PROJECT WEEK
Explore the Waarden

fieldworkproject 2 tto
Biology / Geography / Arts / History

PROJECT WEEK EXPLORE THE ‘WAARDEN’

Gorinchem is located close to the river, at the border of the districts ‘Alblasserwaard’ and ‘Vijfheerenlanden’. River forelands, waterways, mills, a ‘Diefdijk’, pot-holes, many low lying meadows, meadow birds, forts: a real Dutch landscape. A nice topic for a project for history, geography, arts and biology. We want to do investigation into our own environment.

What are we going to do?
The goals set for this project are:
1. Getting to know your own environment: the landscape with its history, natural values and its possibilities - and to see it for yourselves.
2. Experience fieldwork, being an important part of scientific research, and historic research: how it works and what kind of results it brings.

How are we going to do it?
During the three fieldwork days you do soil drilling, measurements and observations, make photographs and do a history tour. Don’t forget to keep track of your results. The preparations for this project will be done in the last few weeks of the year. The fieldwork days will go:

EAST this is mainly history (city of Gorinchem, Fort Vuren, position of Loevestein), but also Arts (a photography assignment).

NORTH this is soil and landscape (soil drilling, ecological farm), but also biology (meadow birds, water animals) and the history of the area.

WEST this is mainly fieldwork for geography and biology (soil drilling, water research, birds) and landscape - including an excursion on foot through Avelingen.

Each of the subjects will do its own way of marking. Your teachers will tell you all about it. You will recieve separate information about it with the roster and a list of items you need to bring.

Assignments

Besides background information (biology, geography and history) you will find some technique charts and assingments for the different theme-days. The technique charts are meant for NORTH and WEST, but these will be available in plastic on the spot, besides sets of result tables (can also be downloaded).

PROJECT WEEK EXPLORE THE 'WAARDEN'

1.1 Fieldwork: the training

During the fieldwork we'll use several techniques: handling the soil drill, distinguishing soil types, handling apparatuses for measuring humidity, oxygen and conductivity), determining the pH-value of the soil and the clarity of the water, catching water animals and spotting brids. Before going into the field to gather data, your must have practised a number of techniques - in het field of course!

Drilled out soil has to be placed in a gutter in the right order; we'll also measure humidity

SOIL RESEARCH

1. What do you want to investigate?

a. How do you conduct soil drilling?
b. What can be investigated looking at the soil?
c. What kind of differences can be seen between different locations, at different distances from school?

2. What are you going to do?

Fieldwork technique charts are available for each technique and teachers and laboratory technician(s) are there to help you.

2a. What do you need?
** technique charts*
** soil drill*
** gutter & measuring rod*
** soil table*
** pH measuring set*
** hygrometer*

2b. How are you going to do it?
** We'll do some soil driling close to school (SOIL 1)*
** We investigate the layers and the soil types of this location (SOIL 2+3)*
** We determine pH and humidity of each layer (SOIL 4)*

LANDSCAPE DESCRIPTION

1. What do you want to investigate?

How do you carry out a landscape desciption?

2. What are you going to do?

You're going to carry out your first landscape desciption under the guidance of your geography teacher. You'll need the technique chart and a topo map on a 1:25.000 scale.

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WATER QUALITY

1. What do you want to investigate?

a. How do you catch and identify water animals?

b. How do you investigate the water quality of a ditch or pond?

We put water animals in a tray; in the middle a larva of a dragonfly can be seen

2. What are you going to do?

Technique charts are available for each technique and teachers and laboratory technician(s) are there to help you.

2a. What do you need?

** technique charts*
** landing-net*
** white tray*
** key to water animals*
** water animals table*
** Secchi-tube*
** pH-papers*
** oxygen sensor*
** conductivity sensor*

2b. How are you going to do it?

** We'll investigate a ditch close to school*
** We'll measure temperature and oxygen using the oxygen sensor (OXYGEN)*
** We'll determine pH and conductivity (pH and CONDUCTIVITY)*
** We'll determine the clarity of the ditch (CLARITY)*
** We'll catch as many water animals as possible and try to identify them (WATER ANIMALS)*

3. What did you find? (*water quality*)

The technique charts WATER QUALITY 1 and 2 explain that water quality can be determined in two ways: abiotic and biotic. Write down the results of the abiotic factors in the table.
Determine the abiotic water quality, using the table, and the biotic water quality, using the identified species of water animals.
Save these results to be able to compare these with the data of your fieldwork in Avelingen later on.

Water research in the Avelingen: a nature conservation area in the river foreland of the Merwede, close to Gorinchem

PROJECT WEEK EXPLORE THE 'WAARDEN'

1.2 WEST: doing fieldwork research for a whole day

We do'll five activities in Avelingen. Each group will rotate along the following activities: water animals, abiotic water-factors, soil drilling, birds and a landscape excursion (on foot).

1. What do you want to investigate?

a. What are the natural values (biotic and abiotic) in the Avelingen?
b. Which soil types will be found here?
c. What kind of landscape will be found here?

2. What are you going to do?

Use the technique charts; teachers etcetera are there to help you.

2a. What do you need?

* *technique charts*
* *landing-net*
* *white tray*
* *key to water animals*
* *table of water animals*
* *Secchi-tube*
* *pH-papers*
* *oxygen sensor*
* *conductivity sensor*
* *soil drill*
* *gutter with measuring rod*
* *soil table*
* *pH measuring set*
* *hygrometer*
* *1:25.000 topo map*

2b. How are you going to do it?

* *Work in groups of 4 students*
* *The groups rotate along the different fieldwork spots - each spot having its own set of techniques*
* *Determine temperature and oxygen using the oxygen sensor (OXYGEN)*
* *Determine pH and conductivity (pH and CONDUCTIVITY)*
* *Determine the clarity of the ditch (CLARITY)*
* *Catch and identify as many water animals as possible (WATER ANIMALS)*
* *Drill into the soil and determine the soil types of all the layers (SOIL 1-3)*
* *Determine pH and humidity of each layer (SOIL 4)*
* *Carry out a landscape description*

3. What did you find?

Fieldwork data are to be written down in a number of tables:

★ a soil table
★ a tabel of water animals
★ a table for abiotic factors
★ a bird table

Complete your tables, determine the water quality (biotic and abiotic) and work on the landscape description. Hand in all tables etc. next morning. Use the data for your final assignment on friday. Save the landscape description for geography.

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1.3 NORTH: an excursion into farmers country

This day you'll cycle northward, in two groups. One group will cycle via Schelluinen to Noordeloos (to do a number of assignments up and around an ecological farm) and back via Hoog Blokland (to do soil drilling and water research). The other group will do it in a reverse order. We'll have our lunch break at the ecological farm.

FIELDWORKLOCATION HOOG BLOKLAND

On your way to or from Noordeloos we'll stop in Hoog Blokland. Try and find out why this village has a higher position in the landscape. In the village we go eastward to arrive at our fielldworklocation. We'll do the following:

1. Soil drilling in two spots: upon the 'ridge' and close to the ditch, including measurements of pH and humidity.
2. Water research: water animals and abiotic factors.

Fill in all the tables: you'll need these later on.

ORGANIC FARMING

Half of your group will take the tour on the farm (**A**), the other half does the fieldwork assignments. You'll have to bring the other half of your group up to date afterwards. Don't forget to ask on if you don't understand exactly what the others are talking about. HAND IN TABLES AND ANSWERS AS A GROUP!

GROUP A: tour on the farm

It'll be your task to get to know as much as possible about organic farming compared to 'normal' farming. Think of:

1. the used techniques,
2. stables (build, position, function, etc.),
3. manure (production, storage, distribution,etc.)
4. cows (how they look and are treated, etc.)
5. landscape (position of the farm, etc),
6. times cattle is outside (when, why, problems?etc.)
7. the importance of ditch, border and meadow bird management
8. water level management

Pay attention to other things the farmer tells you about (subsidies, European rules, agreements with other farmers, etc.)

Take notes to be able to bring the students of **group B** up to date.

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Organic farming. GROUP B: fieldwork tour

It’ll be your job to get to know as much as possible about plants, birds and their prey, landscape and soil of this area.
You’ll split up in four groups. Two groups start at the end of the tour and two at the beginning. Take a look at the impact of ecological farming for the management of ditches, borders, birds and their prey and landscape.
The tour will lead along several assignments.

Assignment 1: bird watching
Use field glasses and bird charts to see which species you can detect, where they can be found and what behaviour they show.

Assignment 2: looking for prey
On the especially marked spots you can scoop up some material of the toop layer of the soil. Put into a white tray and try and find out which species are present and which birds could on them. Use the insect sucker and the key to soil animals.

Assignment 3: comparing plants
Try and find out which plant species van be found on the especially marked spots in the meadow and along the ditch, comparing the different locations. Be careful to trample the plants!

Assignment 4: landscape
Study the landscape during the tour. Also jump up and down to find clues to the type of soil.

Take notes and pictures to be able to explain everything you did and discovered to the students of group A.

