URBAN NATURE ANALYSIS

THE FIRST STEP TOWARDS
NATURE INCLUSIVE DESIGN

Explore lab
Graduation research

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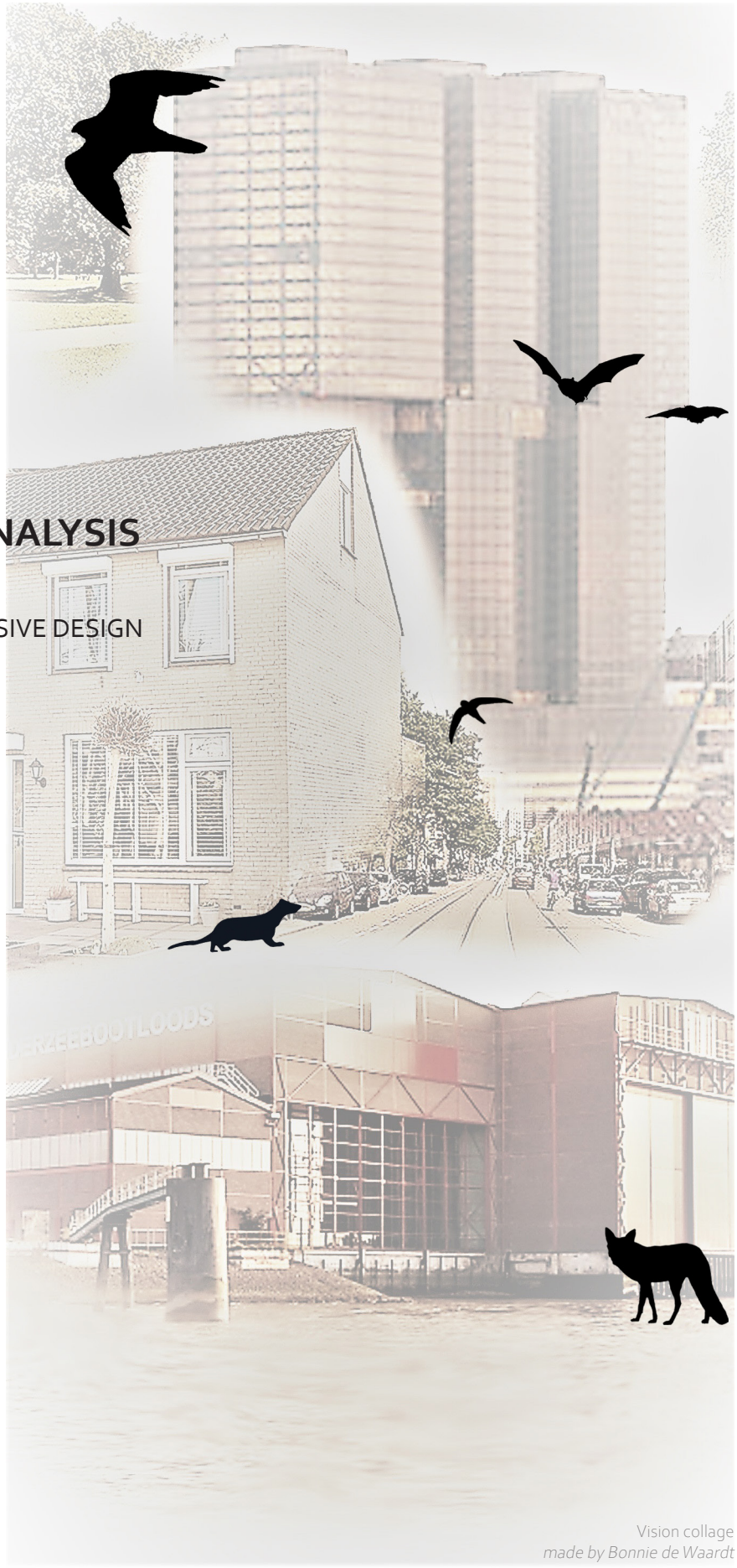

Vision collage
made by Bonnie de Waardt

Rotterdam skyline
Picture source Flickr

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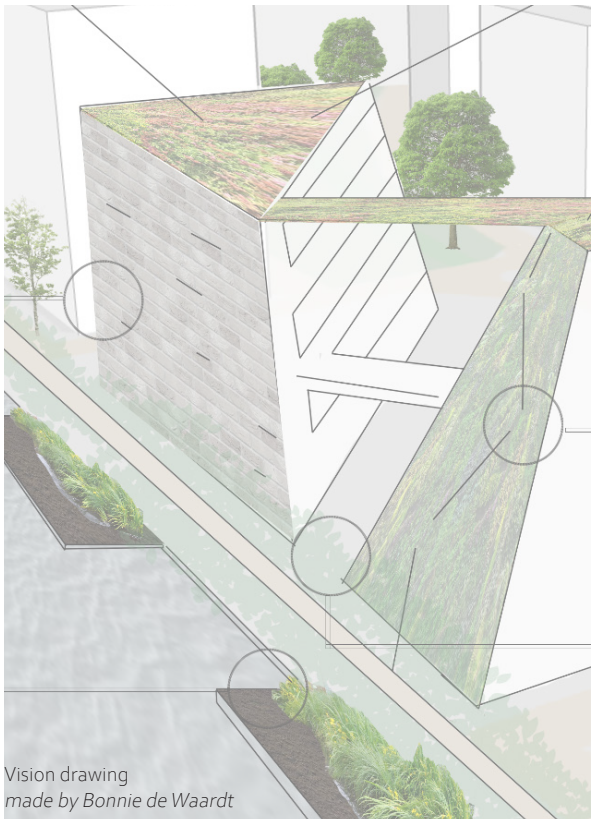
Pollination
Collage by Bonnie de Waardt



Vision drawing
made by Bonnie de Waardt

Nesting bats
source church in Tjerkwerd

Common swift
Picture by vogelbescherming

Oystercatcher with chicks
picture by Geert de Vries

Fox in urbanenvironment
source Gettyimages

ABSTRACT

Nature inclusive is a large topic that is still in its pioneering phase. There is a need for clear elaboration and ways of incorporating this new way of thinking into design.

In order to have a functional nature inclusive design one must fist know the existing ecosystem to contribute to this.
The research question: how can a designer analyze a Dutch city to find the existing ecological structure and nature inclusive potential? Will be answered by making an analysis method.

This analysis method will use insights of literature and ecological knowledge in combination with already broadly known analysis methods. By combining the way of analyzing of designers with the knowledge of nature inclusivity, a method is formed that will help create an nature inclusive design vision.
The method can also be used as a tool to talk to city ecologist in order to make a well balanced ecological plan.

This research limits itself to the animals of the Dutch city. Use of the method will apply best to cities comparable to the city of Rotterdam, which is used as example city in the research.

The outcome of the analysis method is a clear vision on the nature inclusive potential of a site. Using visual aids and a list of recommendations this vision can be used in the start of the designing phase.

RESEARCH INTRODUCTION

To make good nature inclusive design one must see the city not as opposite to nature but as a sort of nature in itself.
The city has its own ecological structure and there for a city can be viewed as a ecosystem in itself. Within this ecosystem there are many biospheres that contain habitats for many different species. In this research the focus for analyzing the city will lay mostly on the conditions needed for the animals that live in the city. The flora analysis will be in service of the requirement of the animals. By analyzing the city a system will become visible. It will show which animals are living in the city and where. It will show what is threatening the animals and how they can be helped. These so called problem points will point out spots that are in need of an intervention to make the ecosystem work better and support one or more species.

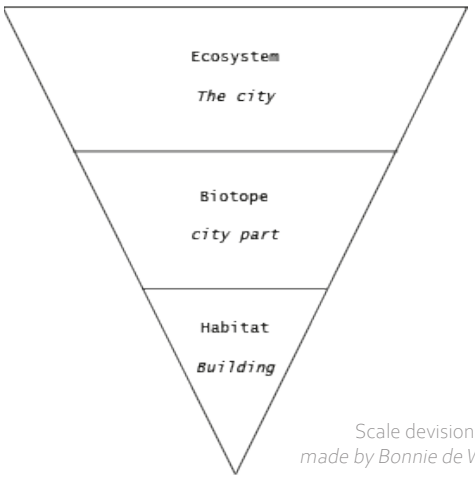
The city is home to many humans and is being expanded almost daily. But besides humans the city is also home to many animals. Nature inclusive design is meant to benefit both humans and animals. Maintaining a balanced ecosystem in the city contributes to health, prevention of the greenhouse effect, pest control and many more. Nature inclusive design is still in its pioneering phase and is in need of more awareness and adaptation. When reading about nature inclusive design it states that: one must use the ecological structure that is already existing in the city and build forward on that. Finding this existing ecological structure in a city is problematic. There is no clear way for designers to analyze a city on its existing ecological structure. Therefor it is almost impossible to find the cities nature inclusive potential because the existing structure should be the starting point is unknown.

This is why the question of this research is:

How can a designer analyze a Dutch city to find the existing ecological structure and nature inclusive potential?

The method of this research is based on gathering information and processing this information into an analysis method. By doing literature research and talking to experts, criteria will be divined to fabricate an analysis method. This method will be tested by analyzing a Dutch city on its nature inclusive potential.
The city chosen will also function as the design location for the second part of the graduation. This way the research and the design question have an direct correlation.

To structure the analysis it will analyze the city on multiple scales. The scales have a correlation to the scales of an ecosystem. Each scale has its own focus points. The research will focus mostly on the ecosystem and biotope scales. The habitat will be further explored in the design phase of the graduation.



Scale devision graph
made by Bonnie de Waardt

Besides scales there will also be an focus on different species. Target species will be used as starting point for making designs that help species in the city. The target species are related to the distinctions made in the analysis. The most zoomed in analysis scale will focus on the species specific requirements.

To understand this research it is important to understand the following background information.

The research is based on intel from literature regarding natureinclusive design and insights into the ecosystem of a city. The interview with Dolf van der Gaag was an big inspiration in structuring this research. Because this interview was of such importance to the research, it is included in the background information. The summery of the interview connects the literature knowledge with the field expertise of an ecologist. Making the perfect starting point for the analysis method.

Dolf van der Graag
Picture source Linked-in

Through the eyes of an city ecologist

Dolf van der Gaag is an city ecologist for the city of Rotterdam. The ecology department of Rotterdam has around 14 people working for them. The department supplies advise and conducts research on ecological questions in the city. For example they are charged with making sure all building endeavors of the city comply with the law of nature protection. During the interview I got an glimpse of what an city ecologist can bring to the table of a designer.

Green design visualisation
Drawing dreamstime.com

Dolf talks about the need for regulations in order to enforce change. To the frustration of many city ecologist, most plans and projects of the build environment don't have ecology high on their list of requirements. It is usually a subject that comes to the table only to comply to the regulations at the end. For ecology this is not beneficial. The ecology view should be considered at the start of the project. Ecology has to be integrated throughout the entire plan else it will not make an significant difference. Also there is not one way to how a building can contribute to the ecology of an environment. Every project is unique and has its own unique challenges and opportunities for ecology in the city.

Visualisation of the *"Groene Promenade Hofpleinlijn"*
by De Natuurlijke Stad

Common swift
Picture by Klaus Roggel, Berlin

Pygmy bat
Picture by Salvatore Ferraro

Marten
Picture by Jeroen Francois

This is why consulting an ecologist in the early stage of an project is encouraged. Consulting an ecologist when a design is already finished, will make little to no ecological difference. On a larger scale ecologists try to be involved in educating project developers on how an area could look like in the future. The notion of not building nature inclusive because there are no other buildings in the environment to connect to, is one of the main reasons why project developers do not want to build nature inclusive. Nature inclusive building is still in its pioneering stage. What is needed are example! Yes nature inclusive buildings function better if they are connected to a larger ecological system. But if there are no pioneers that start building in this way the larger ecological system will also never occur.

Ecologist are able to make an assumption on which species are most likely to inhabit an area. They base this assumption on ecological knowledge of the preferred environments of species and data collection. They are looking to expand the data collection to have a more accurate view of what species are inhabiting the spaces. Now data is collected by green maintenance and sightings of interest groups such as the Bird protection of the Netherlands and Dutch Mammal Society. To research species, ecologists use a grouping system to make an overview. They use the main groups: birds, bats, amphibians/reptiles, insects, mammals and fish. Some of these groups also have subgroups. Birds are divided into primary protected (these are always protected by the law of nature protection), protected birds (the red list of the Netherlands changes every year) and general birds. Bats are sub grouped into tree bound and building bound. Insects are sub grouped into terrestrial, aquatic and aerial. A special focus is also the plague animals.

