

Sun wind **water** earth life living

legends for design

AR1U130 SUET (design) 4ECTS

AR0112 Civil engineering for dummies (calculations) 2ECTS

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Prof.dr.ir. C.M. Steenbergen

Ir. M.W.M. van den Toorn

Publish on your website:

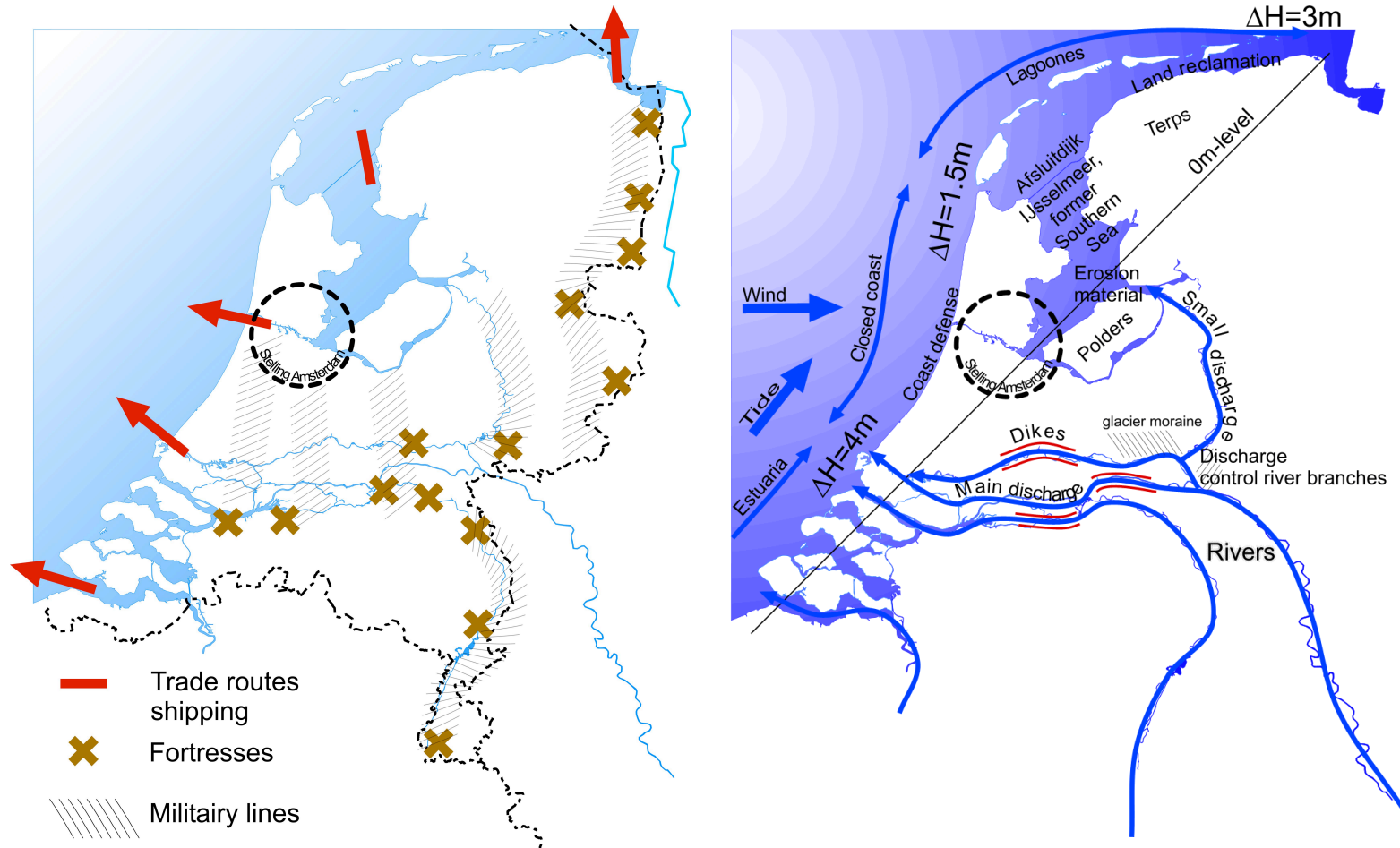
AR1U130 (4 ECTS)

how you could take
water into account in
your
•earlier work, and
•in the future
using .xls experiments.

