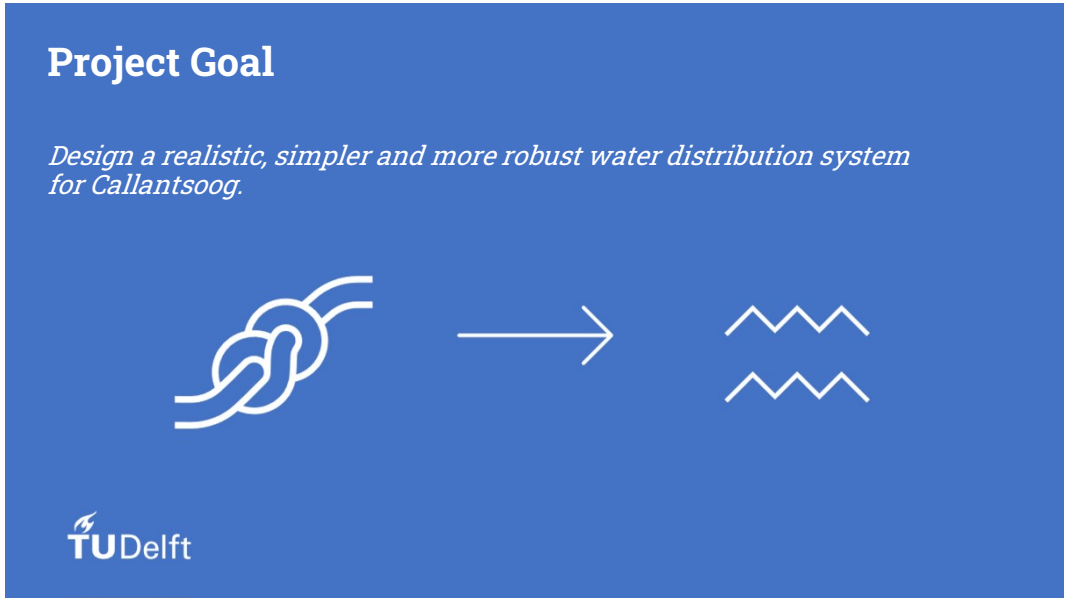
Callantsoog Water System Redesign

Group 5:
Anne Versleijen
Christine Martin
David Haasnoot
Dwiva Anbiya Taruna
Thomas Poort

TU Delft

Hello everyone, we're group 5. My name is David Haasnoot & this is Anne versleijen, and we will be looking at our strategy for the redesign of the callantsoog water system



The goal of the project is to *Design a realistic, simpler and more robust water distribution system for Callantsoog.*

Overview

Problem: extreme rain events lead to flooding and subsequent damages of stakeholders' property.

Proposed strategies:

1. **Reduction in the amount of water level decrees**
   - 31 decree levels → 10 decree levels
   - Impact: simplified and controllable

2. **Additional water storage**
   - Addition of flood plain north of the polder
   - Impact: robust for the coming century

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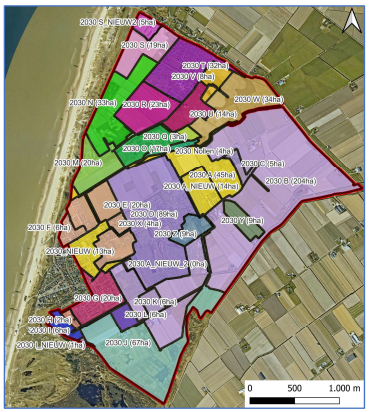
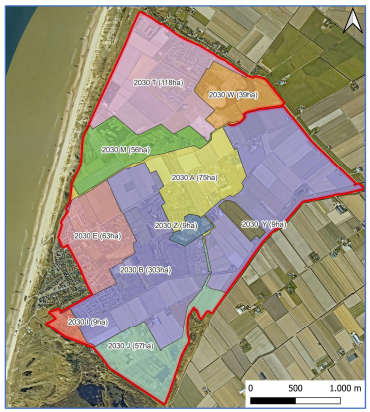
- Our focus was mainly on extreme rainfall events and how to make the system better in dealing with these.
- We developed two strategies in order to tackle with this:

1. By reducing the number of decree levels from 31 to 10 it will simplify the control structures and make the system more manageble
2. To deal with excess water during extreme events by adding a larger water storage in the north east to reduce the steress on the system

Change of water level decrees



Current



Proposed

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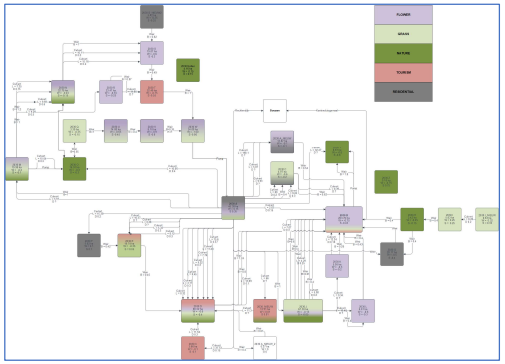
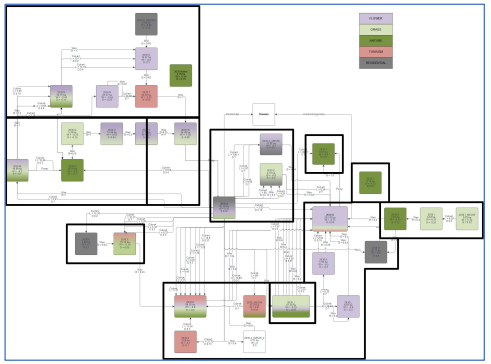
Here we see the current system with 31 water level decree systems, which vary in size and complexity.
Here is the new system we aimed to reduce this amount, however the nature areas are quite sensitive and different in operation.
For this reason they are left as their own regions. We formed these areas by looking at elevation, current & past land use and infrastructure.
The main consequence of changing the water decree level is that the levels decrease. This allows more storage of water when large amount of rainfall occurs suddenly.

Change of water level decrees



Current



Proposed

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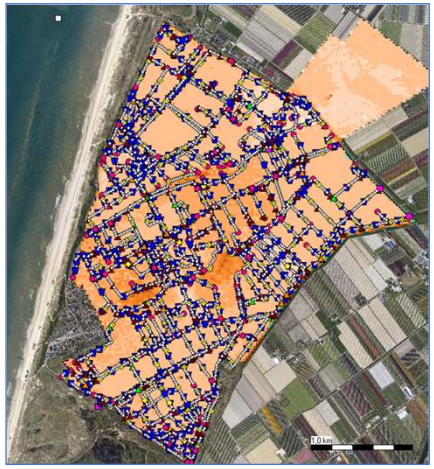
This is another representation of the system we just saw, this highlights the complexity of the current system.

SOBEK Model



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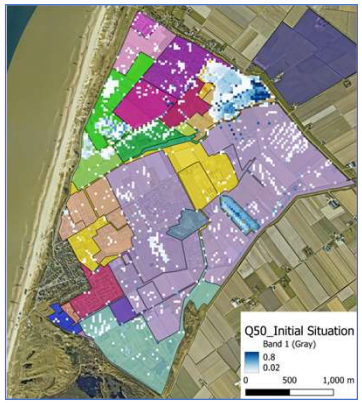
made with SOBEK

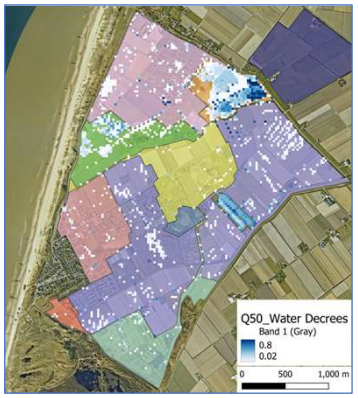
We used a sobek model of the area to run a series of simulations to show how the system reacts. First we looked at the exisiting system and then compared how our changes are effectesd by it. The model is but a representation of reality, thus intercoparison is the best way to access how changes work/