When ecologist are asked to advise on a project site, they make an assumption of the species that could inhabit it. By giving the ecologist time to analyze the site this assumption will become more accurate. It is therefore wise to calculate the research time into the design planning. Only after the ecological advice one should start forming a vision for the area. It is essential that an ecologist is enlisted at an early stage. The advice of an ecologist will contain a recommendation of species that might benefit from nature inclusive design decisions on this spot. This can be species that are endangered, have verry specific needs or would be beneficiary if reintroduced to the site.

Besides animal species ecologist will also give an advise about particular greenery. The most abstract advice is, to use mostly indigenous types of green. This can verry from a particular tree that is originally found on this spot to the choice of a tree that is most close to the site. For example when choosing an variation of a tree, a tree originating from France is better than choosing an tree originating from Asia. The biodiversity of a tree is also verry bound to the age of the tree. An old tree has one hundred times more biodiversity as a young tree. When planting a tree it is crucial that it has space to grow, so keeping distance from roads or buildings would be advised. Also make sure that the ground is suitable for this type of tree and it has space to root.

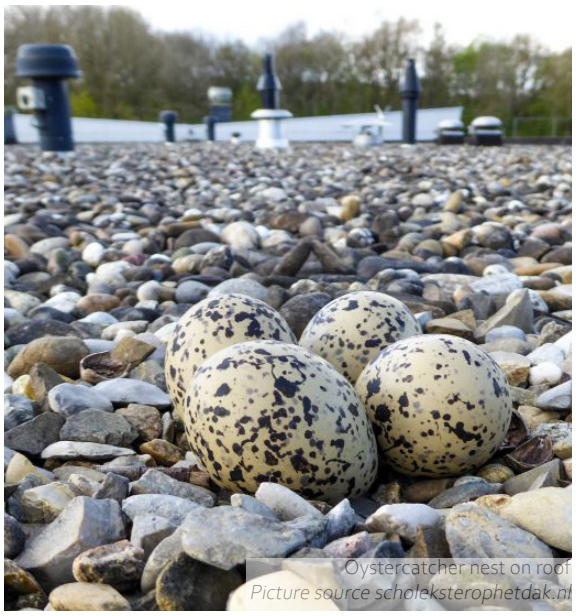
The survival of a species at a specific location is directly related to the, in Dutch so called, five v's. These are food (voedsel), safety (veiligheid), reproduction (voortplanting), connection (verbinding) and variation (variatie). If one of these links is missing a species will not survive. In the city connection is usually verry challenging to achieve. This has ofcourse also a direct effect on reproduction and variation. The topic of connection is one that is almost impossible to solve on a single site.

It has to eighter be regulated on a larger scale or the location has to actively create connections between existing routes. An species verry effected by the connection in the city is the bat. Bats are dependent on their line based routes that must be dark. If these routes are disturbed by light they will not fly there and therefor will also not inhabit a space on the location. Bats can endure up to 2 lux on their flight route. But this also difference between types of bats. The Water bat for instance is verry sensitive to light and can only endure 0.1 lux, which is the same as moonlight. Good ways to help bats in lighting, is to have low hanging streetlighting that will shine down. The flight route of a bat is usually located at the top of trees. By having your streetlights lower than this route and shining down you are still able to accomplish the safe light environment without disturbing the bats. Also white light is most harmful to bats, the redder the light, the less invasive it is. Besides outside lighting it might also be important to think about inside lighting. Large windows that will have lights burning can also prevent bats from using flight routes. Having lights point inwards, or keeping flight routes in mind in the orientation of windows can prove extremely beneficial to bats.

An ecologist will base their assumptions on the species that inhabit a space, on the sort of environment that space has. In the generalization of a Dutch city there are a number of different environments. Highly urban spaces such as the inner part of the city characterized themselves by the large amount of stone in the environment and the high presence of humans. This means that species that like quiet and lots of green will most likely not be found in these parts. Encouragement of species such as the swift (gierzwaluw), house sparrow (huismus), various bats and the basic insects are the so called target species for this environment.

Peregrine falcon
Picture by Manu De Hauwere, Gent

Natural borders
Collage by Bonnie de Waardt



Oystercatcher nest on roof
Picture source scholeksterophetdak.nl

Industrial sites are a lot more quiet. They contain large surfaces of gravel and make the perfect opportunity for the implementation of so called brown roofs. Species such as the black redstart (zwarte roodstaart), oystercatcher (scholekster) and the common tern (visdief) use these roofs for their nests. The industrial sites can be easily adapted to accommodate these species. Due to the location of these sites they might also attract some lager mammals such as foxes.
The suburban areas can be divided into two groups. The garden villages and the garden cities. Garden villages have a lot of green in between houses, contain backyards and usually have the traditional tiled roofs. The height of the buildings is usually quite low. Garden cities have the same quiet level as the garden village but instead of low buildings the garden city has high rises. In between the high rise buildings there is a lot of green. The buildings are more robust and usually have flat high roofs. A garden village can create great opportunities for the house sparrow (huismus), swift (gierzwaluw), various bats (also those who prefer more quite spaces) and many insects. The amount of green in both the garden village and garden city will attract small mammals such as a hedgehog or martin. The garden city can provide a great environment for bats that need a verry steady temperature. Due to the lack of tiled roofs it is less suited for the swift or house sparrow. The amount of green does create an opportunity for many insects. The use of vertical greens can also be verry beneficial to these species.

An nature inclusive design is always about finding the balance between the needs of the animal and the needs of the humans. The need for recreation for instance creates a field of tension. The more recreational spaces the less safe spaces there are for animals. But if all spaces where safe spaces for animals no human would want to be there anymore because it would feel unsafe to them.

It is key to find a balance in between these two. An green roof can be used partly for recreational space and partly as a safe space for animals. Parts that are unappealing to humans such as roof spaces with ventilation shafts and technical facilities. Can be perfect for animals. In the design these spaces can be assigned to be unavailable to humans and this will create an safe space for animals.

Animals in the city face many threats. The most prominent of which is humans. The city is constantly changing which means that habitats are disappearing all the time. Species living in the city have to be verry resilient in coping with changes or else they will die out. An example of a species that used to inhabit Rotterdam and is now extinct in Rotterdam is the squirl. Traffic, city planning, street lighting, tree felling policy and disruption of quiet are some of the threats animals are faced with in the city. Many of these threats can be lessened or even eliminated when animals are considered in the planning stages of an design. Nature inclusive design does not limit itself to buildings. It must also be a topic in urban planning, infrastructure, green maintenance and all other design related topics in the city.

The city must change its view in some ways. The notion that not everything has to be accessible to humans would make a huge difference in suppling some safe spaces for animals. Also some nature inclusive notions might be helpful to some animals but can have no effect on others. It is important not to focus on one nature inclusive principle. A city must always be an system and any intervention has to be integrated into the greater whole. Stepping stones for instance are an nature inclusive tool used in urban planning. They are small patches of green throughout the city to create a sort of resting spot for animals to "step" from one green space to the other.

This is a great tool for species such as birds. But fish for instance will have no use for it. Species such as hedgehogs are able to cross a road but they need a safe space immediately after. Martens can cross a little further but not as far as steppingstones are placed. Insects that can fly will be able to cross over much better than insects that are terrestrial. The level of awareness also plays a big part in this. An terrestrial insect has to "bump into" an opportunity of green. For instance an green roof can be verry beneficial to terrestrial insects as well, but they will only get there if there is a gradient green way to get there. Vertical green on the side of buildings or green stairway buildings create a lot of opportunity for these insects. Ringways around a city create a big problem for the bat population in the city. The lighting around the ringway makes it impossible for bats to exit or enter the city. This is a verry big problem for the variation and it can create an instable gene pool.

Besides animals there are also decomposers. The balance of decomposers is a big problem in the city. Almost all parts of the natural ground in the city is excavated and replaced by sand in order to use as building ground. This ground contains almost no natural nutrients that plants need to grow. The city ground has almost no decomposers in the ground because it gets extracted so often. The best way to deal with this problem is making an clear plan on how to deal with the ground on a construction site. Only extricating the part where the building is planned instead of extricating the entire plot. Many trees for instance get declared unsafe after a few years because they are not able to root down far enough. A tight compressed ground layer of sand is usually only a meter under the surface. This layer cannot be penetrated by the roots making the trees root outwards. The spreading of the roots can cause problems in roads and buildings and it will make the tree unstable.

visualisation drawings for building nature inclusive
made by Bonnie de Waardt

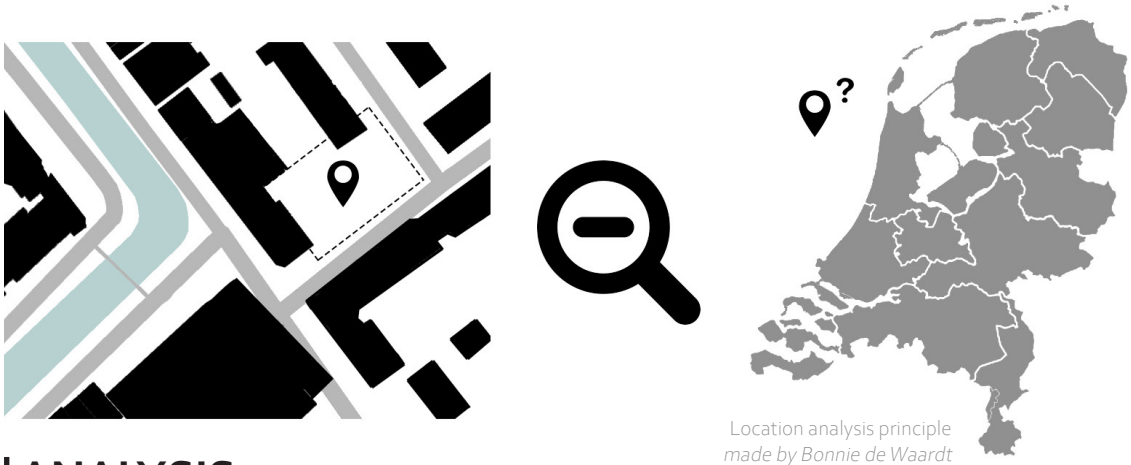
RESEARCH OUTCOME

The outcome of the research will be shown in the elaboration of the analysis method. The analysis method is made for designers. It uses techniques already broadly used in the designing field. The method is meant to give the designer insight in their location.

The in depth analysis method will create an comprehension on the wide topic of nature inclusivity. The method focuses on animals in the Dutch city. The method can be used for any city, but it might need adaption if the city differs to much from the example city. The method is based on mostly Dutch sources about nature inclusive design. Information regarding need of animals often originated form organizations of interest such as the mammal association and bird protection of the Netherlands. Besides literature the interview with city ecologist of Rotterdam Dolf van der Graag is used to make the analysis method. The method is an combination of obtain knowledge trough these sources together with own experiences and designer analysis methods. The exact sources used in this research can be found in the bibliography.

The goal of this analysis method is to give the designer input for there design vision to help integrate nature inclusive measures into the design.

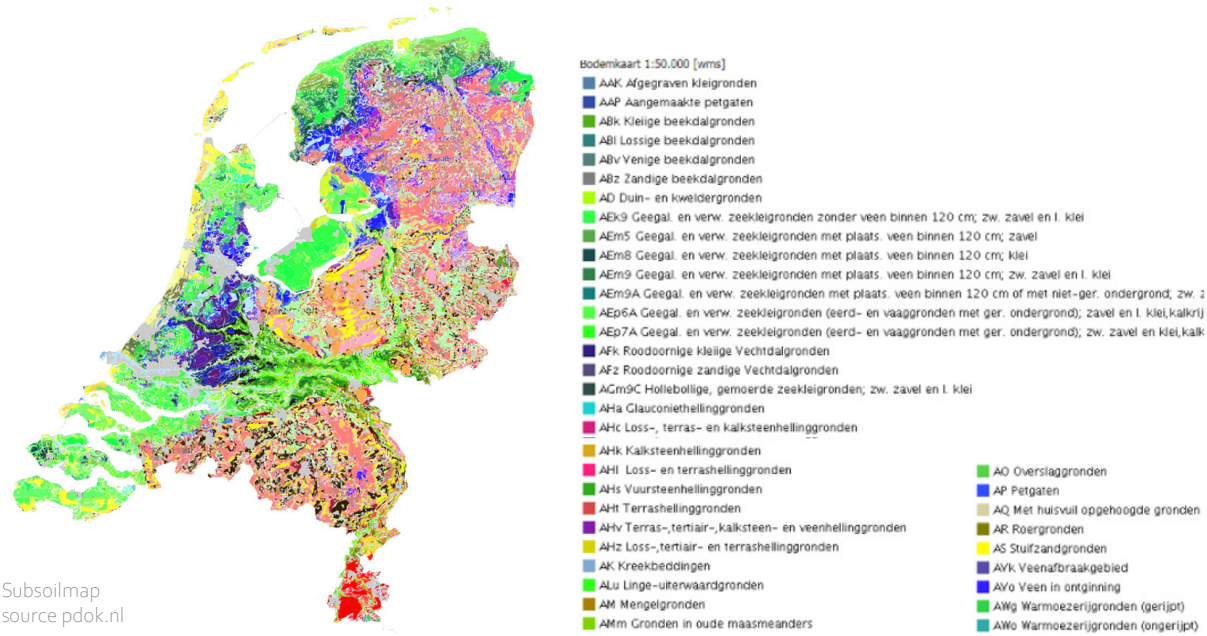
The analysis method is also a great starting point to have an conversation with an city ecologist. The information obtained from the analysis will make it easy to talk to the ecologist.
With this information the ecologist can further elaborate on the specific location you are designing, without first having to analyze or explain the entire system. The analysis method and ecologist intel will create the perfect starting point for an nature inclusive design.