Assignment 5: soil drilllng
(technique charts SOIL)
Do this as you’ve been taught, including determination of pH and humidity.

Fiil in the tables (soil and birds) and take notes to bring the students of **group A** up to date..

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1.4 EAST: a historical excursion with an Arts taste

Today you cycle east to Fort Vuren. You either start with a tour through the Fort or with the Arts assignment. Cycling back to Dalem you will finish the day with a history tour through Gorinchem.

Directions History Tour Gorinchem

Watch it: The description starts at your starting point (given to you by your teacher).

As you are not alone in the street, keep an eye on the traffic around you!
If you got separated from your group, stay where you are and call one of your group mate

If your done with the assignments before time, walk to the bikes. If your not finished with the assignments, also go to the bikes when time is ready.

The numbers on this page refers to the assignments in the scheme. Don't fill in the X-assignments.

Assignments:
Everybody must fill in the assignments! Take care everybody in your group does have the same answers. At the end of the day the assignments of one student will be collected by a teacher. The result of the assignments of this student will be the result for the group.

Photo's:
For each group: Print your photo's and give them to your teacher this week.

1. You face the entrance of the **Gorkums' Museum (1)**

On the facade you can see the picture of a half-closed city-gate. This picture refers to Jan van Arckel. He was one of the most important figures of the city of Gorinchem in the late Middle Ages. One day he was chased by some robbers. He drove his horse through the city Gates with the robbers on his heels. Having arrived at the gates he clamped his legs tight around his horse and pulled himself and his horse up on the gate. The robbers galloped right through under him inside the city. Jan closed the gates and the robbers got stuck inside, where Jan, helped by some sturdy guards took them prisoner.

2. Continue to your right , along the museum towards the church tower. On your right hand you see a (closed) door. This is the **Hugo de Groot – gate (Hugo de Groot – poortje) (2).**
3. Continue your tour to the entrance of the **Main Tower** (**Grote Toren) (3)** behind the church.
4. Face the entrance of the Main Tower, go to your left and turn right after 150 meter into the Gasthuisstraat. On your right hand you will see **Gasthuisstraat 25 (4).**
5. Continue your tour and turn lef (just before the Coolcat) into the Arkelstraat. On your right you will see a church: **The Chapel of the Holy Ghost** (**Heilige Geestkapel (5).**
6. Go along the right hand side of the church, through the Kapelsteeg into the Kortendijk, and turn left. Take a look at the lids in the ground (putjes) in the **Kortendijk (6).**

7. Follow the Kortendijk until you reach the Korenbrugstraat. Turn to your right there, across the Korenbrug and turn right again. There you will see the little statue of **Hendrick Hamel (7)**.

Hendrick Hamel was born in 1630 in this house on the Kortendijk. Roughly twenty years later he "discovered" Korea. Here he was held a prisoner. In prison he wrote books about his voyage and the Koreans. In the western world he is regarded as the discoverer of Korea . For several years now. Gorinchem has a Korean sister-town, thanks to Henndrick Hamel.

8. After the Kortendijk take a right turn into the Havendijk. Follow this dike for as long as 250 meters until you reach a crossroad . Turn left there and follow the Brugstraat. At the end of this street you see **Brugstraat 30 (8)** at your right.
9. Turn right after the Brugstraat. Continue straight ahead for 80 meters and go between the trees. You're at the **Kalkhaven (9)** now**.**
10. Take the First street to your right , through the Lombardstraat in the direction of the Dalemwal. Walk towards the statue of the salmonfisher at the **Dalemwal (10).** On the Dalemwal you see a gun. That gun is a remembrance to Gorinchem as an important fortress in the Dutch Waterline **(***Hollandse Waterlinie).Fifteen men were needed to handle and move this gun.*
11. Walk back through the Lombardstreet and cross over at the Kalkhaven and turn into the Spaarpotsteeg. Continue towards the water. Take a left turn and stay at the right side of the bridge. At the right side of the bridge you see the house **"In den Blowen Hoet" (11).** This was the home of the bridge-operator and tax-collecter of Gorinchem.
12. If you have crossed the bridge, go to the left. You'll bump into the **Waterpoort (12)**.
13. Take a right turn in front of the Waterpoort, into the Tolsteeg. Watch out, this is a dangerous road, so walk at the righthand side of the road. When you're down at the bottom, you see on your right **Tolsteeg 3 (13).**
14. To your right you walk into the Molenstraat. In front of **Molenstraat 65 (14)** there's hanging something at the wall.
15. Continue walking through the Molensteeg and take the first street to the right. If you've reached the Langendijk, go to the left until you reach Langendijk 72. Here you can find a **Schuilkerk (15).**
16. Continue walking through the Appeldijk, until you see on you left the Weessteeg. At the end of the Weessteeg go tot he right (Molenstraat again). The second house on the right is **Huize Matthijs-Marijke (16).** Think about this: why this picture above the door?
17. Go further to the fountain on the "Grote Markt". This fountain is named **"de Wilhelmina-fontein" (17).**
18. Behind the Wilhelmina fountain you find **the Gorkums Museum te (1)**.

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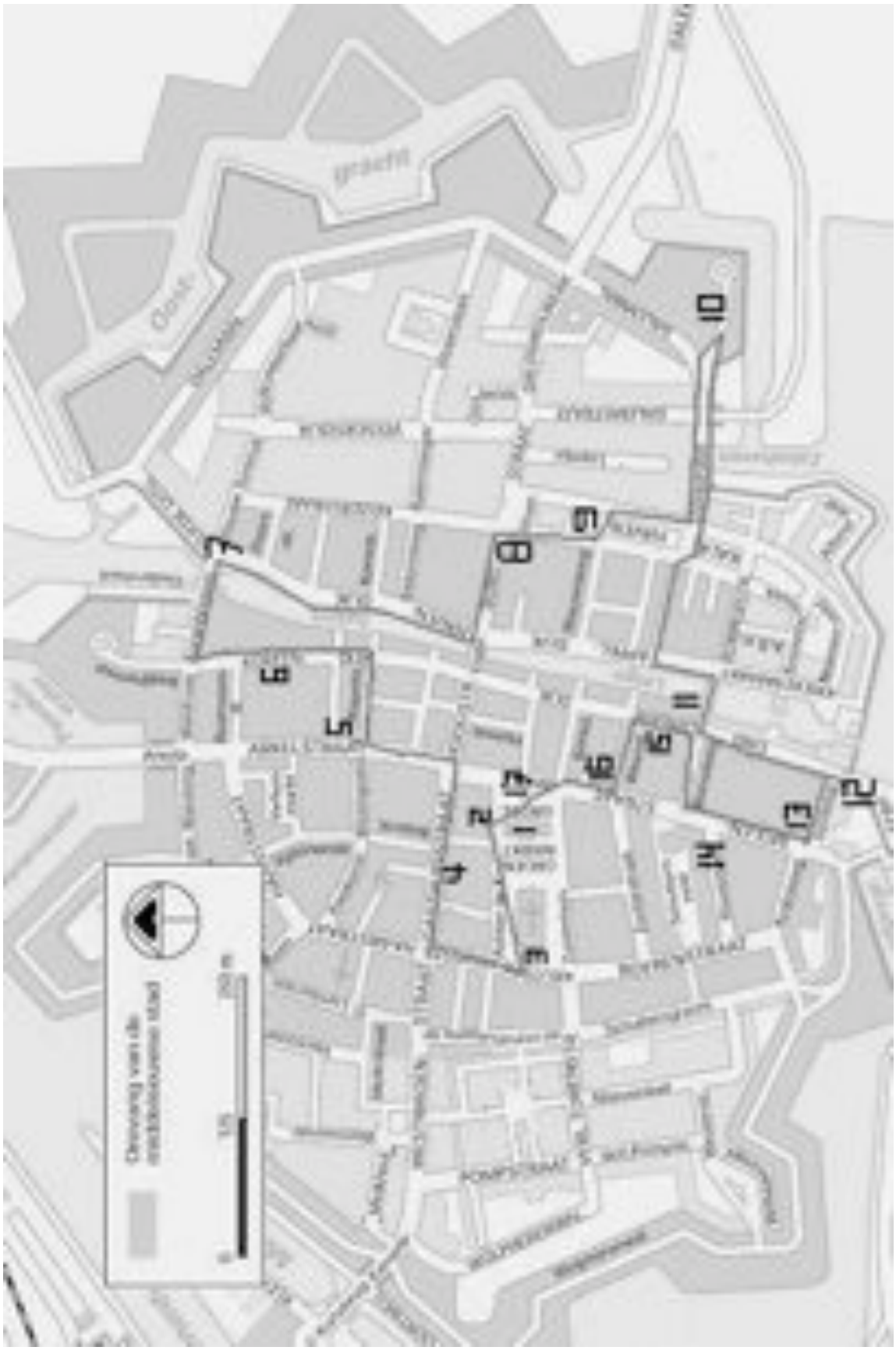

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CKV-OPDRACHT: Kijken en klikken

Voor het vak CKV ga je fotograferen. Een selectie (zes stuks) van de door jou gemaakte foto’s moet je bewaren. Je print ze thuis uit en levert ze in bij je docent Handvaardigheid of Tekenen. Volgend seizoen heb je deze afbeeldingen nodig bij CKV.