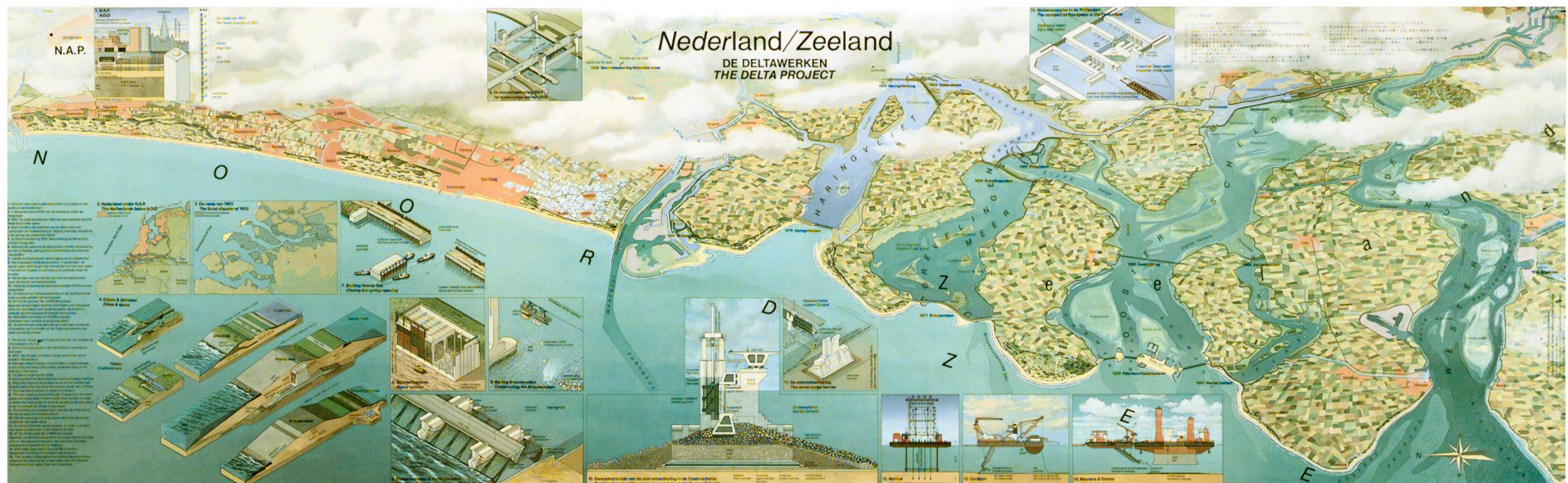
AR0112 (2 ECTS)

calculations and
observations of water
in any location and
your design, check
your observations
using .xls experiments
and math.