Location analysis principle
made by Bonnie de Waardt

ANALYSIS METHOD

At the start of any design there is an design location. This location will be the starting point of the analysis. Before we can understand the Eco structure on the site we need to understand the Eco structure on a much bigger scale. By zooming out to an country level the first analysis can be made. An ecosystem is not an isolated thing it connects to many other ecosystems. Therefor the surroundings and environmental aspects of a location are verry important. At the country scale the analysis will focus on three important starting points that will have an influence on the Eco structure on the site. We divide this scale in subsoil analysis, urbanisation and large green blue mapping.



Subsoilmap
source pdok.nl

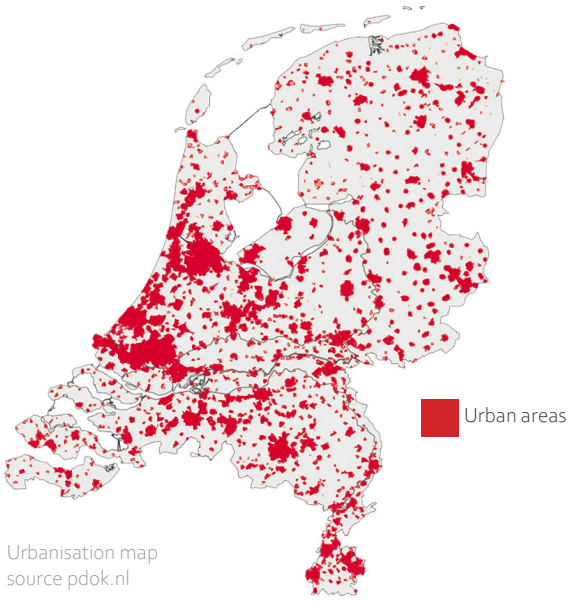
The mapping of subsoil gives an indication for which soil is present on the design location. The subsoil is an important factor on whether or not plants can grow. Animals that are reliant on certain plants are therefor also affected by the soil of the site. The Netherlands has an great diversity in soil and therefor diversity in plants and species. This analysis will prove useful later on when designing greenery and connecting to the bigger ecological system.

The urbanization map shows the amount of build environment in the Netherlands. The so called Randstad is the most urban part of the Netherlands. This also effects the animals that live there. Because there is so much build environment near by, one can assume that only city adjusted animals will be able to live here or come to the city. Because cities in this part of the Netherlands are so close together an interaction of species from two different cities is to be expected. This could prove useful for the variation of the animals living in the city.

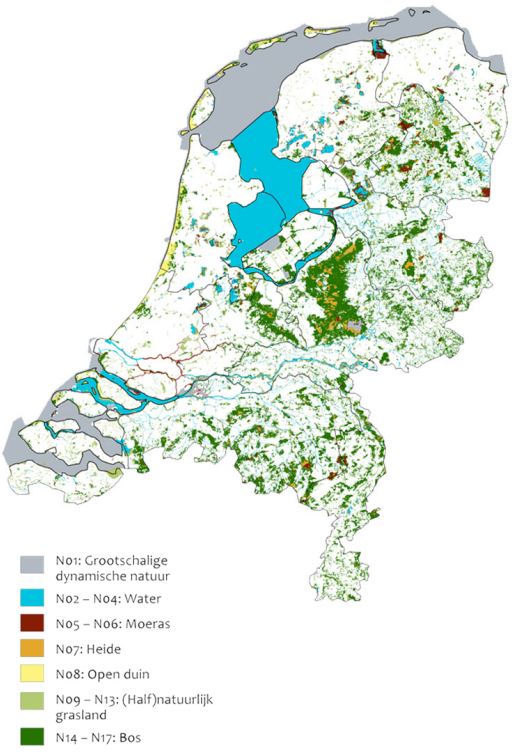
Urban areas that lay more free such as in the north of the Netherlands could become attractive for animals that now live outside of the city. The connection between the city and its surrounding creates an insight in the biodiversity that can be expected in the city.

This map shows the interaciton with the surrounding of the city. If the surroundings are not other cities, changes are they are surrounded by nature.

The nature reserves in the Netherlands are all under care. This means that they are maintained and evaluated. Animals living here could interact with the animals of the city. The presence of near by nature can mean that the species in the city might be different from other cities
.
When laying both the city and nature map besides each other one can notice a lot of white spots still. These are usually filled with eighter traffic or agriculture.
When designing in a spot with a lot of agriculture it is wise to map out what kind of agriculture is being practiced. Farming of vegetables attracts different species to interact with the city as for instance the farming of cows. Research has shown that biodiversity in agriculture lands has been dropping compared to previous years starting at 1900. Currently biodiversity in the city is higher than in rural areas.



Urbanisation map
source pdok.nl



Nature map
source pdok.nl

Location analysis principle
made by Bonnie de Waardt

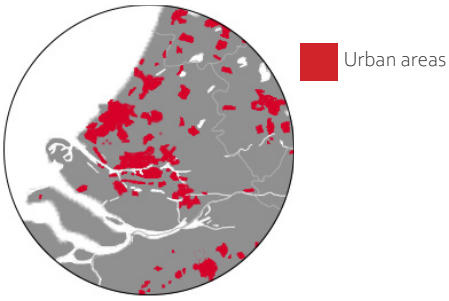
PROVINCE ANALYSIS

Moving from the country scale to the province scale analysis will start to show more detail. This scale is meant to give a clear view of what is surrounding the city. Points of interest are urbanization and nature. The province border might not be ideal in giving the best overview of the surroundings. By drawing a circle with the location as a midpoint you can divine the analysis area. The ray of this circle should be 50 kilometers to give a clear overview of its surroundings.

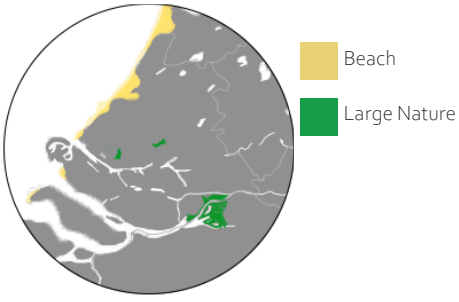
On this scale the urban and nature mapping will be done once more. Only this time it will be a bit more detailed. In making these maps an understanding of the surrounding connections of the ecological system will appear.

In the example maps, a part of the Netherlands is shown that is highly urban. The urban map gives an overview of how close the nearest cities are and if these could create an interaction for city animals. The nature map shows that there is a relative small amount of nature around. The most interaction of species will most likely be from the coastal area. The occurance of coastal cities becoming inhabited by birds that are sea dwellers proves this hypothesis. The movie 'de wilde stad' shows the examples of seagulls and oystercatchers in the city of Amsterdam.

Divining the province scale
made by Bonnie de Waardt



Urban mapping province scale
made by Bonnie de Waardt



Nature mapping province scale
made by Bonnie de Waardt

visualisation drawings for building nature inclusive
made by Bonnie de Waardt

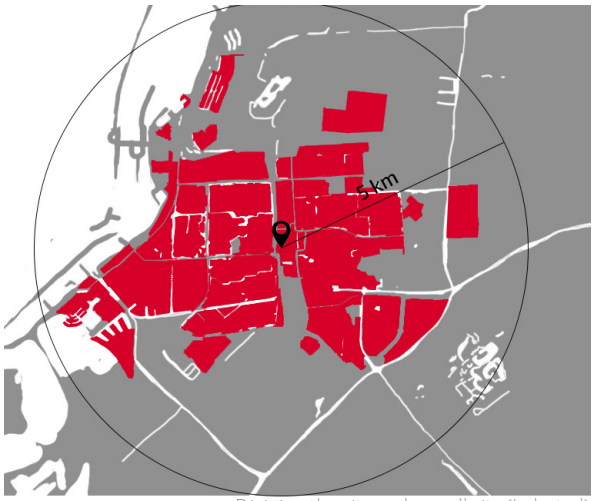
CITY ANALYSIS

The mapping of the large scale surroundings will already give an rough indication on the species inhabiting the location.
To understand the ecological structure of a site the city analysis is the most elaborated part. It is important to choice your city scale wisely. The exact scale will vary according to the city one is analyzing. The design location is hereby the starting point. From this location you will zoom out to have the best overview of the city that it is located.
In some cities this will be the entire city. Other more fractured cities this will only include the city parts directly connected to the location.

For example a city as Lelystad would be the entire city but for an city as Rotterdam this would be only the inner city not also Delfshaven and the harbors.

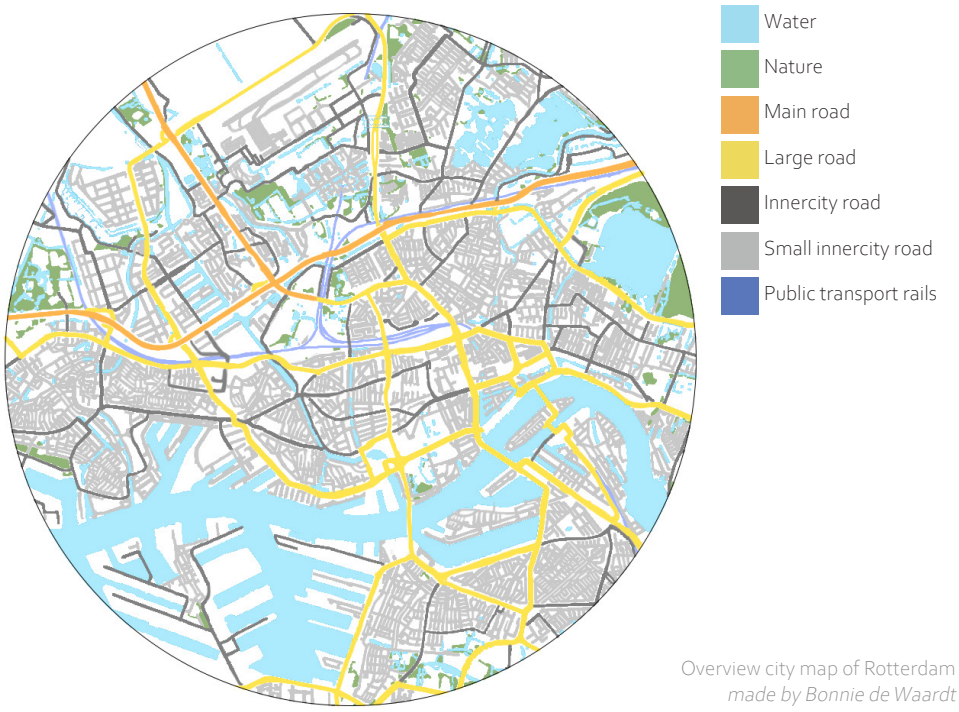
By drawing a circle with the location as a midpoint you can divine the analysis area. The ray of this circle should be no bigger than 5 kilometers to active the amount of detail needed in this analysis.

On the city scale there are four analysis to be made. Mapping of green and blue, point and line mapping, mapping of traffic and categorization of city parts. Based on these mappings you will be able to list the starting criteria to be used in the design and analysis of the city part of the location itself.