Voor deze opdracht heb je vandaag 1 à 1,5 uur de tijd.

Benodigdheden: fototoestel of smartphone

Opdracht 1 Foto van een detail

Loop rond en zoek een detail dat interessant is om te zien. Bijvoorbeeld vanwege de vormen, lijnen, kleuren of de afwisseling van licht en donker. Maak van het detail een foto.
De foto moet min of meer onherkenbaar zijn: je moet niet makkelijk kunnen zien wat het voorstelt.
Zorg voor een goede vlakverdeling.
Maak meerdere foto’s van meerdere plekken. Kies later de drie foto’s uit die je het meest aanspreken.

Sla drie detailfoto’s op.

Opdracht 2 Voorgrond en achtergrond

Loop rond en kijk goed. Wat ga je fotograferen? Het onderwerp kies jezelf: het fort, de Waal, gras of wolken, stenen of schapen.
Zorg dat er steeds iets op de voorgrond is te zien. Door de voorgrond krijg je meer diepte in de foto. (zie afbeelding)
In het algemeen geldt dat je de zon beter niet in de rug kunt hebben. Dan zie je namelijk weinig schaduwen waardoor alles platter lijkt.
Tegenlicht kan een slecht resultaat opleveren. Maar als je zorgt dat het felle licht niet in de lens komt, zijn goede resultaten mogelijk

Maak meerdere kiekjes.

Tip: ga ook eens door de knieën (laag standpunt) of probeer eens een hoog standpunt in te nemen.

Selecteer je drie beste foto’s met een voorgrond en sla ze op.

In totaal sla je dus zes foto’s op.
Thuis druk je deze foto’s af op één of twee vel papier (A4-formaat)
Geef elke foto een code. In de code staat je naam.
Voorbeeld van eerste serie: KLAAS vd BERG-DETAIL-1
Voorbeeld van tweede serie: KLAAS vd BERG- VOORGROND-1
Als je weer op school bent, stop je het A4-tje met de zes foto’s in je kunstmap.

PROJECT WEEK EXPLORE THE 'WAARDEN'

1.1 Natural values (preparations Biology)

You can hardly find 'real' nature (meaning: without human influence) in the Netherlands. Still: a lot of natural values can be found in our cultivated landscapes. Let's first of all find out what the landscape of our environment looks like and what kind species live or can live in it. We will have to look into the essential contributions of farmers.

1. What do you want to investigate? (*research question*)
Which natural values belong to the landscape of our area and how can we stimulate the development of these natural values?

Vrouwenhuiswaard: a conservation area in a river foreland of the river Linge, close to Arkel

2. What are you going to do? (*method*)
Read the information in the information book and use the internet (partly in science class). Try and answer all the questions in the infobook. Work in two's or three's.

3. What have you found? (*results*)
Take notes of the answers to the questions asked. Save your notes for the final assignment (friday in the project week)

Avelingen: a nature conservation area in the river foreland of the Merwede, close to Gorinchem - an excellent fieldwork location!

PROJECT WEEK EXPLORE THE 'WAARDEN'

Chapter 1: Natural values in the "Waarden"

Osier beds and pollard willows in the wetlands of the "Waarden"

The *Zuidhollands Landschap* manages many osier beds as nature conservation areas. Long, thin willow branches shoot out of a thick short trunk (willow stump). Because the branches are cut off regularly much sunlight reaches the ground, enabling rare plant species to grow among the willows. Alongside the paths you often find *pollard Willows*. Pollard Willows have a trunk of about two meters. They develop by cutting the shoots every 3-5 years, the branches being used for building plaited fences, in the vegetable garden or as firewood. Cutting the branches results in rain water seeping in the wounds, causing the soft willow wood to rot away. That way the tree can become hollow and even partly torn apart. Inside hole breeders like the (rare) Little Owl can build their nest. Gaps and holes upon the pollards fill up with decomposing plant material, resulting in fertile soil in which seeds may germinate. Upon the pollards you often find rare plant species. If the branches are not cut in time, the crown of the pollard willow will become too heavy. In stormy conditions the pollard willows will be blown over quite easily.

figure 1: in, upon and around a pollard willow many plants and animals may live

The maintenance of osier beds and pollard Willows

If the branches aren't harvested every 2-4 years osier beds will turn into a forest, Willows running wild will suffocate each other and the osier bed will wither away. Rare plants and animals will disappear and a piece of real Dutch history will be lost. New ways to use osier wood (i.e. for the production of chip-board) can prevent this.

Pools and duck decoys

When a dyke bursts the power of the water can create a deep, usually round pot-hole. This way pools developed which in the 16th century were turned into duck decoys. Groves around the pool give the ducks resting there a feeling of safety. Since the 16th century a stake-out right is valid around a duck decoy: in a circle around the duck decoy no disturbing activities are allowed. The catching of ducks hardly occurs these days – in some places it's still carried out but for scientific research. Duck decoys are important as nature reserve and cultural monument. Many species of plants, insects and mammals live there, around 80 bird species breed there (on average).

Wooded embankments and old tithe-roads

Except osier beds we find groves for various use in the open and flat landscape of the "Waarden": for timber, for burning and burying cows killed by the pest or anthrax and around the pools of duck decoys. Low dykes or embankments were sometimes used as tithe-roads: stewards used these roads to travel between the villages to collect taxes (tithes). Taller trees are used by birds of prey as look-out posts.

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Wet meadows

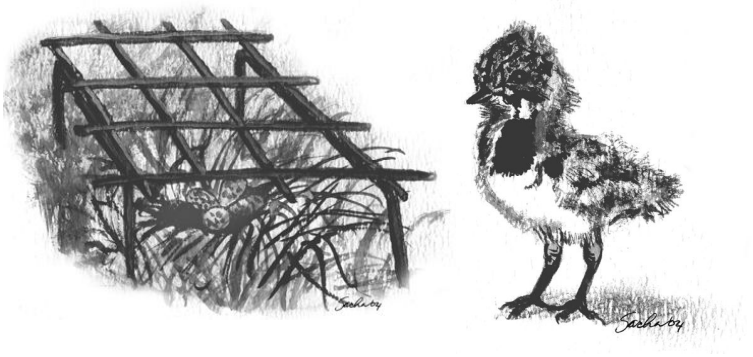
Having developed in places too wet to be cultivated easily, wet meadows were used as hay-fields. They were mown once or twice a year. Not being manured they developed into low-nutrient meadows. A lot of different species can thrive on these wet meadows, many of them quite rare, the flowers of them attracting many insects like butterflies. In fertile meadows fast growing species drive out many other species, so they will show a much lower biodiversity.
The more natural the grassland is, the more different plant species will be found. Small soil animals play an important part in this. They stimulate a faster development from grassland into a more natural plant community, upgrading biodiversity. Root eaters among them (like some nematodes and wireworms) keep dominant grasses low in number, allowing other species to flourish. Maybe soil tranplants can quicken natural development because soil animals may spread from these tranplanted spots, their limited mobility hindering a pure natural dispersion of soil animals over long distances.

Farmers for nature

Modern farming has many benefits in supplying us with food and income, but it may also result in the disappearance of several species of plants and animals. An increasing amount of farmers want to preserve natural heritage, deeming it important that meadow birds can nest on their land and several plant species can thrive in and along the ditches. These conservation ideals require extra work, but they're willing to do that. Sometimes the land yields less as a result of conservation measurements. The government grants the farmers money for rare plant species growing and for each bird hatching on their land to help them with their conservation tasks.

Meadow birds conservation

Typical meadow birds are Lapwing, Black-tailed Godwit, Redshank and the Skylark. These species nest and search for food in the meadows. Farmers and cattle may damage their nests or trample their young quite easily. Good conservation management can result in meadows being rich in bird species.



Questions:

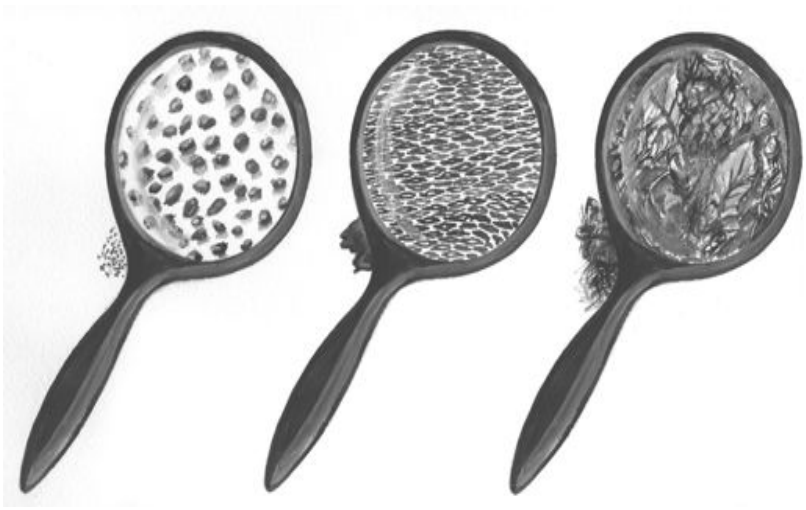
1. Try and find out how farmers manage the field margins and what can be achieved by such conservation management.
2. How come the field margins will become less fertile than the meadows because of this management?
3. Look for four ways in which farmers can protect meadow birds on their land.
4. Explain the disadvantages farmers may have putting these measures into place.
5. Which other measures can help farmers to enlarge the natural values on his land?