Results



Current

T50 - 69.5mm in 24hrs, model length 3d after rain



Proposed

8% Flood extent decrease

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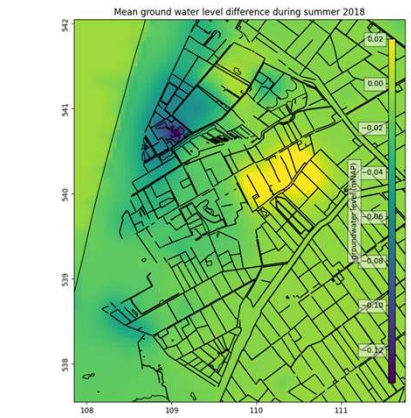
Here we see the current system moddeled for a rain event with a return period of 50 years.
This consists of 70mm across 24 hrs with a peak of around 8mm in a short time.
The decrease of 8% isn't much, but it shows that with less water decree levels the flood extent is still similar.
Most of the heavy areas flooded here are designated to flood as these are non-essential grasslands or nature areas which can cope with some water.

Groundwater Modeling



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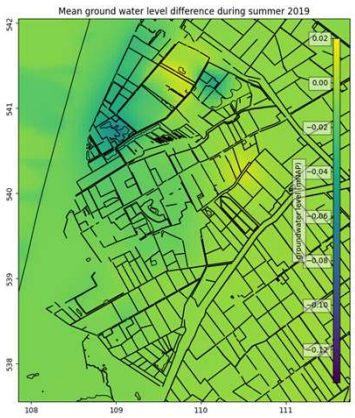
Mean difference Summer 2018



Mean difference Summer 2019

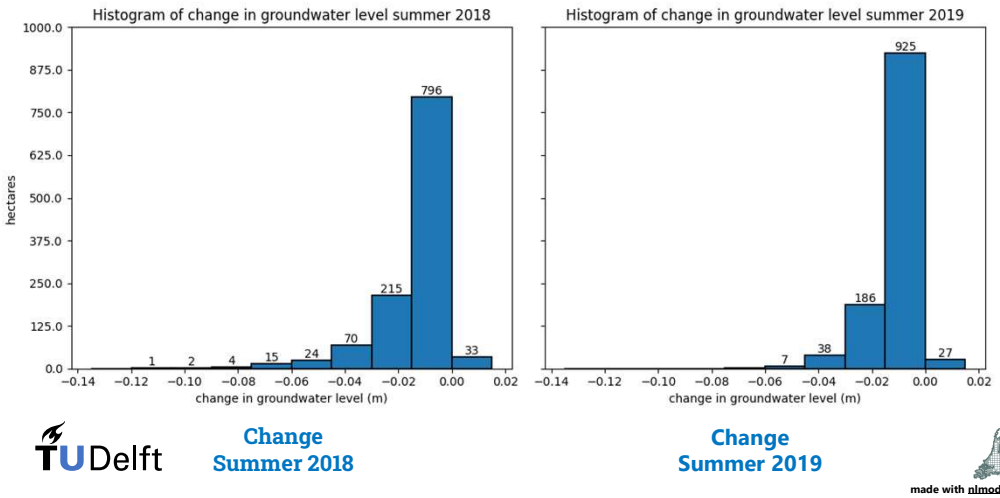
made with nlmod

For the ground water level, we looked at the ground water levels during the summer. In the groundwater model, data of KNMI is used for recharge. WITH NL MOD

To see the effect of changing the initial water level for the summer, we took the mean ground water level during the summer months.
As you can see, it depends on the year how big the effect is, but the most effect areas are in the north, which are also nature of grass lands.