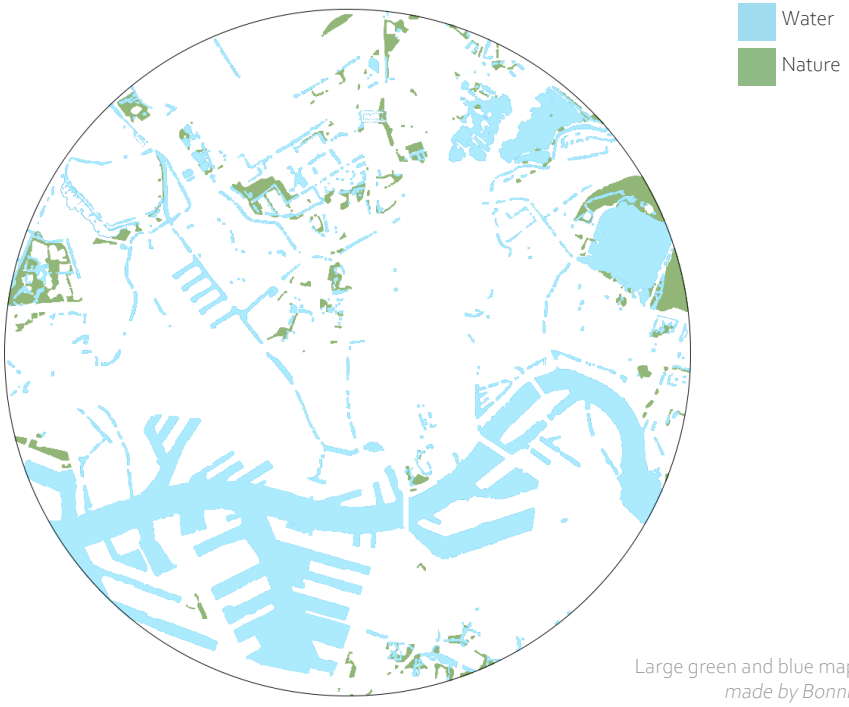
Divining the city scale small city (Lelystad)
made by Bonnie de Waardt

Divining the city scale large city (Rotterdam)
made by Bonnie de Waardt



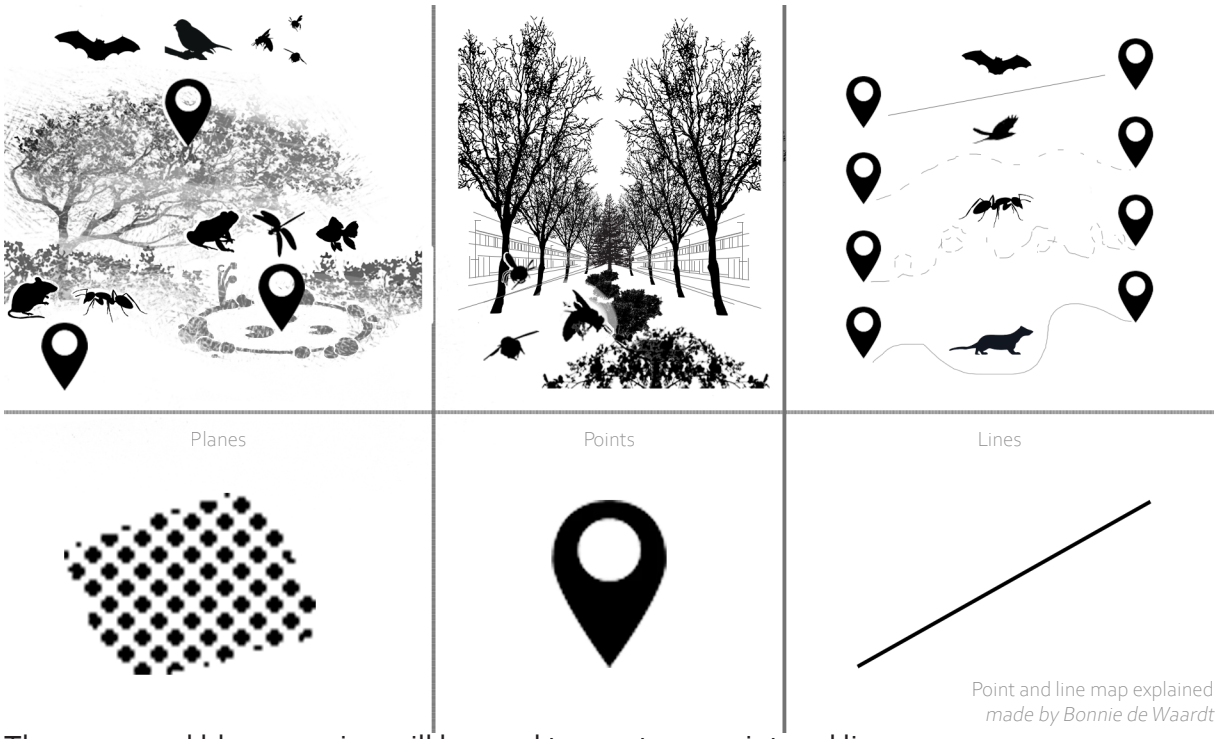
Overview city map of Rotterdam
made by Bonnie de Waardt

In order to make a clear overview of the analysis method the example of Rotterdam will be taken as an example. Using the maps of PDOK Viewer and Google maps (both are openly accessible to all) a customizable map is made. Using this map as shown above it is possible to isolate the interest subjects and use these for the analysis.



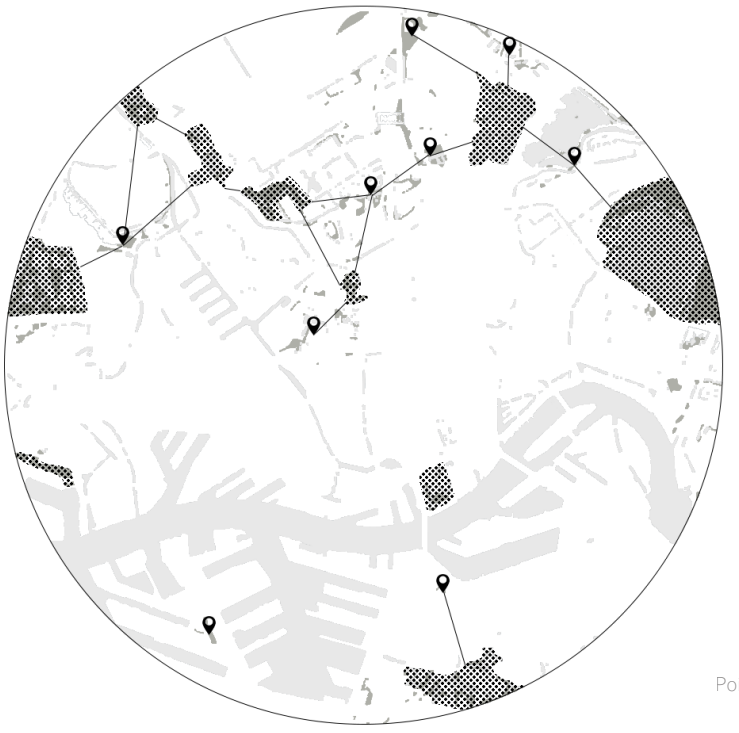
Large green and blue map Rotterdam
made by Bonnie de Waardt

Large green and blue mapping will show the locations of parks and big bodies of water. These urban nature elements have an big influence on the biodiversity in the city. The connection between the large green areas are an point of interest regarding the routing for animals. This map will be used as a tool in order to make an point and line map.

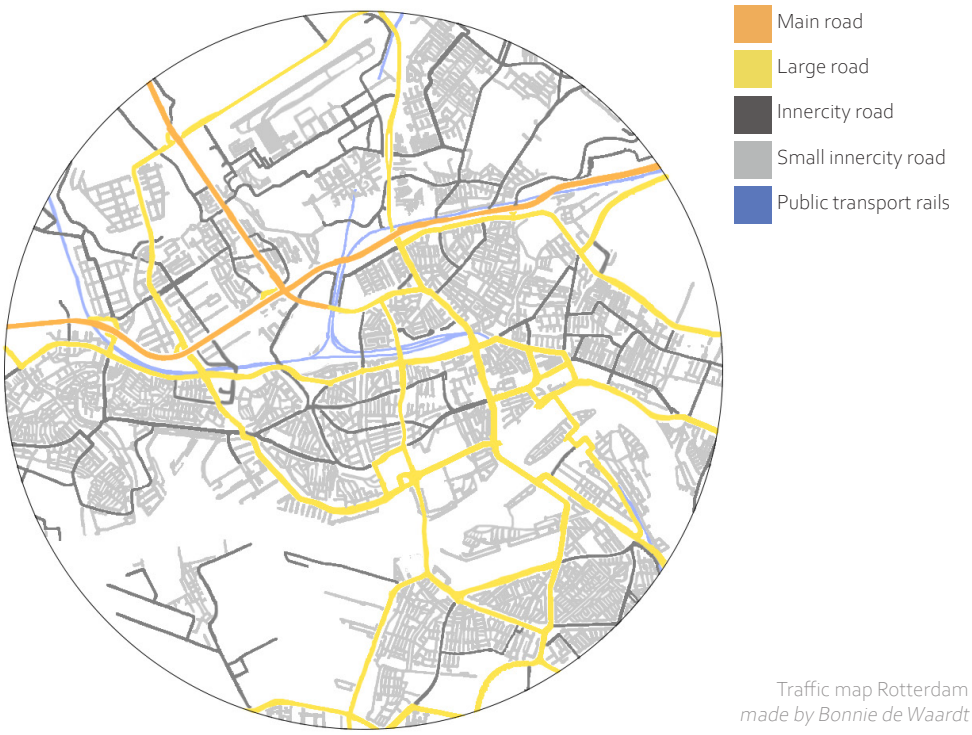


Point and line map explained
made by Bonnie de Waardt

The green and blue mapping will be used to create an point and line map.
Points indicate an habitat for species. On this scale these are smal green areas that can be used as so called stepping stones. Planes indicated a large number of habitats, these are usually located in parks or other large green areas. The lines connection the planes and points together symbolize the routes. The connection between habitats is essential for a functional ecosystem. The line and point map gives mainly insight in the connection and safety locations of the animals in the city. Especially the lines can be an essential part of the eventual nature inclusive design. If the design location has one of these lines or habitats on them it is essential to incorporate this and not disturb the natural route of the animals. A lack of connection, plains or points can also be an point of interest for city planners in locating new green areas.

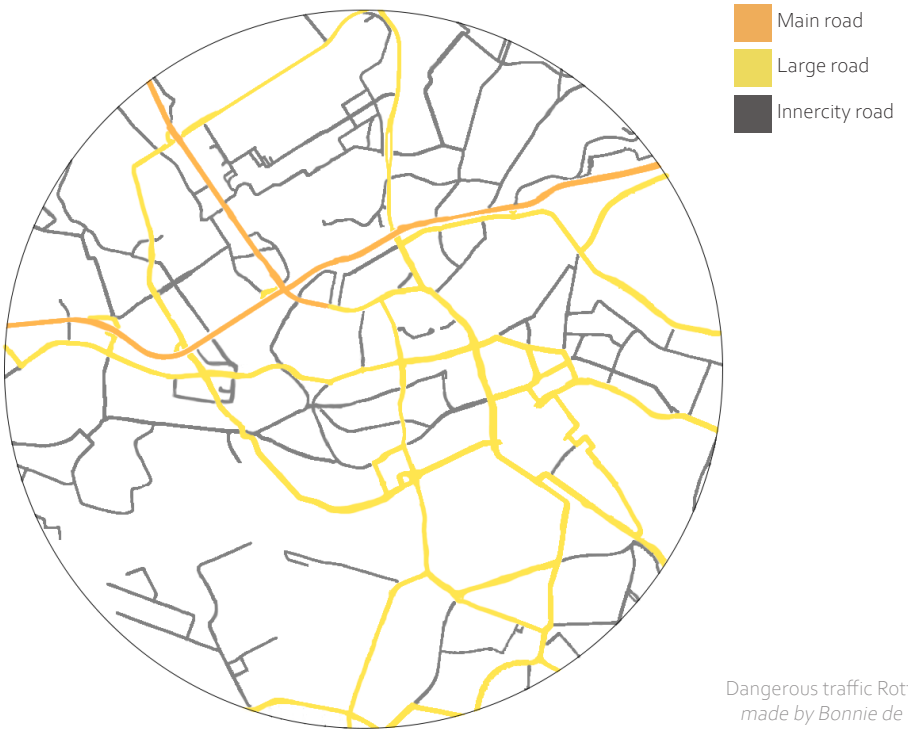


Point and line map Rotterdam
made by Bonnie de Waardt

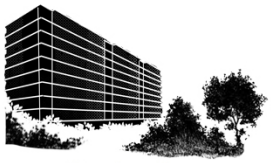


Traffic map Rotterdam
made by Bonnie de Waardt

One of the biggest treats for animals living in the city is traffic. Many roads separate the habitat of species making it hard for them to interact. Traffic causes danger to 3 of the 5 v's that animals need to survive. Safety, connection and variation are all threatened by traffic. The traffic map will show the roads that are most dangerous to animals. Small mammals such as martins and hedgehogs are often found as roadkill. The traffic map will show opportunity to include nature inclusive overpasses to prevent roadkill. Larger roads that have constant traffic and highspeed traffic are the most dangerous in the city.