Chapter 2 Landscape and soil type

2.1 Peat bog in the "Waarden"

In the Netherlands different types of soil can be found. Sand, clay, loess and peat are some of the well known soil types. Sand, clay and loess are small particles eroded by wind and / or water. Rocks and stones have never been alive which is why we call them lifeless. Peat is made up of *dead* plant matter. If you look at peat in detail you will be able to see thousand year old plant remnants, such as stems, branches and seeds. Peat develops in humid marshlands.

Soil types viewed through a magnifying glass.



Dead plants don't break down

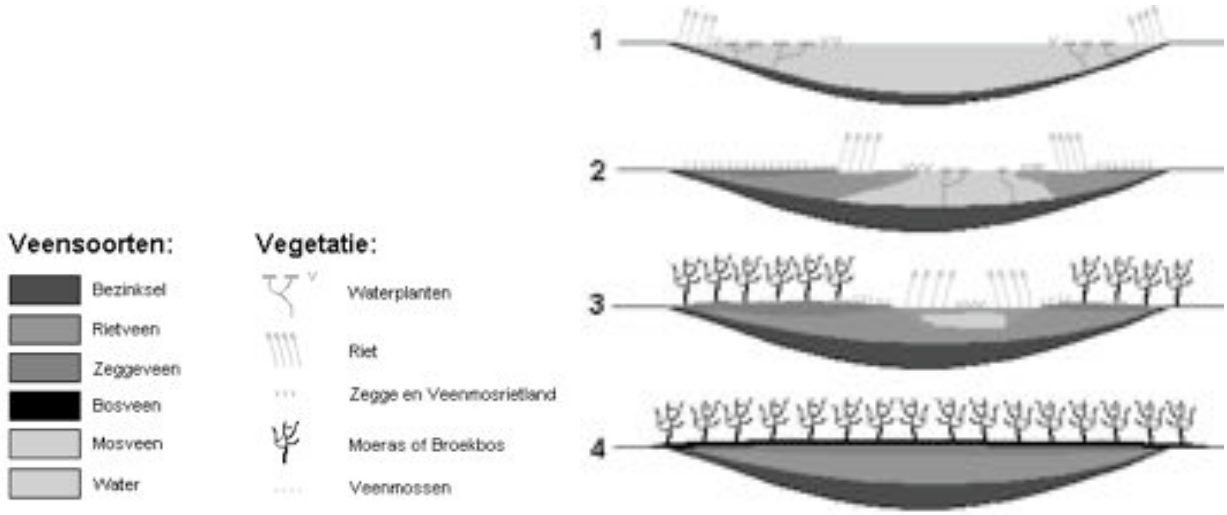
Plants die, and the dead plant matter can then be found on the ground. Stems and leaves are broken down by a variety of soil animals. The small particles left behind usually are decomposed by bacteria and fungi. Humus (fertile soil) is the end product of this process.

When plants die in water, they sink to the bottom of the lake or creek. Bacteria and fungi also play their part here in the decomposition process and in doing so they use oxygen. However, in water oxygen is depleted quickly thus the bacteria and fungi die and the process stops, leaving partly decomposed plant matter on bed. Over a long period such as thousands of years this deposited material builds up and can be meters deep. This is called peat.

Peat in the Netherlands

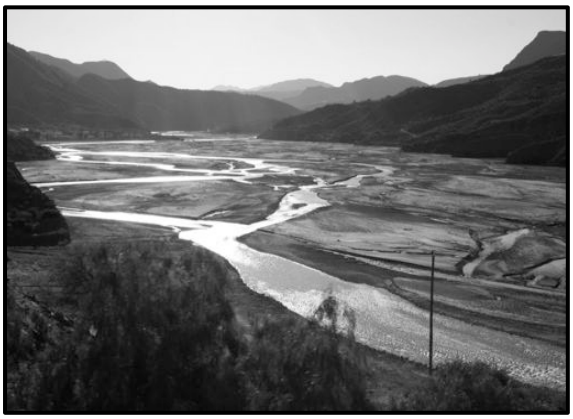
In many places in the Netherlands deep layers of peat bog can be found, generally with a thin layer of clay (sometimes up to 30 cm deep) on top. In the "waarden" a lot of it can be found. Peat was formed during the Holocene. After the ice age, warmer periods followed, in which the ice melted and the water level rose. In the wet sea clay-area great marshes of still water were created because the lower plains were covered by high water levels. These were ideal conditions for the formation of peat bogs. The decomposition of the plant matter was a slow process due to the lack of oxygen. Eutrophic peat, a peat with many minerals, developed because the water containes silt. It is sweet or salty depending upon the quality of the ground water. The vegetation of the sweet variety is "broek- and ooibos": alder, willow, poplar and reed. The vegetation of the salty variety is reed.

Proces of formation of peat



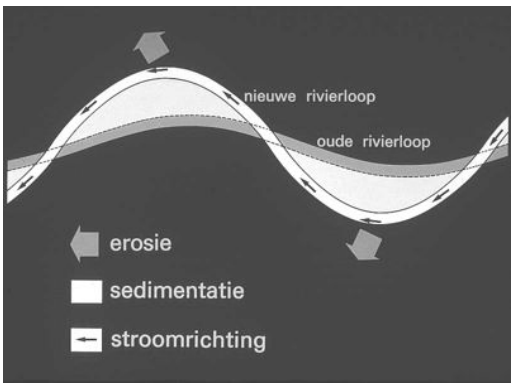
2.2 River sediments

Just like peat bog the river landscapes were created during the Holocene. After the last ice age the temperatures rose and the rivers' flow rate gradually decreased. The braided rivers, depositing much sand and pebbles, changed into meandering rivers, with sediments of sand and clay. This had a major impact on both the east and west river clay landscapes (east and west of the line Leerdam-Culemborg-Vianen)



Braided river

Meandering river



The river beds of meandering rivers are constantly moving because of the lateral erosion and accretion. A meandering river doesn't only move sideways but also in the direction of the current.

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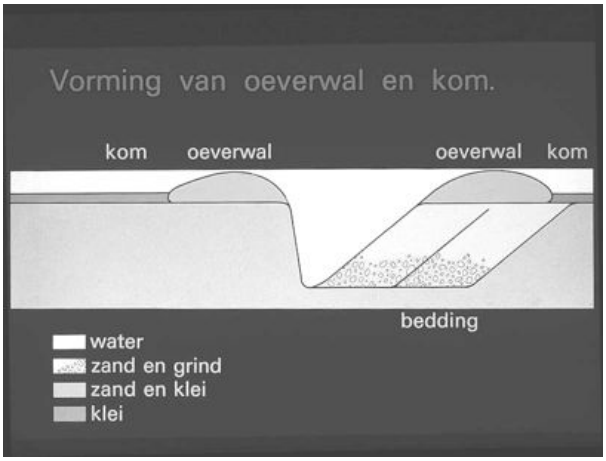
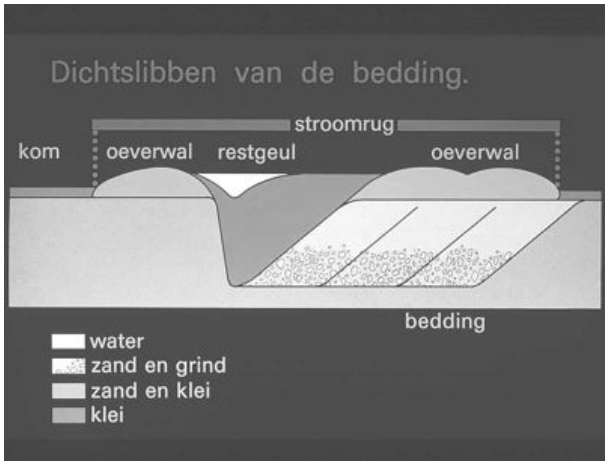
The eastern river clay landscape
The river beds became smaller and winding because of the slow and even water flow during the Holocene. Flooding occurred in case of extra high water run off, resulting in depositing sand and clay by the meandering rivers. Sand weighs more and has bigger particles than clay, so it sinks more quickly to the bottom and thus is deposited closer to the river bed forming natural levees: a somewhat higher sandy bank.
Further away from the river the clay sank in basins. A basin is a lower lying area between rivers and consists of clay. These days the basins can be found 1 to 2 metres lower than the natural sand banks. The clay grounds generally aren’t very porous and therefore generally used as grassland.