Ground water level already varies with climate conditions

Groundwater Modeling



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Ground water level already varies with climate conditions

Additional water storage

Current

Proposed

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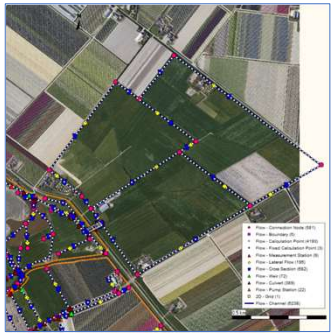
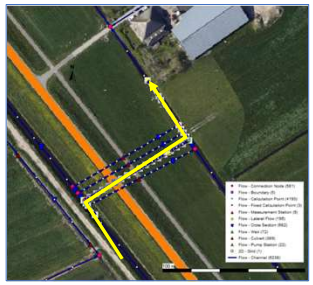
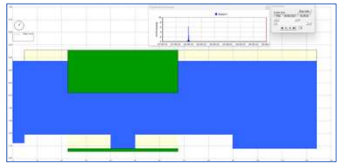
Our second strategy is to add an additional water storage. located just north of the polder system.
This location is grass land, which makes it feasible for water storage.

For now the plan is that it is only used for extreme rain events. A gate could be used

Modeling



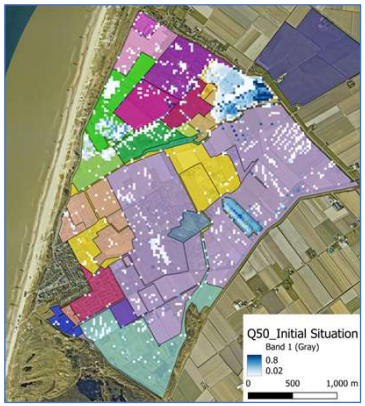




4 Round Culverts - ø1100 mm

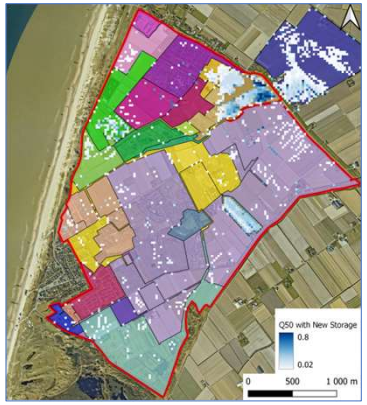
The water storage is connected to the system by 4 round culverts. The 4 culverts are added to the sobek model to make a connection between the areas.