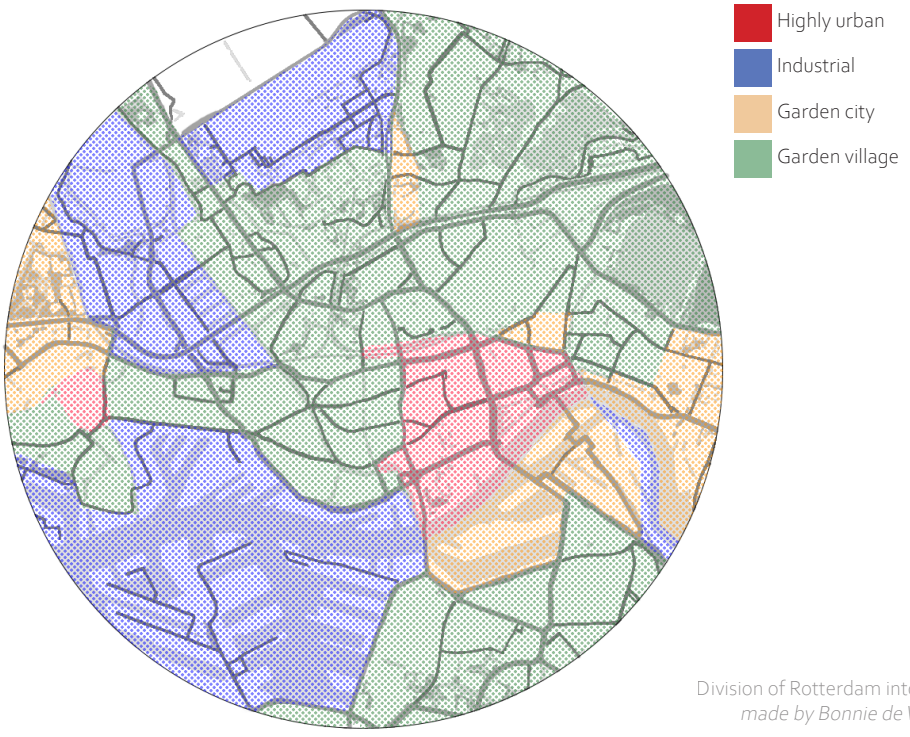
Dangerous traffic Rotterdam
made by Bonnie de Waardt



Highly urban	Industrial	Garden City	Garden Village
-Inner or Centre part of the city -Large amound of stone -Crowded -High noice level	-Secluded city part -Large amound of concrete and steel -Not much human interaction -Large open areas	-High flat roof buidings -Robust material such as brick and concrete -Large green spaces inbetween buildings -Relatively quiet	-Low buildings -Traditional materials such as rooftiles -Large green spaces and gardens -Relatively quiet
Most common target species -Swift -House sparrow -Building bound bats -Various basic insects terrestrial and aerial	Most common target species -Black redstart -Oystercatcher -Common tern -Larger mammals such as a fox	Most common target species -Building and tree bound bats prefer steady temperature prefer quiet spaces -Large amound of insects -Small mamals	Most common target species -Swift -House sparrow

Division of the city into types
made by Bonnie de Waardt

The city can be divided into four groups. Highly urban, Industrial, garden city and garden village. By dividing the city into these groups you will have an easy overview of the type of city part the design location is in and surrounded by. Based on the categorization of the city in the four groups you can assign the most likely target groups to the areas. Keep in mind that this is a generalization of an area, not every industrial site is the same therefore not in every industrial site the same target groups apply.



Division of Rotterdam into types
made by Bonnie de Waardt

CITY PART ANALYSIS

The city part analysis is focused on the part of the city where the design location is located. During the previous analysis the city was divided into four categories.
Each of these categories has its own specific focus points. In order to give a complete overview of the depth of the analysis four example locations will be shown.
Each of the locations is situated in another category of the city. The locations choices are based on the overview of
Top 10 nieuws.nl showing recently realized or still to be realized new buildings in Rotterdam.

Location one Coolsingel 4-18 is located in the **highly urban** category.

Location two RDM-straat 3089, is located in the **industrial** category.

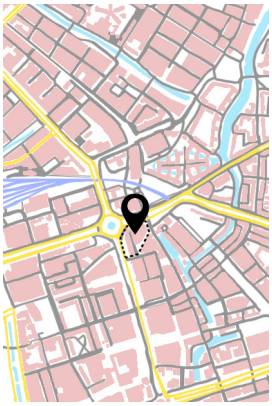
Location 3 recently designed Havenkwartier Katendrecht, is located in the **garden city** category.

Location four Noordsingel 250, is located in the **garden village** category.

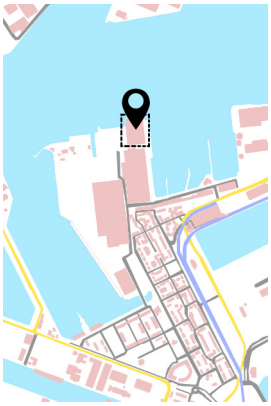
These locations will be used to explain the analysis drawings during the next chapters.

Example locations map
made by Bonnie de Waardt

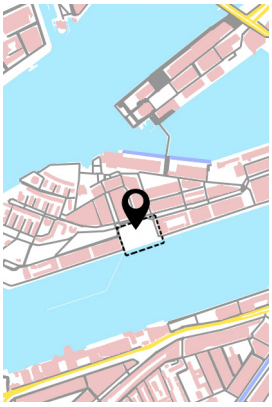
HIGHLY URBAN



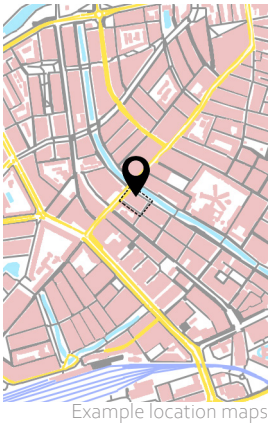
INDUSTRIAL



GARDEN CITY



GARDEN VILLAGE



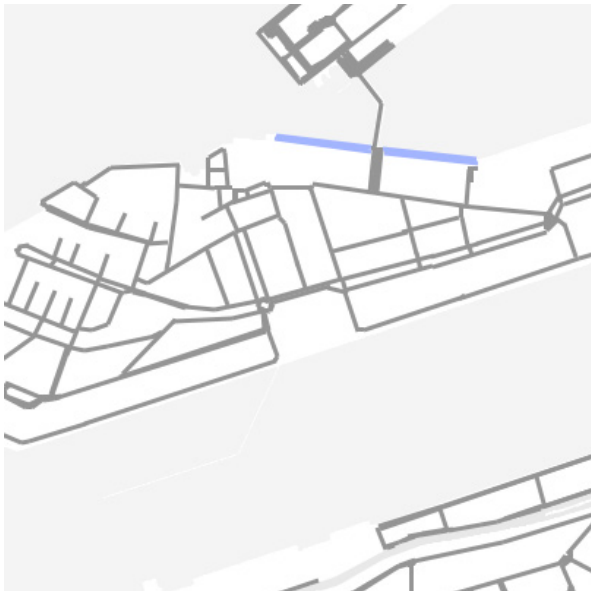
Example location maps
made by Bonnie de Waardt

HIGHLY URBAN

INDUSTRIAL

To give a broad overview of the city part two analysis are made on a zoomed in scale of the city analysis.
This scale is used to create a clear view of the traffic danger situation on site mapping the large roads in yellow and the rest in grey. The traffic map also shows the train network in blue.
Traffic is one of the main dangers for animals and is an essential point to take into account when designing nature inclusive. This is why it is essential to analyze this topic on different scale levels.
Using all the traffic maps together, larger nature inclusive traffic plans can be made. On the smaller scales it is important to understand the potential connection to the larger system and anticipate on changes that will be made in the future.
By incorporating the nature inclusive traffic structure on a small scale it will create an example for other designs and it creates an opportunity to achieve large scale changes in small steps. This method is often referred to as lead by example. Because nature inclusive design is still in its pioneering phase it is an verry important strategy to use.

GARDEN CITY

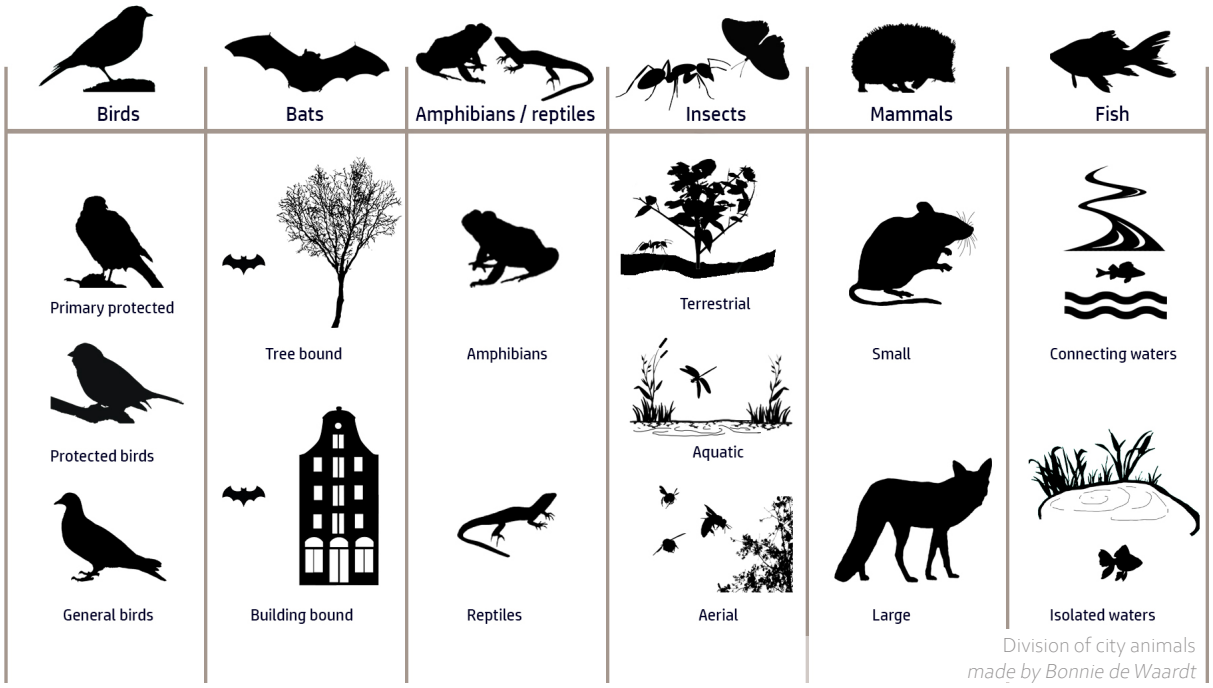


GARDEN VILLAGE

The same idea is used for the mapping of green and water. The mapping of green and water is done on multiple levels to create an clear overview. Like the traffic map the more zoomed in the more detail the map will show. The larger maps show the basic structure of green in the city. The zoomed in map shows a more accurate portrait of the situation on site. Connection of green spots can be done by the small steppingstones of green. Connections of green and traffic have an interrelation. Because most of the danger for animals is crossing the road, to get to the other greenery.

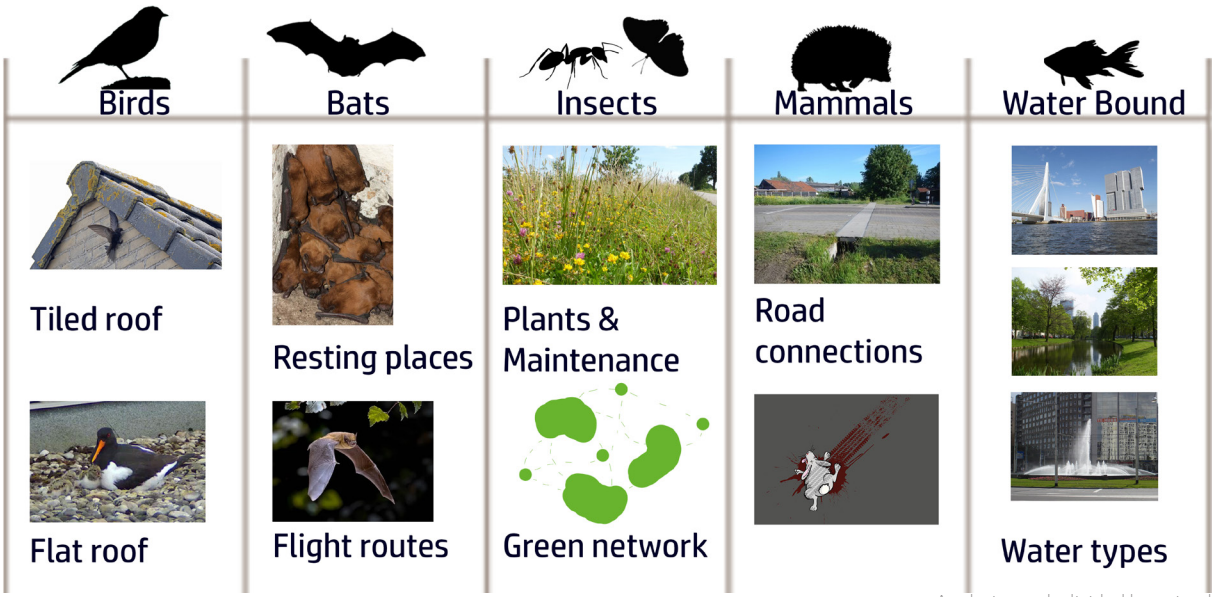
The green map can prove helpful in predicting where animals will cross most often. The green map also shows where more green is needed to have a good interaction between greenery.