Over the years the rivers have shifted many times. More sand being deposited along the river beds and the rising sea level caused the river water levels to rise. Eventually the river flooded and a new course was created. These old riverbeds with the natural levees are called channel belts.





Another characteristic of river clay landscapes are the so called “donken” (sand dunes) These are river dunes which came into existence along rivers at the end of the ice age. Over the years most of these have been covered with clay, however some have stayed the same. The “donken” consist of sand that has been deposited by the wind, that’s called an aeolian deposition.

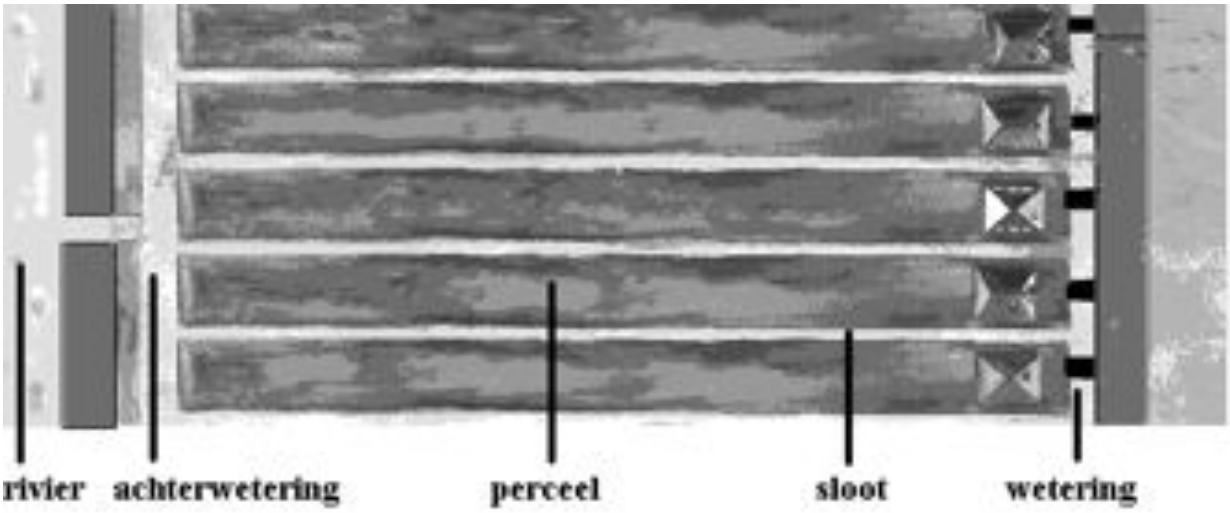
The western river clay landscape
The western river clay landscape is different to that of the eastern because of the bigger influence of the sea. The influence of the tide upon the flow of the river results in other types of sedimentary deposits. At high tide the excess river water is unable to stream off easily: the water is blocked by the incoming sea water. Flooding will occur easily. The flow of the river will slow down because of the clashing currents of river and sea water. The low water velocity causes the sand to stay on the bottom of the river beds so no deposition of sand will take place on the banks as in the eastern river clay landscape. However, the lighter particles such as clay are deposited along the river. That’s why the natural levees and the channel belts in this landscape entirely consist of clay. The basins in the western clay river landscape consist out of silt containing forest peat. The sand dunes in the west are raised considerably by clay and peat.

Ch 3 Land reclamation and land use in the "Waarden"

The first inhabitants
Around 1,000 years ago the 'Waarden' and the western part of the Netherlands were largely marshland areas. The place in which you now live was generally uninhabitable, being far too wet and consisting of reed areas, marshland and lakes. The rivers flooded regularly. A few people did however live here, but on higher ground.

3.1 Land reclamation in peat soil

Land reclamation in the early middle ages
Around 1000 AD more fertile ground was needed due to population growth, so people ventured into the marshlands following little rivers. Clay was heaped up along the rivers to create land on which to live. The marshes were reclaimed in straight strips. From 1100 AD the area between the rivers was also reclaimed, by digging wide straight ditches and watercourses.
The marshlands were at that moment owned by the bishop of Utrecht. He decided as to who was allowed to reclaim which section of the marshes, very often people of the nobility or who had done something for the church. A permit was issued for a low (symbolic) sum of money and was called a 'cope'or 'koop'. To drain the marshes farmers dug long ditches which filled with ground water, these ditches were connected to watercourses which in turn were connected to the peat river system, lying lower than the marsh areas. So the water from the marshes could stream away to the larger rivers. To avoid the marsh areas from flooding, the naturally formed river banks were raised to a higher level about 1200 AD, thus creating the first dykes.



Diagrammatic drawing of 'cope' reclamation.

PROJECT WEEK EXPLORE THE ‘WAARDEN’

The settling of the ‘waarden’

After a number of centuries of drainage, changing marshlands into fields and pastures, the inhabitants noticed that the water no longer automatically drained off into the rivers. A noticeable change between the river levels and that of the reclaimed land had occurred. The land had sunk and was now lower than the levels of the rivers. This had happened in the ‘waarden’ because the land consisted of wet peat soil. As water drained away the top layer of clay pressed the peat together. The peat shrunk and the land sunk. As previously explained peat consists mainly of plant remnants. Water disappeared and oxygen took its place. The semi-dormant bacteria and fungi could once again decompose the peat efficiently. The soil literally disappeared beneath the farmer’s feet. The fields once again reverted into marshlands, wet with a threat of flooding.

The building of water windmills

Over a few hundred years the land had sunk so far that the ‘waarden’ now lay lower than the rivers making drainage impossible. The inhabitants had to think of a way to bring the water into the river. The marsh areas became a sort of polder – the land lay lower than the rivers. In the C12th windmills already existed, used to power saw and grain mills. Around the C15th there were hundreds of windmills in the ‘waarden’. The water wheel was used to pump excess water out of the polders, keeping the ‘waarden’ dry. During the C19th and C20th many of the windmills were demolished, pumpstations had taken their place, initially run by steam and later electrically. These days the remaining windmills are monuments.

Peat lakes

Besides reclamation of peat bog for agrucultural purposes a lot of peat bog simply disappeared, both naturally and through human influence. The sea had had a lot of influence on the landscape in the time of the forming of the peat. High tides and floods had a great deal of influence flushing the peat away. This way the ‘Zuiderzee’ (currently the ‘Ijsselmeer’) and the ‘Biesbosch’ came into existence. People began to dredge the peat bog (wet peat excavation). Dried out the peat (now called *turf*) was an important and necessary fuel of the times. Many lakes are now dry, due to land reclamation. These are called “droogmakerijen”. A good example is the ‘Prins Alexander polder’, lying -6 metre N.A.P. - the lowest point in the Netherlands. Raised peat bogs (‘hoogveen’) disappeared and in its place sandy valleys appeared.

Potholes in the peat lakes. Up to 1927 peat was dredged. © Topography services, Emmen.

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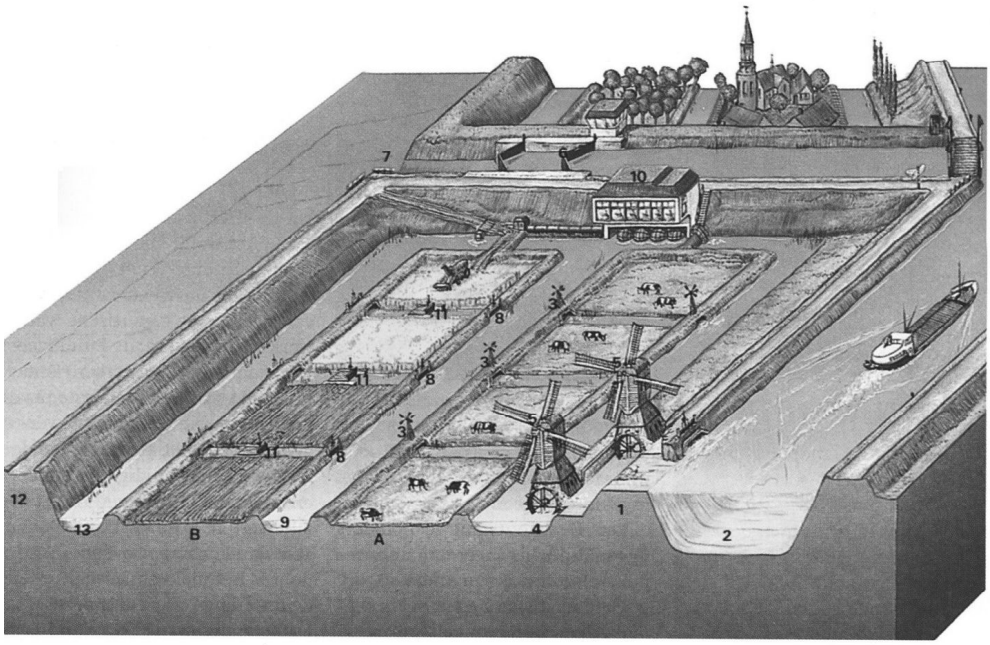
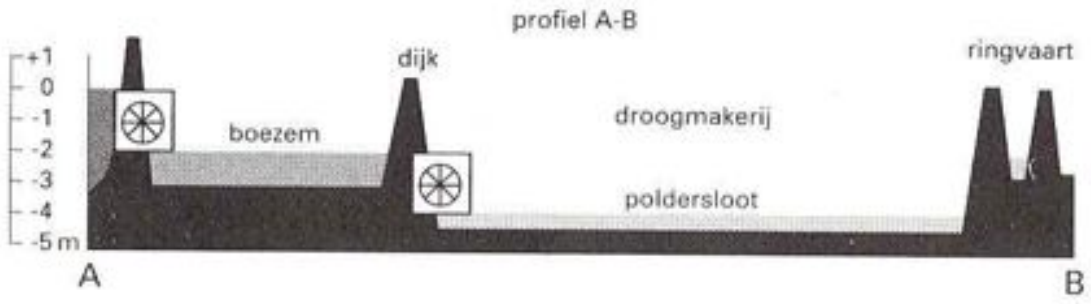
“Droogmakerij”