Results



Current

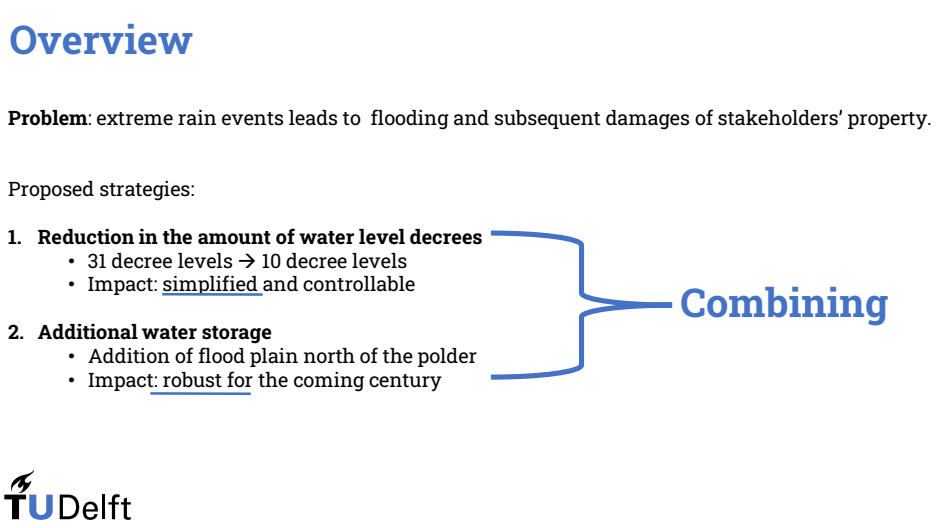
T50



Proposed

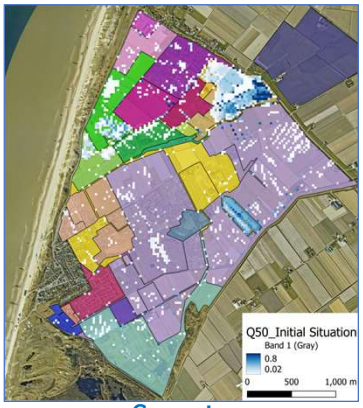
37 % flood extent decrease

The systems is also modelled in sobek by adding this addition area. We also modelled it with a rain even with return period of 50 years. On the right the result is shown. By adding this extra storage, the flood extent decreases with 37%. In the top part, the flood is also decreased and moved to the water storage location, which is favourable



- Until now looked at the two strategies seperatly. But we also had a look on the effect of combining the strategies. So adding a water storage in the north of the system and reducing the water level decrees.

Combined Results



Current

T50

Proposed

26% Flood extent decrease

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In the middle there is more floods compared to strategy 2, but this flood in on nature areas.

Stakeholders

Nature

- Mostly untouched

Farmers

Impact

- Decrease in farm area impacted by flooding
  - Reduction in valuable crop damages
- 75.83 hectares in NW region lower water levels

Expected response

- Continue regulating own water levels

Suggestions (long term)

- Adjust farming practices
- Land use change (leasing, selling, relocation)

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Damages = (400,000/hectare) (2.5 hectares/farmer) (20 farmers) = 20,000,000 euros / flood of same scale

The main stakeholders in this project are the farmers. decreasing the flood extent has a possitive effect for the farmers. It results in less crop damages. But on the other hand, almost 76 hectares in the north west region is affected by a lower water level. This has an impact on the way they are farming now.
Because of this, we expect that they will continue regulating their own water levels.
Farming practive --> less effected by water level change.

Next Steps

Testing & optimization
- Find ideal weir and pump placement

Cooperation with farmers
- Share proposed strategy
- Prepare for reactions to system changes

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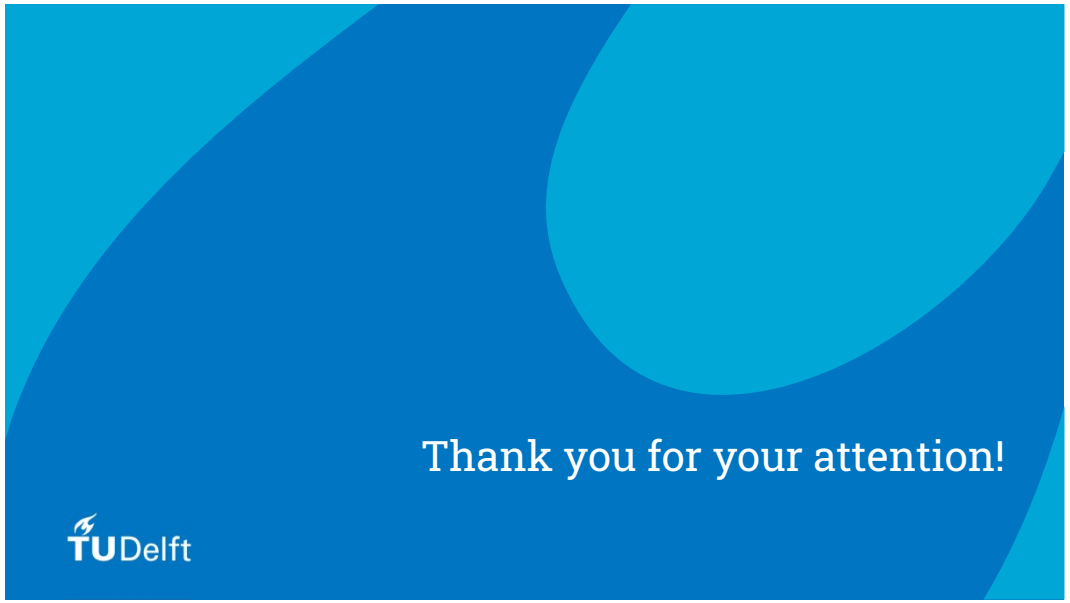
(continuation of individual pumping etc.)