SPECIES SPECIFIC ANALYSIS



Division of city animals
made by Bonnie de Waardt

Besides the site situation being of influence on the analysis. The animals expected on site are also of importance to the analysis. More accurately they will determine the conclusion of the analysis. In the chapter city analysis the division of the city into four groups is made. Each of these four groups have there own most common target species linked to them. These target species are the main focus point in incorporating animals in the design.
Each animal has there own specific needs. In this chapter we divide the species into five species specific analysis. The species groups are birds, bats, insects, mammals and water bound creatures. Each analysis focuses on the main need of the animal or main threat. For each animal an analysis is made on each of the sites. Keep in mind that the outcome of the analysis is related to the target species of that site. The examples will show how the analysis is linked to the target species and what points to incorporate in the nature inclusive design.



Analysis needs divided by animal
made by Bonnie de Waardt

BIRDS ANALYSIS

Birds are one of the most common species in the city. There are various species of birds that do not need any help surviving in the city. Target species of birds are the birds we want in the city and that are already making an appearance in our urban environment but need a bit of help. The bird target species vary per city category. The need of the target species is all connected to the safety and residence of the bird.

A popular residence in the urban environment of birds are the roofs. This is where it becomes important to know your target species. The swift and house sparrow prefer tiled roofs but the Black red start, oystercatcher and common tern prefer gravel roofs. In both cases an roof analysis of the situation must be made. Depending on the target species you can conclude if there is sufficient space for the species to inhabit. Green roofs can be verry beneficial in the urban environment but it is important to keep in mind the need for tilled roofs and so called brown roofs for beneficial species of birds.

HIGHLY URBAN

INDUSTRIAL

GARDEN CITY

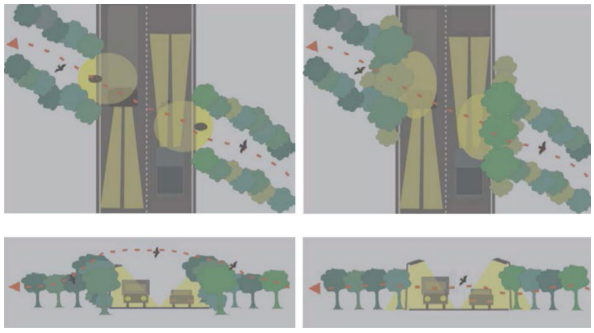
GARDEN VILLAGE

Roof mapping example locations
made by Bonnie de Waardt

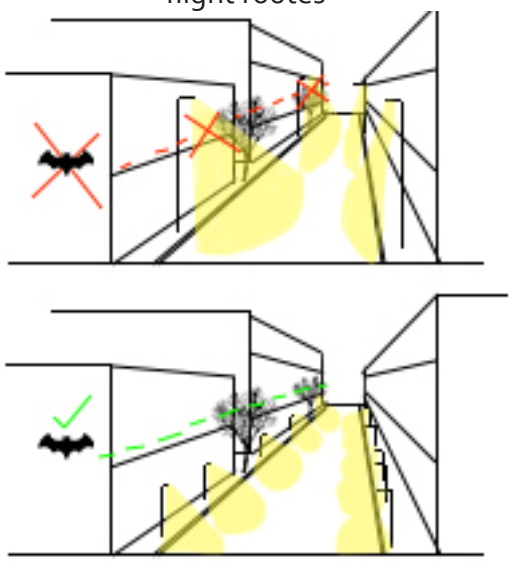
BATS ANALYSIS

Bats are sensitive to light and sound. The busier the space the less attractive it is for bats. Those factors may seem like bats do not like to live in cities. But this is not true. There are around ten species of bats that like to inhabit cities. This is because buildings are like the rock environment they inhabit in the wild. Bats like to inhabit the spaces in between our walls. These are a perfect space for them to rest, mate and for the maternity colony. Bats do not cause nuisance and they help by eating insects that are annoying to humans such as gnats. Bats need tree separate facilities to rest, mate and for the maternity colony. The most common bat in the city is the common pipistrelle they are building bound. These can be found in most parts of the city. The water bat, late flyer and red bat are tree bound and are more sensitive to light and noise. They are often found in the more quite and green spaces such as the garden city or garden village. The bearded bat and fringe start only hibernate in the Netherlands. They need a space with a steady temperature. Spaces between the walls of chimneys and elevators are comfortable for them. Bats fly in a linear line. Treetops are the most common way for bats to travel. The distance between treetops has to be smaller than 15 meters else they will not cross them. Lighting is verry important to consider while designing for bats. Most bats have a max of 2 lux on there fly route. By using lighting that is shining down and not up you can create a safe space for both humans and bats. Bats are most sensitive to white light so an orange tone could also help bats. When designing spaces for bats to inhabit there are specific conditions that you have to follow in terms of size and location. The orientation and planning of the spaces inside the building can also be important to consider. Windows can cause light to shine on flight routes at night. Orientation and placing of the habitats for bats must be done with an high level of precision. Smart positioning of lights in and around the building will help the bats inhabit the city.

Rest	Mate	Maternity colony
Hollow space min 3 cm Fly in opening min 1.7 cm at min 3m from the ground Not reachable to animals of prey No obstacles or light several meters from the opening. Possibility to choice once own spot	Space in the building where the female can be lured to Preferably high from the ground	Min 0.7 m2 preferably larger 1 or more layers of 1.5 to 3 cm Warm spot -Extra insolation -South or West orientated Rough inner material Fly in opening at the bottom 1.7 to 2.5 cm and minimal 4 cm wide



Trees can help guide bats and shield light in flight routes



By using more low streetlights instead of a few high once, bats won't be disturbed

Bat space needs and light explanation
made by Bonnie de Waardt

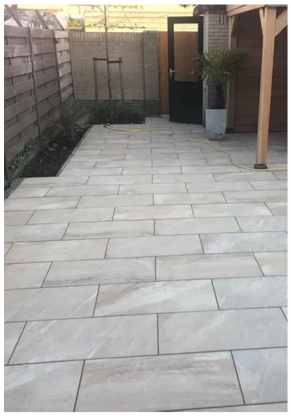
INSECTS ANALYSIS

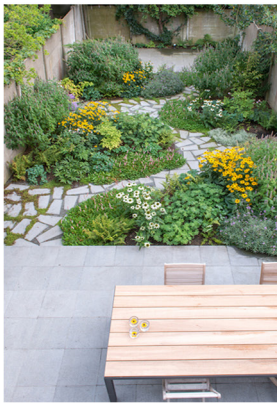
Insects are largely dependent on the amount of green. In this analysis the focus lays on the terrestrial and aerial insects. Aquatic insects are more dependent on water and are therefore part of the water bound species analysis. Insects profit the most from the wild growth plants. As a guideline the more wild, natural and even 'messy' greenery are the more insects profit from them. Aerial species such as bees and butterflies need flowers to live. Plants provide a large amount of food and shelter for insects. Because insects are small they can not cross large spaces in between greenery. Aerial species could benefit from the so called stepping stones if they are close enough together. For bees this is a maximum distance is around 3 km, but preferred are green spots every kilometer or so. Terrestrial insects are dependent on linking greenery. They need to bump into new environments or else they will not inhabit it. They are not likely to cross large roads. One of the biggest treats for terrestrial insects in the city is variation because they can get isolated from other habitats. Green roofs are a perfect spot for insects to inhabit but they do have to be able to reach it. For terrestrial insects this is mostly the case. Vertical green along the building or green stair designs can help terrestrial insects reach green roofs. Gardens in de city are often a large amount of the available green in the city. Urging inhabitants to incorporate green and have a more natural garden or even a section in the garden will help the insects immensely. This also goes for the now verry clean maintained public green spaces. A less intense maintains system or adding of more wild grow species of plants will make a green space more attractive for insects and will increase the bio diversity. Insects are a valued food source for a lot of larger species such as mammals and birds.

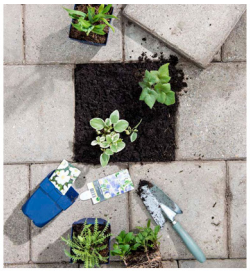
So by increasing the inhabitation of insects the number of other species will increase as well.

Insect attracting plants throughout the year

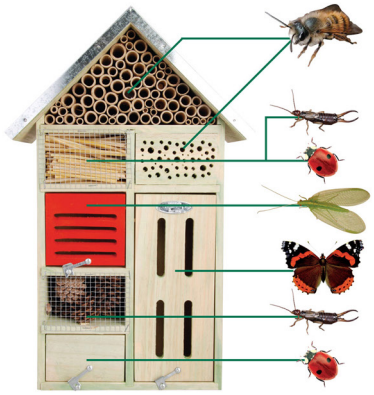
Source
natuurmonumenten







Garden motto:
Stone out plant in!



Insect needs
made by Bonnie de Waardt

HIGHLY URBAN

INDUSTRIAL

GARDEN CITY

GARDEN VILLAGE

Green mapping example locations
made by Bonnie de Waardt

The green analysis is also beneficial for mammals. Small mammals such as hedgehogs and martins like to inhabit green spaces. The connection between green spaces will largely determine where mammals are most likely to cross the road. Same as insects mammals like a more 'messy' or natural greenery. Less intense maintenance like leaving leaves under the bushes in fall and keeping grass higher will help mammals find safe spaces in the green spaces. Fences often limit the habitat of small mammals such as hedgehogs because they are unable to go from one garden to the other. Leaving an opening in the fence for small mammals will help increase the biodiversity. Take note that they also can get stuck in mesh fences.

Non crossable fences should be avoided
picture qrschuttingen

Danger of mesh fances
source dierenbescherming

Opening in fences
source tuinadvies.nl

MAMMALS ANALYSIS

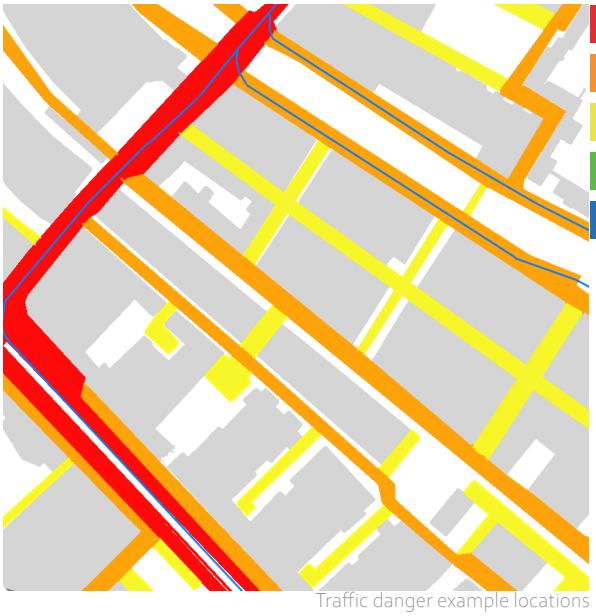
One of the biggest threats especially for mammals is traffic. Green spaces are often isolated by buildings and roads. Making it necessary for mammals to venture into traffic to get to other greenery. The habitat of a small mammal often exceeds the greenspace it is resented at. By making a road map analysis you can mark roads to its amount of danger. The larger the road or the higher the speed of the traffic the more dangerous a a road is for animals. Nature inclusive crossings will help mammals and terrestrial insect to get to other greenery safely. To determine where such crossings would be helpful one can use the green map to determine with roads mammals are most likely to cross. If this road is deemed dangerous a passage underneath the road much like a gutter will grant the animals save passage. To ensure the animals cross trough the passage and not at other spots it is wise to use nature inclusive guiding towards the crossing. Simple tools such as a log of wood to guard of the road will do. These tools will also provide new safe spaces as a bonus.

HIGHLY URBAN

INDUSTRIAL

GARDEN CITY

GARDEN VILLAGE



Traffic danger example locations
made by Bonnie de Waardt

WATER BOUND ANALYSIS

Water is of great importance for a balanced ecosystem. The type of aquatic animals that is located in a body of water is dependent on many factors. Types of water can be large connecting waters like rivers, seas or large channels. Isolated waters, are waters that do not connect to larger bodies of water. These are usually ditches or ponds. And then there are less functional bodies of water such as fountains, pools etc. Each body of water has their own ecosystem that has to be explored before being able to interact with it. When designing bodies of water it is important to keep your target groups in mind. The transition between water and land is usually the most crucial in its effectiveness in the ecosystem. Natural transitions will help species that live in between water and land. Waterbirds, amphibians and insects benefit greatly from a natural transition between water and land. It also creates opportunities for mammals to cross bodies of water. Hedgehogs can swim but often drown because they are unable to climb the steep wall of the shore.