A polder is a piece of land surrounded by dykes, where it’s possible to regulate the water levels. In the Netherlands there are 3 types of polders: sea clay polders, peat polders and reclaimed land.

“Droogmakerijen” originally were lakes. Around 1600 the first lakes were drained by pumping out the water. These days the bottom sometimes lies more than 5m below N.A.P.

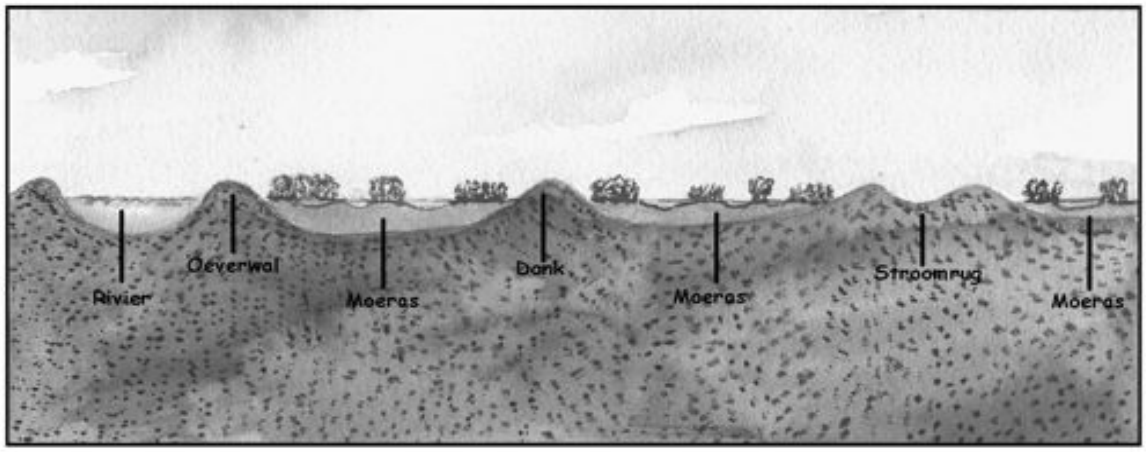


figuur 4.4 Afwateringssysteem in een polder



3.2 The human influence on the river clay landscape

The first settlements in the river clay areas stem from around 2000 BC. To be safely away from the water people chose to live on higher ground, such as natural river banks, sand dunes and channel belts. Years later they piled soil into mounds on which they built their settlements.



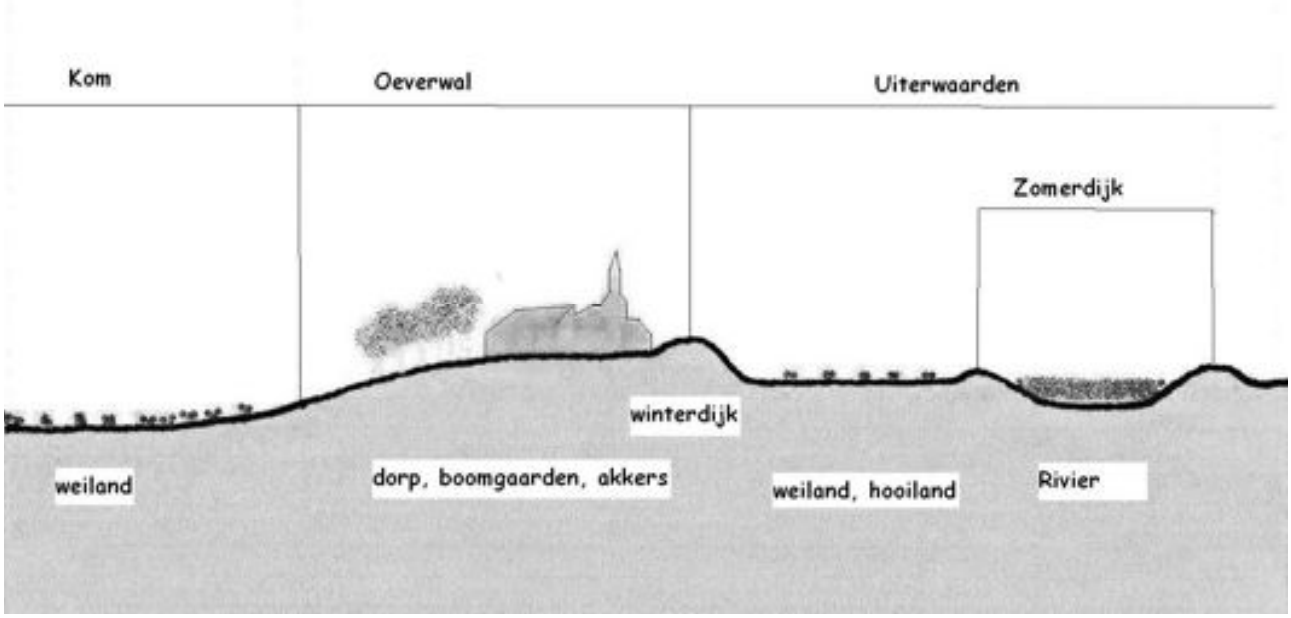
Diagrammatic cross-section of the ‘waarden’.

In earlier times the basins were extremely wet. Not only rainwater, but water seepage and flood water would collect in these basins. To drain off this water, watercourses were built. At high water levels dykes could be too low or would even breach. The power of the water running down the back of the dyke could create a deep, usually round pot-hole. The soil ripped out of the hole would fan out around the pool and create layered ground (“overslaggrond”). The pot-hole was often so deep that it was impossible to close the dyke at the same place. The dyke would therefore be built around the pot-hole, creating a twist in the dyke. These days one can recognise the dykes that bursted regularly burst: these dykes are generally very twisted.

Pot-holes

PROJECT WEEK EXPLORE THE 'WAARDEN'

To enlarge the water hold and to lessen the water break through a winter dyke was often built, somewhat further inland. When water flooded over the summer dyke (the dyke bordering directly at the river) into the neighbouring pastures, the winter dykes could prevent the flooding of the settlements. The area between the two dykes is called a river foreland ("uiterwaard"). At high water levels sandy clay was deposited in the foreland, sometimes causing the foreland to lie higher than the lands on the other side of the dyke. Except for the water hold the foreland was also used for the dredging of sand, clay and gravel. In the summer they were also used as pastures and hay fields.



Cross-section of a river area

Land allotment and the use of the land

In the eastern river clay landscape the allotment on the natural river banks is generally in blocks and irregular. These, being well drained parts of the landscape, were ideal to use as orchards and for agriculture. In the wet basin soils, the allotment of land is in strips and the soil and ground was used primarily as grasslands. Only from 1950 could the land be made liveable because of better drainage techniques.

In the western river clay landscape the allotment of land was in strips and elongated. The land was used as grasslands almost everywhere. Only the natural sand banks could be used for agriculture.

Orchards on the natural sand banks

PROJECT WEEK EXPLORE THE ‘WAARDEN’

Ch 4 Water: FRIEND AND FOE

4.1 Water in history

In the Netherlands water has always been our friend and foe. A large part of our country lies below sea level and therefore we were forced to use dikes and pumping stations to keep our “polders” dry. In the past windmills were used for this task. Alas a couple of times during big storms the water won and the sea reclaimed land causing lots of casualties. The last big one in 1953 claimed 1800 people in Sealand, West Brabant and South Holland.and another 100.000 lost their homes. The many rivers in our country brought us many advantages like fertile ground, fishing possibilities and easy trade routes. In the past we learned how to deal with the water and even managed to drain lakes and marshes to use them for agriculture. But fact remains that without pumping we could easily lose those grounds again and many people would get their feet wet.