Thank you for your attention!
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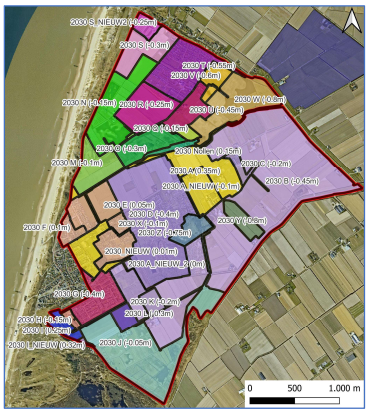
Change of water level decrees – summer levels



Current

Proposed

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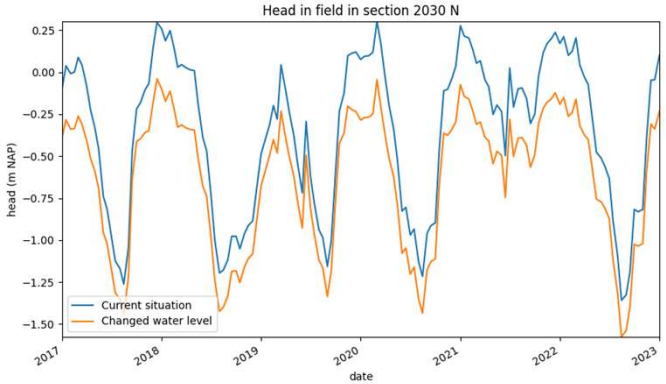
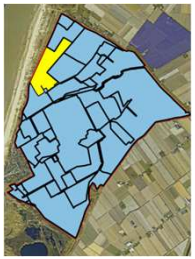
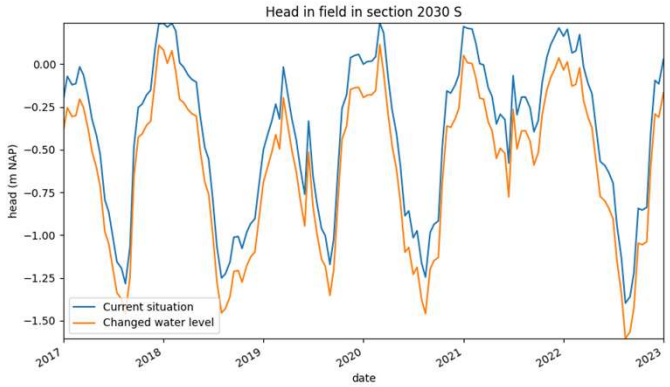
Groundwater level section 2030N

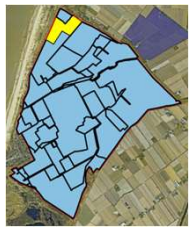




Groundwater level at farm field
Change: −0.15m to −0.45m

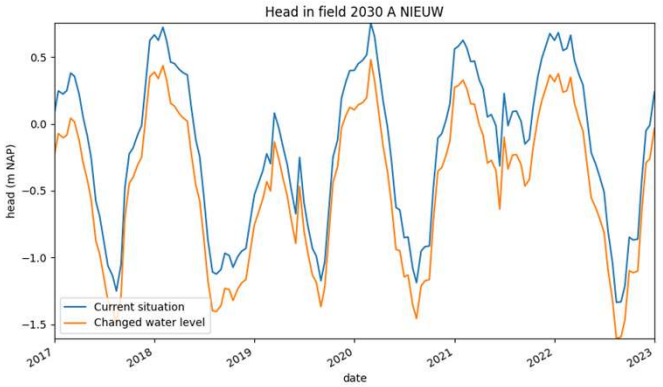
Groundwater level section 2030S





Groundwater level at farm field
Change: −0.30m to −0.45m

Groundwater level section 2030A NIEUW



Groundwater level at farm field
Change: −0.10m to 0.35m

Effected by surrounded areas