HIGHLY URBAN

INDUSTRIAL

GARDEN CITY

GARDEN VILLAGE

Blue map example locations
made by Bonnie de Waardt

Rotterdam map
Made by Art of Rotterdam

ANALYSIS CONCLUSION

By using the analysis method described in the previous chapters a clear idea is formed on the nature inclusive potential of the site. This insight can now be translated into an vision for the project.
The conclusion of your analysis should include the most important aspects that would have to be included in the design in terms of nature inclusiveness.
In the examples a vision is shown for a plot in an highly urban environment and for a plot in an Garden city enviroment. Not all aspects of the analysis can be translated into this one vision. It is therefore important to prioritize and show what is most important on that site. Insights that might have less priority and will therefore not be in the vision but can still play a part later on in the design. Making a list with optional nature inclusive factors will help the design include the most nature inclusive elements at the end.

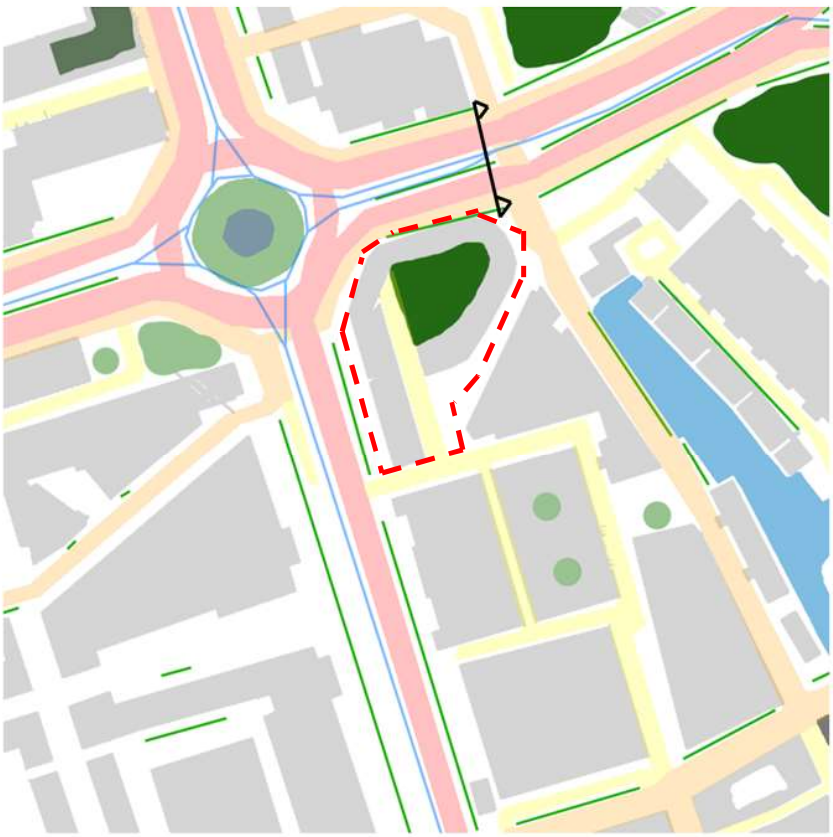
Besides the vision the analysis will also be used further on in the designing phase. Products in the final design that will benefit form this analysis will be the plot design, orientation of design elements, landscape design and care plan, façade and/or roof design and the sections. Also the floorplans could be effected by the nature inclusive ambitions depending on the priorities of the site. If implemented correctly this should result in a nature inclusive project that will become a part in the bigger ecosystem and have a positive effect on the biodiversity of the city.

The eventual goal of this research is to inspire all future projects to work together as one large ecosystem. So to anyone that has any influence on the build environment big or small, this research would like to encourage you to become a pioneer in nature inclusive design and do your part in making the city one well balanced ecosystem with a large biodiversity.

Be the change
you wish to see
in the world.
Mahatma Gandhi

EXAMPLE
VISION HIGHLY URBAN

Target spiecies



REF:
Animal Wall Delux
Cardiff UK 2009
Gitta Gschwendtner

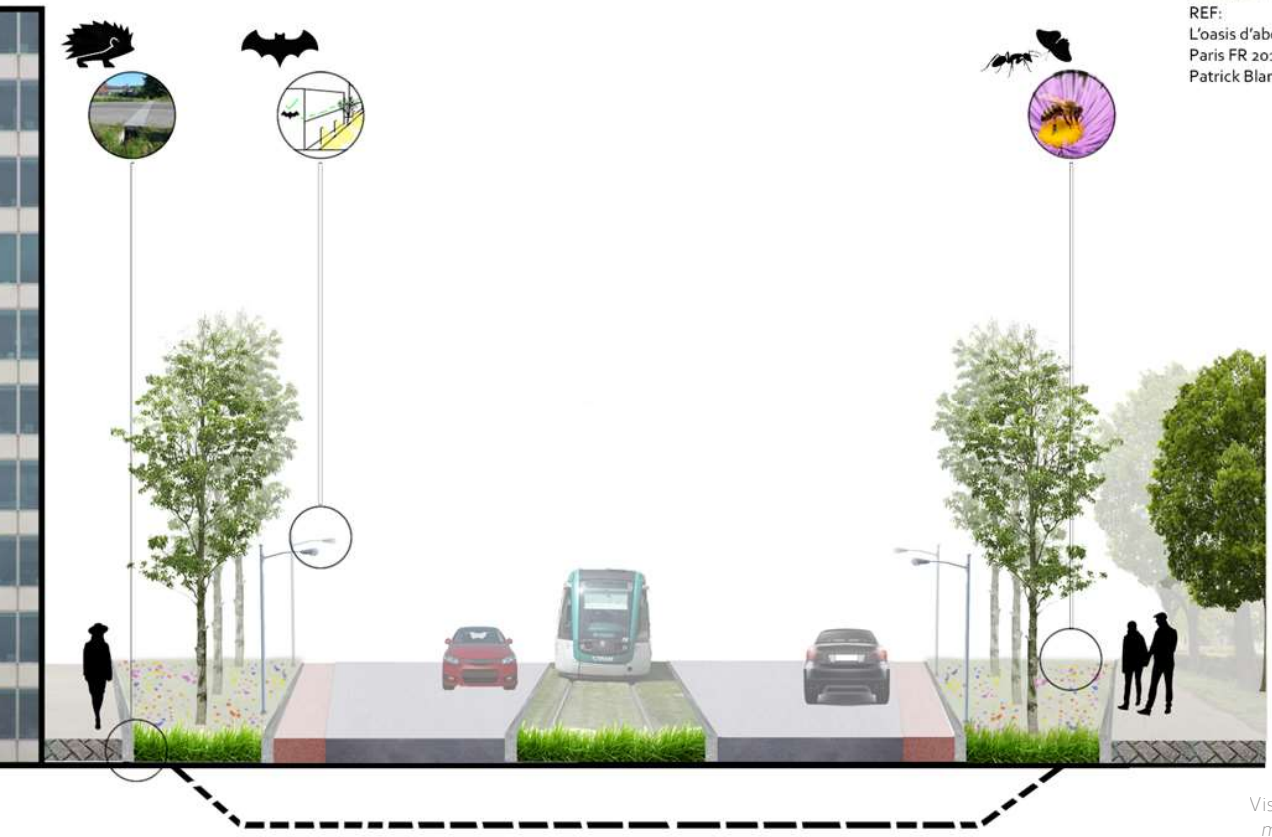
REF:
Fledermausturm
Meiningen D 2007
Housing Association Meiningen (
Stiftung Fledermaus, Erfurt

REF:
Brown roof Laban Dance centre
London UK 2003
Herzog & De Meuron, Vogt Landschaftsarchitekten

REF:
L'oasis d'aboukir
Paris FR 2013
Patrick Blanc

WBG)

Vision



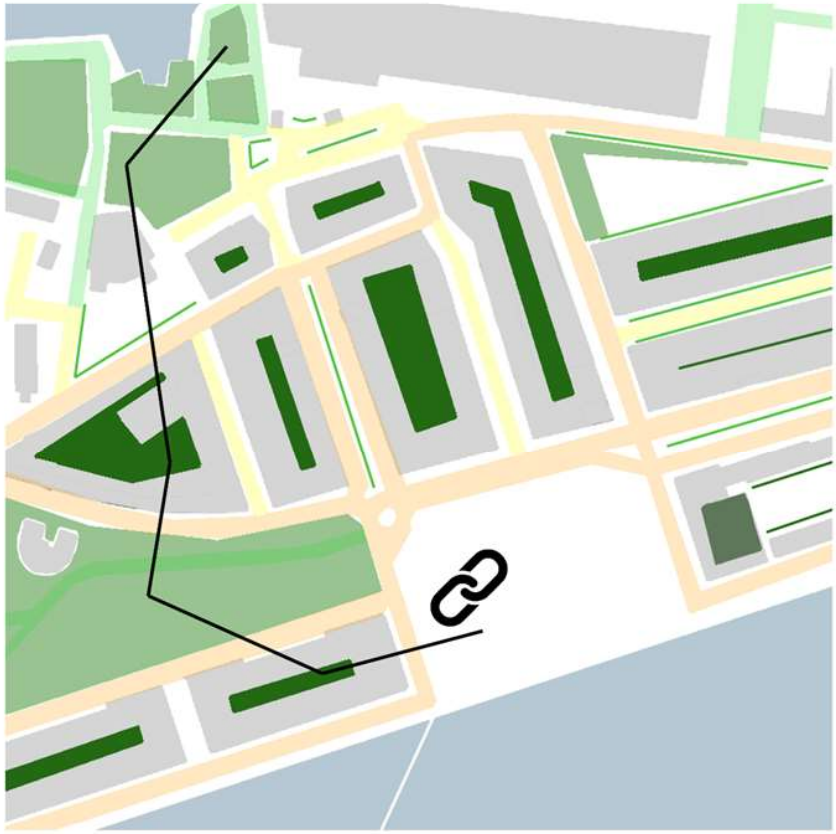
Vision example Highly urban
made by Bonnie de Waardt

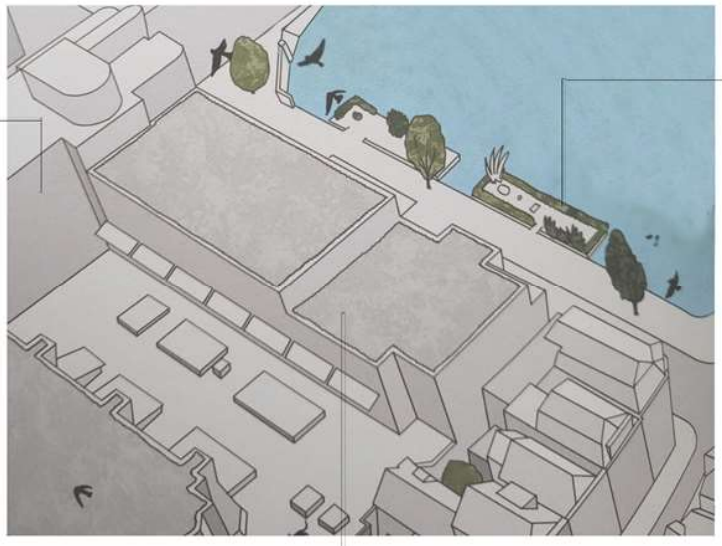
EXAMPLE
GARDEN CITY

Target spiecies

REF:
Beebrick
Brighton UK 2020

REF:
Bat Bridge
Monster NL 2015
Next Architects

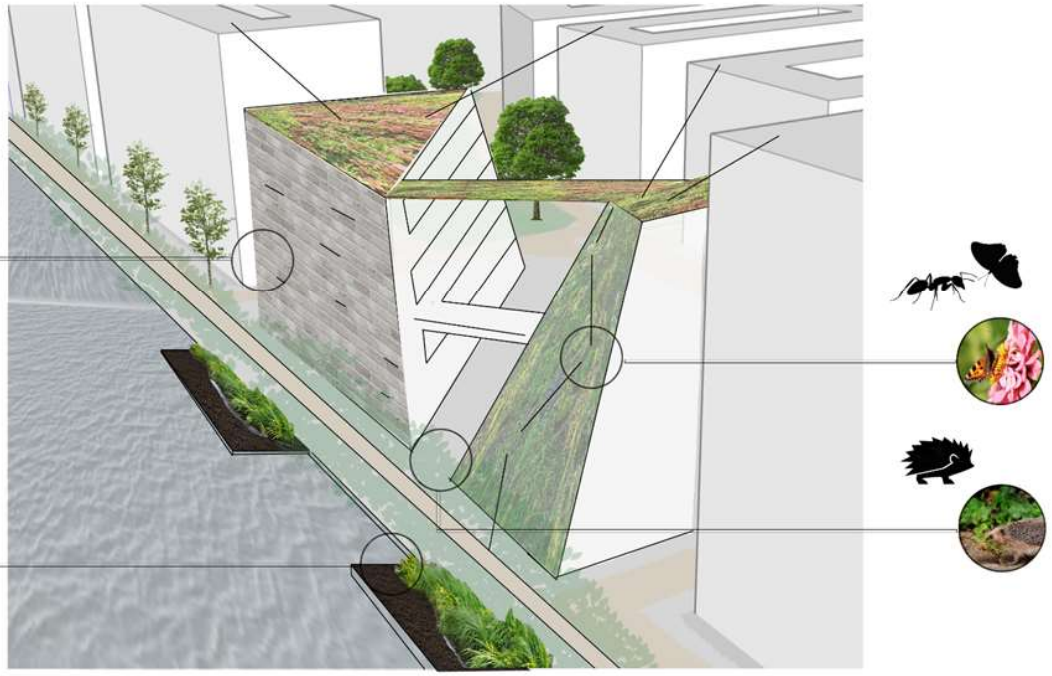




REF:
Green floating banks
Utrecht NL (planned)