4.2 Waterline

Normaly we will try to keep the water in the riverbeds and away from our fields and houses. But in times of war it became quite customary to flood large parts of our country. Dikes were pierced and sluices were opened to let the water reclaim special parts of land alongside rivers. These were called “inundations” and were meant to keep the enemy at bay. Preferably the fields were covered with 40 to 50 cm. of water. Under this layer of water roads and ditches became invisible. Flooded area’s sometimes were several kilometers wide. For armies it was impossible to cross these areas with all of their heavy equipment. The layer was not deep enough to cross by boat. The areas behind these inundations were safe. The waterline was an effective barrier to keep the enemy out.

Figure 1: the Waterlines

4.3 Different waterlines

Waterlines were first used during the Eighties Years War (1568-1648). Small area’s around cities were inundated to keep the Spaniards at bay, preventing them from attacking these cities. This proved so succesful that largers inundations were planned and effective waterlines created to defend our country as a whole. In this way the Old Waterline (de Oude Hollandse Waterlinie)was created. Figure 1 shows where it was and which parts were inundated. In 1672 this defensive line was effectuated and kept the French armies at bay, protecting “Fortress Holland”. In the winter of 1672 however some French troops managed to cross the waterline when it was frozen over and sacked Zwammerdam.
As you can see: every defensive line has its weaknesses.

Building the New Waterline (de Nieuwe Hollandse Waterlinie) started in the early 19th Century. King William I approved the proposal and the waterline shifted Eastward to include Utrecht in the “fortress Holland”. The NHW reached conclusion around 1870.

Construction on the "Fortress of Amsterdam" (Stelling van Amsterdam) started in 1880. The idea was that Amsterdam would be the last pocket of resistance. This defensive line has never been put into effect contrary to the Grebbeline. This was used against the Germans in the early days of WW2 in May 1940. Construction began already in the 18th Century. When WW2 broke out this line was in a rather poor shape but was used after all. Area's in front of the line were inundated to slow the Germans down.

Ch 5 Fortresses, sluices and roads

5.1 Fortresses

When inundating polders a layer of water of 40 to 50 cm should cover the fields as mentioned earlier. However, some dikes and roads on top of them might stick out and still be usable.The enemy might use such roads to get access into the defensive line and the land behind. That's why we call such high places an "access" (acces)

figure 6: The Grebbeberg

figure 7:a road through inundated area

To prevent the enemy from crossing the waterline the high grounds must be defended. For this reason fortresses were built at strategical positions. Every fortress was different and "custom made". Still most fortresses were "torenforten": a large tower containing heavy gunst that could fire in all directions to keep the enemy at bay.

These tower fortresses look very like Medieval castles containing a draw bridge and moat. These fortresses were mainly built alongside rivers and could fire in a 360^{o} circle. At the end of the 19th Century these fortresses became obsolete because of the invention of new type of grenade containing revolutionary explosives (brisant) the so called "high explosives"

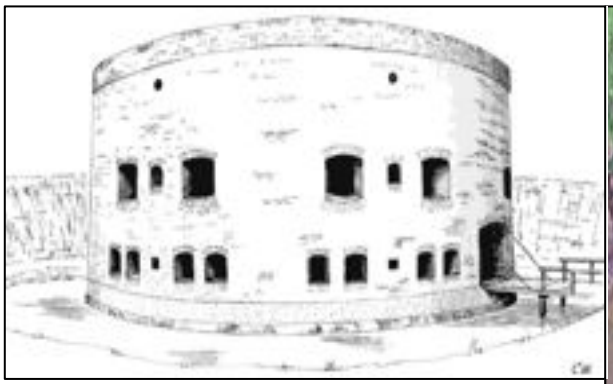


figure 8 towerfortress

figure 9 high explosive grenade

When biking through fields you often see concrete "bunkers". These were built just prior to WW2 and most served as hidingplaces. In war they were conected by trenches. The metal hooks on top served the purpose of attaching camouflagenettings.

figure 10: bunkers near fort Everdingen

5.2 Forbidden circles and wooden houses

In 1853 a new law made it illegal to build houses in circles around fortresses, the so called "forbidden circles". Three circles were constructed around any fortress: circles of 300, 600 en 1000 meter around the object. Article 1 of the "kringenwet":

"*Tusschen de buitengrenzen van vestingwerken en de lijnen, in deze wet verboden kringen genoemd, is het niet geoorloofd te bouwen, houtgewassen te planten of eenig werk te maken, dan voor zooverre zulks bij deze wet is toegestaan, of daartoe overeenkomstig hare bepalingen, vergunning is verleend."*

Beneath you see an old map of Utrecht in which the so called "forbidden circles" are drawn. The law was in effect till 1951, but even today you can see wooden houses because of it. Wooden houses were easy to burn down in case of war, because then the houses had to be removed to give the fortresses an open field of fire.

figure 11 : wooden houses near Nieuwersluis

figure 12 : map of Utrecht with forbidden circles

5.3 Inundation sluices

In order to inundate large areas a lot of water was needed This water was provided by rivers. In stead of non interrupted Dikes, sluices were built that could stop the water. In case of a threat of war the sluices were opened and the land behind the dikes was inundated. This was also the case for the sluice at Dalem. These sluices had to be well protected to keep them out of the hands of the enemy. This was one of the tasks of the fortress of Vuren.

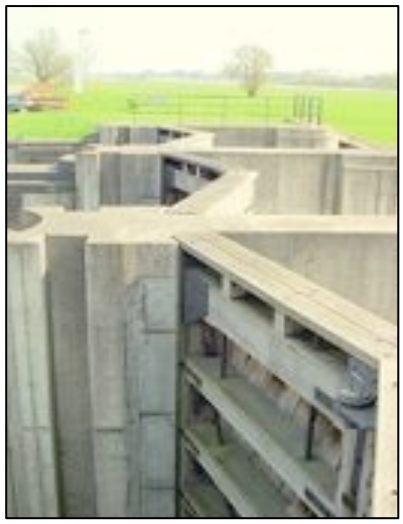


figure 13: the sluice at Dalem

5.4 Fortress Vuren

Fort Vuren is part of the "Nieuwe Hollandse Waterlinie" and was built in 1848. The fortress is also part of the Triangle "de vestingdriehoek" Gorinchem, Loevestein, Fort Vuren. Gorinchem itself is also part of the "Oude Hollandse Waterlinie". In Vuren , originally, there was anly a Towerfortress but it was extended later on. Today you can have dinner or have drinks there.

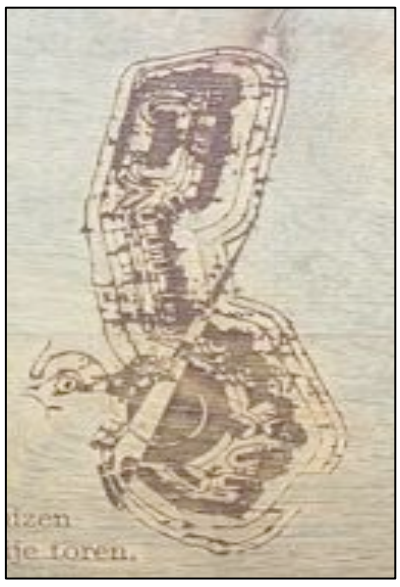


figure 14: plan of fort Vuren

Castle (Slot) Loevestein

Loevestein was built between1358 and 1375 by Dirk Loef van Horne, Lord of Altena. It was built on a strategically important peninsula where the rivers Meuse and Waal join into the Boven-Merwede
and was used to collect taxes. Because the surrounding lands (Munnikenland) were very soggy, this place was not very atractive for permanent residence for noblemen. Also because of this the castle became a prison for enemies of the state.

Ch 6 Gorinchem

6.1 Gorinchem

Gorinchem arose around the year 1000 on the riverbanks of the the Linge as a settlement for fishermen around the homestead of Gorik. The lords of Arkel, granted the place cityrights in 1382. During our trip through the city we will encounter an illustration of one of these lords of Arkel

In 1412 the city fell in the hands of different counts of Holland untill , in 1581, it joined the Republic (the Republiek der Vereenigde Nederlanden). Gorinchem became a florishing place in this period of time as several houses in the city show.

