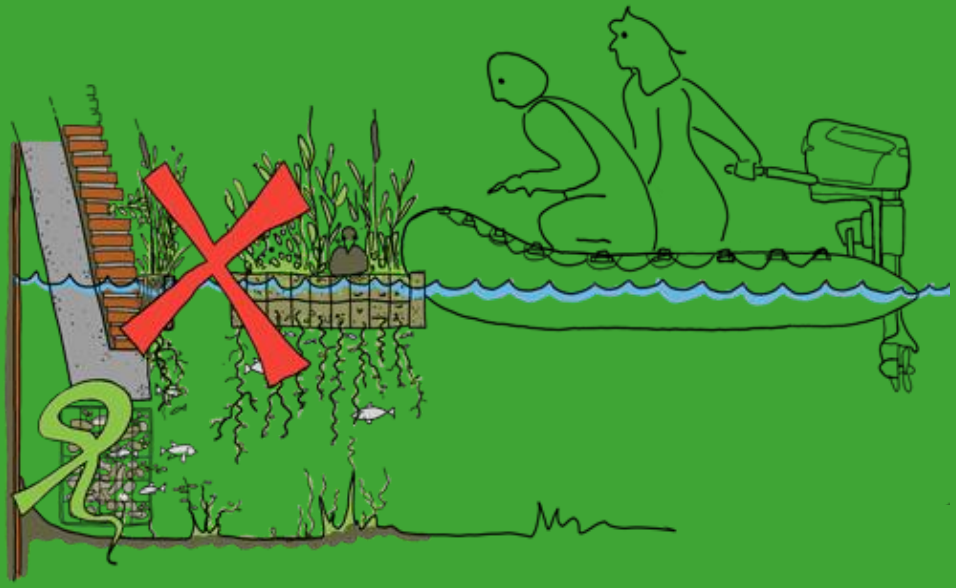
The design for the residence zone (zone 3) includes avenue trees and plant borders. It also includes trees that grow from the quay walls (zone 2) . In consultation with local nature associations, a planting plan was made which combined an attractive appearance for local residents with increased biodiversity. The plan includes plants and shrubs that have something to offer from early spring until late autumn; nectar for insects, berries for birds and a beautiful green neighbourhood for the residents to enjoy. Species that are native to the Breda area (wetlands) form a key part of the plan.

*Nature <-> park*

*The planting plan was modelled on the list of target species, among other things. Not only do bees and butterflies need sufficient sources of nectar, but the desired species also need host plants. This is even more important for bee species who depend on one specific plant species . Host plant Purple loosestrife, for example, was included in the planting plan specifically to support the target species Loosestrife mellita.*

## Safety first

For fish and other water animals, the presence of underwater hiding places is of major importance. In natural waterways this is provided by water and bank plants, and also by roots from trees along the waterway that hang in the water. Suggestions were offered to place small floating plant-covered rafts in the river, or to fasten a construction near the bottom of the quay wall for bank plants to take hold, but these were rejected. The floating rafts did not fit within the appearance the developers had in mind, and the construction on the quay walls was a potential safety hazard for recreational users on the water. We are however looking into possibilities for placing rafts on locations that provide more space. Since it was technically necessary to put concrete on the bottom of the Nieuwe Mark, the establishing possibilities for plants are limited. Even so, it is expected that eventually a water bottom will develop in the lee parts in which water plants like yellow water-lily can root. Below the quay walls is space to realise hiding possibilities for young fish by attaching gabions (filled with timber).



*Due to the safety for people on a boat, floating rafts and fastened constructions for plants are unwanted. The space below the quay walls are used to create safe shelter for fish.*

## Tranquility versus human usage

The desired target species are species that feel at home in environments with plenty of human activity. However, these species need their own place to breed undisturbed, find food, flee for predators or take shelter and rest. Therefore, the design situates facilities for fauna (insect blocks, breeding facilities for birds, bat facilities) in places where chances of disruption by human activity are small. The low quays with walking opportunities are situated on the north east side as much as possible, allowing wall plants to establish themselves undisturbed in the favourable shade of the south west side.

For target species like kingfisher and sand martin, the narrow part of the Nieuwe Mark is too small to create successful breeding possibilities. It was decided not to create special facilities in these parts for these species, but to do so later in the more spacious southern part of the Nieuwe Mark that is yet to be constructed.

*Do recreation and ecology match?*
*With facilities for fauna on less vulnerable places, the area stays attractive for target species.*

## GreenQuays lessons and strategy

Much can be learned from the GreenQuay project, for example the way developers, landscape architects, ecologists and technical engineers cooperated on the nature inclusive design of the Nieuwe Mark. By starting out with a survey on how the Nieuwe Mark could contribute towards increasing biodiversity in the inner city of Breda, and by appointing target species (ambassadors), sharp preconditions could be formulated for the nature inclusive design. It is not just the target species that profit from this design, but it leads to an overall improvement of the basic quality of nature in Breda.

**Colophon**

This guide reflects our experiences with the Green Quays project.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This project is cofinanced by the European Fund of Regional Development by the Urban innovation Actions Initiative (UAI)

1 September 2023