REF:
Sportplaza Mercator
Amsterdam NL 2006
Ton Venhoevencs Architecture+Urbanism,
Copijn tuin- en landschapsarchitecten

Vision



Vision example Garden city
made by Bonnie de Waardt

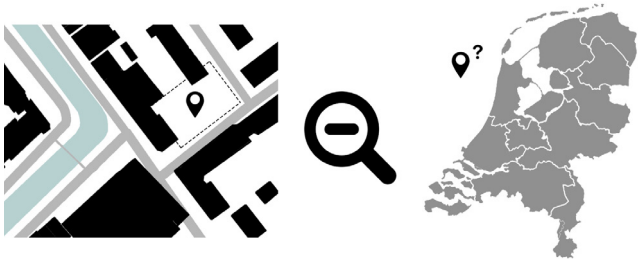
LOCATION

ZOOM OUT

The thing to remember in nature inclusive design is that no project location is the same.

It is important to look at the location from different scale levels to find the connection between various parts.

This way the design will become part of a bigger ecosystem instead of being only functional at the site itself.



COUNTRY SCALE

MAPPING

- Subsoil
- Urbanization
- Nature

The country scale provides a look into the type of climate and city density where the project is based. This overview is crucial for understanding why certain species inhabit the city.

The connection between cities and nature divines its inhabitants for a large part.

In nature inclusive design connections are a key element to create a well-functioning ecosystem.

CITY PART SCALE

MAPPING

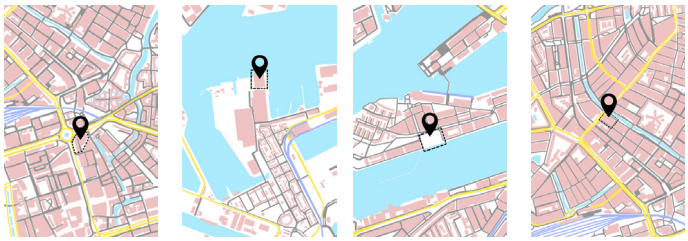
- Trafic
- Water & green

The type of city part is a determining factor in the target species.

This analysis will give more insight in possible dangers and opportunities on the project location.

The city part analysis will create direct design topics for the vision.

It is important to prioritize the target species of the design location.



SPECIES SPECIFIC

MAPPING

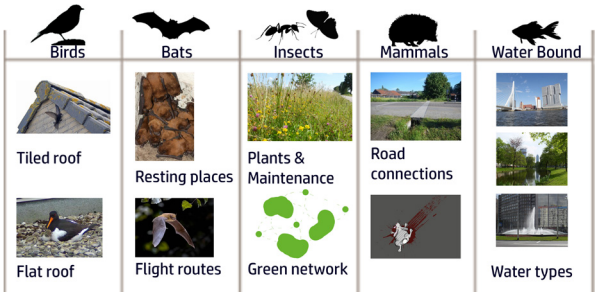
- Urbanization
- Nature

Every animal is different they all have their own specific wants and needs.

In this analysis the dangers and want for specific animals will be mapped.

Using the previously defined target species, species specific maps will be made to find the needs of the target species on the design location.

Findings will be used in forming a nature inclusive vision.



PROVINCE SCALE

MAPPING
- Urbanization
- Nature

The province scale divines the borders of the direct interaction of the city with its surroundings.

Animals that can travel between nature and city will be divined by these connections.
The type of nature and level of urbanization is used to predict the type of species one might expect in the city.

A radius of 50 m from the project location will divine the boundaries of the province scale.

CITY SCALE

MAPPING
- Water & green
- Roads
- Point line map
- City types

The city scale gives an in-depth overview of the direct correlation between the project location and the city as a whole.

The city mapping is used to divine the types of city parts and highlight opportunities for connection in the city.

The type of city part has a direct correlation with the target species of the project site.

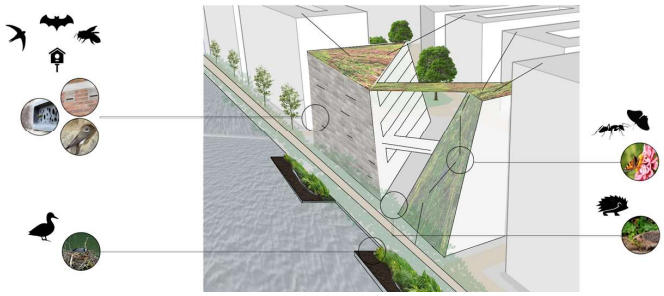
A radius of 5 km from the project location will divine the boundaries of the city scale.

VISION

OVERVIEW
- Target species
- Nature inclusive elements

Based on previous finding throughout the analysis method multiple elements of nature inclusive design will come to light.

In the vision one must combine and prioritize these insight into one clear plan for the nature inclusive aspect of the design.



DESIGN

TRANSLATION

During the entire design process it is important to keep your nature inclusive vision in mind.

With every design choice you must ask the question why am I doing this and how is it contributing to the larger ecosystem.

ANALYSIS DISCUSSION & REFERENCES

The result of this research can be interpreted in many ways. The goal of the research is to provide guidelines on how to analyze a city to find its nature inclusive potential. The examples used in the research are meant to inspire and help in making once own analysis. Use of the analysis method can result in different views and outcomes. Because nature inclusive design is still in its pioneering phase there is a need for more knowledge and methods to use in order to fully understand nature inclusive design. This research hopes to contribute to the understanding as well the implementation of nature inclusive design into the existing designing field. Recommendations made are based on literature, expert knowledge and interpretations of designers.
The implementation of this analysis method in the day to day practice of an designer will result in more and better nature inclusive designs. Due to the limited duration of this research and the broad topic that is nature inclusive design, this research is in ways unfinished.

In the research Rotterdam is used as an example in order to explain the analysis method and show how it can be used. In theory this method could be used for any city that is comparable to the one used in the examples. However this is not tested. Therefore it would be an interesting experiment to use the analysis method on a series of different cities to see if in fact this research can be used for any city.

In this research the main focus is on animals in the city. In further research plants in the urban environment should be addressed as well. Plants are mentioned in this research, but only as an enabling factor for the animals in question. Plants themselves have a valuable role in the ecosystem and therefor have their own part to play in nature inclusive design. An additional research focused on plants, fungi and microorganisms in the city would be an valuable addition to this research.
An analysis method for plants, fungi and microorganisms in the city can be structured in the same way as this animal based analysis. This would result in an even more complete understanding and implementation of nature inclusive design.

BIBLIOGRAPHY

Sources listed have provided the information used in the research. The research itself is an implementation of this information. The writer has used the sources to inform oneself in order to create this analysis method. The information is sometimes paraphrased or used only as background information. Own interpretations of sources and weighed assumptions have been made in order to create this analysis method. For specific quotes and pictures used, the source is listed in this spot of the research.

Bij 12. (2017, juli). *Kennisdocument-Gewone-dwergvleermuis.* https://www.bij12.nl/assets/BIJ12-2017-004-Kennisdocument-Gewone-dwergvleermuis-1.0.pdf

Bij12. (2017, juli). *Kennisdocument-Ruige-dwergvleermuis.* https://www.bij12.nl/assets/BIJ12-2017-018-Kennisdocument-Ruige-dwergvleermuis-1.0.pdf

Breuste, J., Artmann, M., Ioja, C., & Qureshi, S. (2022). *Making Green Cities: Concepts, Challenges and Practice (Cities and Nature)* (2nd ed. 2022 ed.). Springer.

Gemeente Rotterdam. (z.d.). *Stadsprojecten | Rotterdam.nl.* Geraadpleegd op 11 december 2021, van https://www.rotterdam.nl/bestuur-organisatie/stadsprojecten/

Homepage. (z.d.). De Zoogdiervereniging. Geraadpleegd op 14 december 2021, van https://www.zoogdiervereniging.nl/

Kennisdocument-Gierzwaluw. (2017, juli). Bij12. https://www.bij12.nl/assets/BIJ12-2017-006-Kennisdocument-Gierzwaluw-1.0.pdf

Natuurinclusief bouwen. (z.d.-a). Bouw Natuurinclusief. Geraadpleegd op 8 december 2021, van https://www.bouwnatuurinclusief.nl/

Natuurinclusief bouwen. (z.d.-b). Rijkst dienst voor ondernemend Nederland. Geraadpleegd op 12 december 2021, van https://www.rvo.nl/onderwerpen/technieken%2C-beheer-en-innovatie-gebouwen/natuurinclusief-bouwen

Natuurmonumenten. (2021, juni). *Red de insecten.* https://woonwijkmolenpolder.nl/wp-content/uploads/2021/06/Insecten-red-pakket-Natuurmonumenten.pdf

pdok. (z.d.). *Pdokviewer.* pdokviewer. Geraadpleegd op 12 december 2021, van https://app.pdok.nl/viewer/

BIBLIOGRAPHY

Roggema, R. (2020). *Nature Driven Urbanism (Contemporary Urban Design Thinking)* (1st ed. 2020 ed.) [E-book]. Springer.

Rotterdam. (2021, 30 mei). Nieuwbouw Architectuur Rotterdam. Geraadpleegd op 16 december 2021, van https://nieuws.topo10.nl/

Sovon. (2017). *Rodelijst vogels.* sovon.nl. Geraadpleegd op 21 december 2021, van https://www.sovon.nl/nl/rodelijst

Verkerk, M. (2018). *De wilde stad.* EMS Films

Vink, J., & Vollaard, P. (2017). *Stadsnatuur maken / Making urban nature* (1ste editie). Macmillan Publishers.

Vogelbescherming. (z.d.). *Samen voor vogels en natuur.* Geraadpleegd op 15 december 2021, van https://www.vogelbescherming.nl/

Swift nest
Picture by John A Horsfall

EPILOGUE

During this research I was able to explore an topic verry dear to my heart. Growing up in an small town in the Netherlands with a large garden, made me develop an deep appreciation for nature and all its inhabitants. It is my believe that we as humans have a much to large an impact on the world we live in. But instead of condemning the this fact, I want to use this impact to my advantage. Trying to make the world a more balanced space for all species not just humans. For my studies I moved to Schiedam. Living in a city has made me crave for nature and rethink the way cities are made. The urban environment is much too focused on humans and consumption, when in fact it is also nature. When we start viewing the city not as separate from nature but a part of it, a mindset will shift. Possibilities for other creatures suddenly become a field of interest. Many animals are master adapters and have proven themselves to be so by living in cities that are designed and dominated by humans. Just imagine what an amazing natural city and well balanced ecosystem our cities can become, when we let go of the notion that the city is only for humans. It is my hope that in the future all cities will become well balanced ecosystems that will not only be beneficial to humans but all its inhabitants.

By creating this analysis method I hope to inspire people to view the city trough a different lens. By making this research I have developed an appreciation for the small interventions we can make and have found there are more opportunities for nature in the city than one might originally think.

I would like to thank my research mentor Peter Teeuw for guiding me throughout this process. I would also like to thank Dolf van der Graag city ecologist of Rotterdam for letting me interview him and giving me insights in the possibilities of ecology in the city. Furthermore I would like to thank Peter Koorstra my main graduation mentor and Jan van de Voort my building technology mentor for helping me implement this research into my design. Furthermore I would like to thank Ype Cuperus for overseeing my graduation project as a delegate from the exam commission and making sure I meet the requirements of the TU delft and everything is judged fairly. Lastly I would like to thank my friends and family for supporting me during my graduation and for supplying me with feedback.

Thank you for reading my graduation research and I hope to have inspired you to start using my analysis method and design nature inclusive.

House sparrows
Picture by Arjan Berben worker at Vogelbescherming