The 15th Century cityplan, with the Great Market as centre and the 16th Century citywalls are still almost intact. This you can clearly see from the great Tower

figure 15: Gorinchem around 1400

figure 16: Gorinchem in The Republc

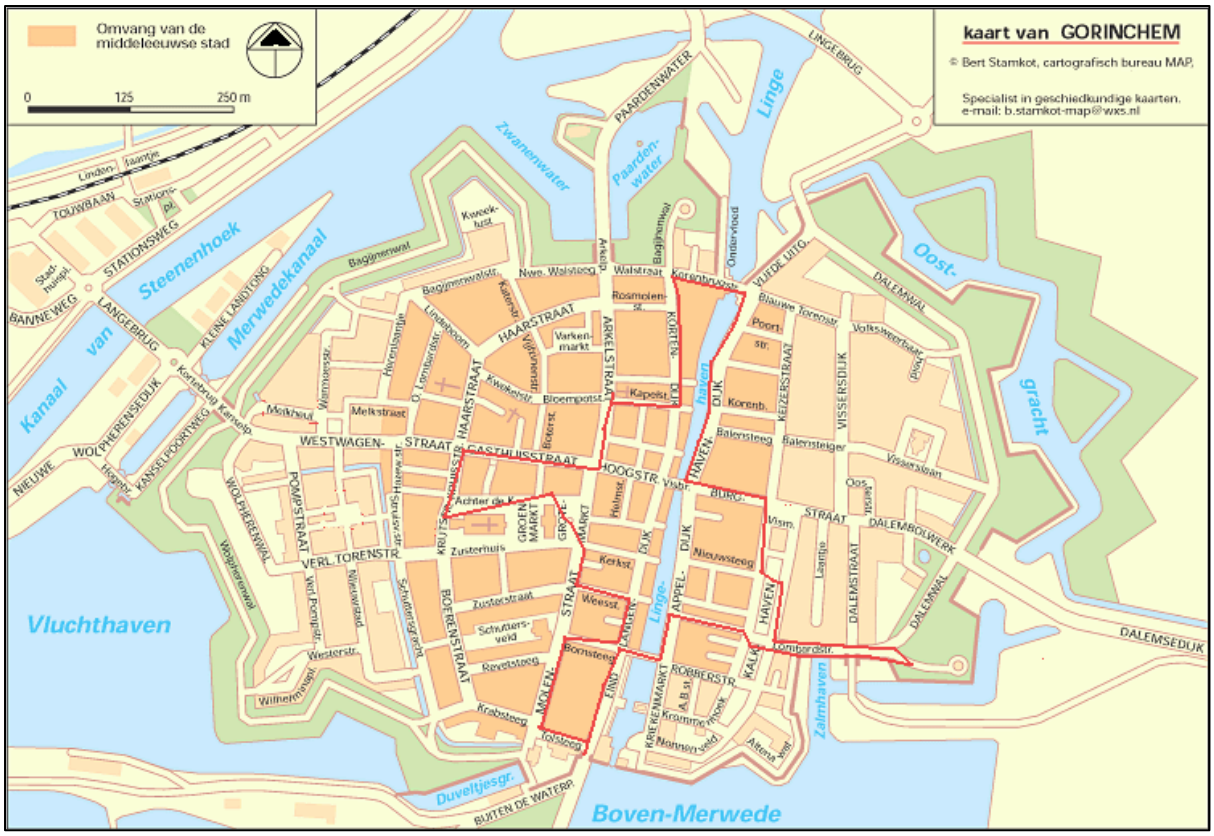


figure 17: Gorinchem as today with the route

PROJECT WEEK EXPLORE THE 'WAARDEN'

TECHNIQUE CHART Description of the landscape

During fieldwork you visit two different landscapes. Similarities and differences between them will be clearer by making a standard description of the two.
Everywhere in the world geographists make descriptions of the landscape as a way to explain the area. Such a description can e.g. help to get to kknow more about the soil and substratum before starting to develop a new residential area.
Making a description of the landscape is a careful process. A good preparation is important because youll visit the area only once. The following questions will help you to do it right:

- To what type of landscape does the area belong? Is it a Peat landscape or a Riverclay landscape?
- Try and find proof in the soil for the type of landscape. Soil drilling will provide this proof.
- Take a careful look at the map of the area before going there. A map can disclose a lot of information like differences in height.
- Use the satellite images of Google Earth to look at the area from above for further insight in the area.
- The most important question a geographist can ask will be: How did this landscape come into being? The answer to this question will provide much information

What you need:

- Topographical map 1:25.000
- Writing board
- Drawing paper, notebook, pen and pencil

Building blocks

To describe a landscape you can use eight building blocks:

1. Which type of soil do we have at hand? Soil types can be recognised by particle size and colour. (type of soil)
2. The height of the landscape, compared to sea level (height)
3. How many differences in the height of the terrain in the area are there? (reliëf)
4. Do people live in the area? Or did people live there in the past? (habitation)
5. The chief and secondary functions. Think of: *agriculture, transport, recreational uses, living, industry, services, nature*.
6. The way in which the fields are divided (by ditches, bushes, barbed wire, etc) and the shape of the parcels: reactangular, square or irregular. In the picture to the right various parcel shapes are shown.
7. Would you call this landscape open, half-open or closed? An open landscape provides you with wide views, a closed landscape usually has many trees (open or closed).
8. What's the infrastructure?

PROJECT WEEK EXPLORE THE 'WAARDEN'

TECHNIQUE CHART Water quality 1

Research of the water quality is done in two ways: biotic and abiotic. Each water is characterised by certain species and depends on temperature, light, oxygen, acidity and the chemicals in it: the ABIOTIC factors. Which species (and their numbers) occur in the water, also depends on things like food, competition, cover and enemies: the BIOTIC factors.

Clean or polluted water?

Polluted water usually contains extra nutrients like manure. This will stimulate the growth of algae and/or duckweed which can result in a decrease of the oxygen level. Clean water won't have any extra nutrients.
In polluted water the most vulnerable species will disappear first, whereas more tolerant species will be able to survive longer.
Not polluted water will show a great variety of species whereas polluted water will show a small variety of species with large numbers per species.

Clarity
Light is essential for the growth of green plants. Light can penetrate much further In clear water than in cloudy water. In clear water fish will be able to find their food more easily. Turbidity is caused by floating particles like clay, silt, organic material and tiny organisms.

Temperature
The temperature of the water influences the amount of dissolved oxygen, the speed of growth of organisms and the susceptibility of organisms to poisons and diseases.

Acidity or pH
The pH runs from 0 (very acid) to 14 (very basic). Pure water is neutral (pH = 7). The pH of natural and clean water is between 6.5. and 8. The susceptibility of organisms to changes in the pH differs for different species.

Conductivity
The conductivity of water tells us something about the amount of dissolved substances. Pure water won't conduct electricity very well. The more chemicals in it, the larger the conductivity. In snow the conductivity will vary from 5-30 microsiemens/cm. A conductivity higher than 1800 microsiemens/cm can cause damage to susceptible crops.

Oxygen level
The oxygen level in the water determines which species of animals and plants will be able to live there. The warmer the water, the less oxygen it can contain. A thick layer of duckweed can prevent oxygen to enter the water and shuts off the light for plants growing under it.

MEASURING ABIOTIC FACTORS *Always read the fieldwork technique charts*
Clarity: Fill a Secchi-tube with water until the black and white disc on the bottom just becomes invisible. Write down the height of the water column.
pH: Dip a small piece of pH-paper in the water and compare the colour with the colours on the scale.
Oxygen and temperature: we use the digital oxygen sensor.
Conductivity: we use the digital conductivity sensor.

PROJECT WEEK EXPLORE THE ‘WAARDEN’

TECHNIQUE CHART Water quality 2

Water quality mark abiotic

After measuring the various abiotic values, fill these in in the correct table. Determine the quality mark by adding up all the points, divide them by the maximum (15) and multiply the outcome by 10, or:

(number of points / 15) x 10 = abiotic water quality mark

Then read the score in the table below and draw conclusions:

points / score	quality in words	quality mark
0 - 7	Very polluted	0-2
7 - 10	Polluted	3-4
11 - 13	Reasonably clean	5-6
14 - 16	Clean	7-8
17 - 21	Very clean	8,5

Water quality mark biotic

After writing down all species you found in the biotic table, determine the biotic quality mark using the water quality table below. Find out to which category most of the species you found belong and determine the water quality mark accordingly. In the table the Dutch species names are used for reasons of convenience.

Category with characteristic species	quality mark:	means:
A Vijverhaftelarve, Kokerjuffer, Bittervoorn, Groene Kikker, Rietvogels	8,5	Very clean
B Schrijvertje, Schaatsenrijder, Libellelarve, Vlokreeft, Waterspin, Waterjufferlarve, Watersalamander, Zoetwaterpoliep, Driedoornige Stekelbaars, Baars, Rugstreeppad	7 – 8	Clean
C Watervlo, Eenoogkreeftje, Zoetwaterpissebed, Rivier kreeft, Geelgerande Waterkever, Bootsmannetje, Duikerwants, Zwemwants, Gewone bloedzuiger, Tiendoornige Stekelbaars, Gewone pad, Bruine Kikker, Fuut	5 – 6	Reasonably clean
D Water scorpion, Posthoornslak, Poelslak, Muggelarve, Karperluis, Waterspringstaart, Schildersmossel, Karper, Brasem, Snoekbaars, Wilde eend, Waterhoen, Meerkoet	3 – 4	Polluted
E Tubifex	0 - 1 - 2	Very polluted