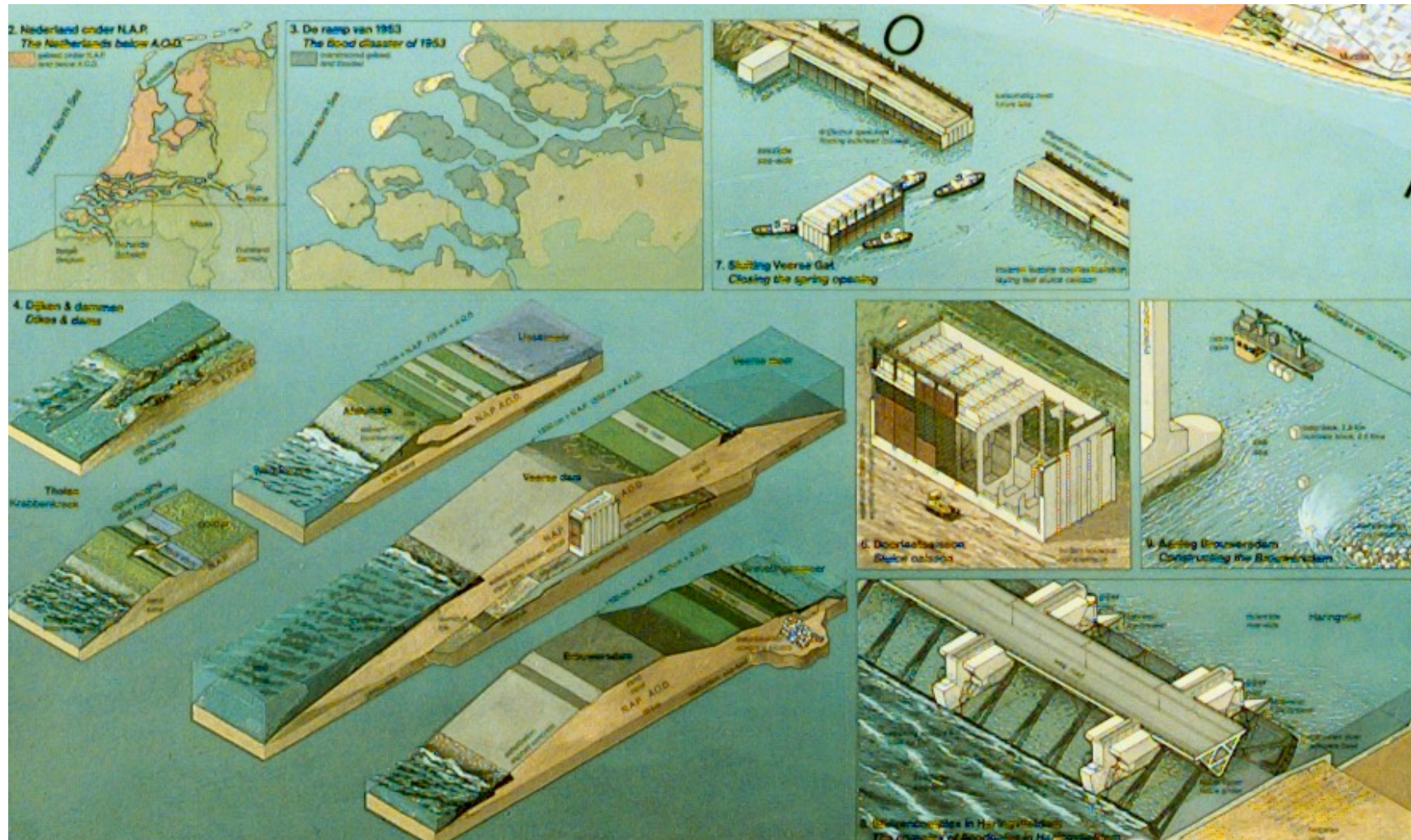
Water as ally and enemy



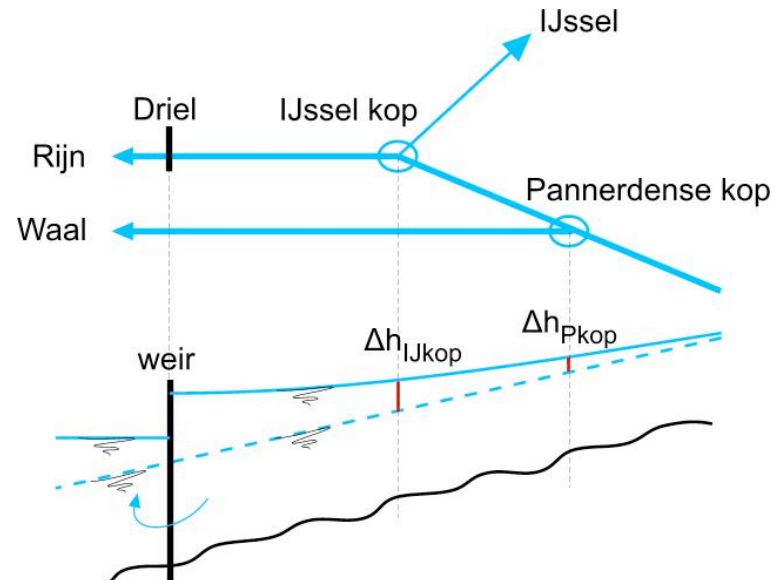
Coastal protection



Delta project constructions



Weirs divide the water of the Rhine

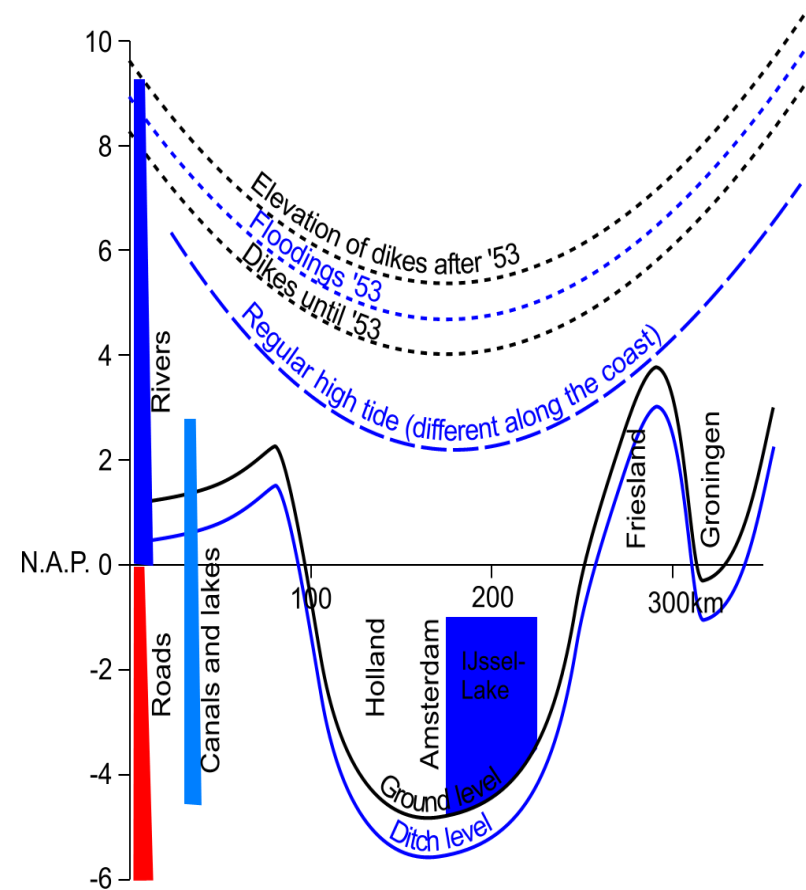


IJsselkop



Pannerdense kop

Water levels between Sluis and Eemshaven



Kinds of water in the Netherlands

| | | SURFACE WATER | | | | | | | | |
|-------------|---------|-----------------------------|-----------------------------|-------------|-----------|----------------------------|-------------------------------------|------|-------|--------|
| | | SALT | | BRACKISH | | FRESH | | | | |
| | | cur. | stag. | cur. | stag. | cur. | stag. | | | |
| deep | shallow | Oosterschelde, Waddenzee | Grevelingen, Veerse Meer | Haringvliet | Biesbosch | Uiterwaarden Maas, Rijn | Ijsselmeer, Oostvaarders plassen | | | |
| | | | | | | | | bank | | |
| | | | | | | | | | swamp | |
| | | | | | | | | | | bottom |
| | | | | | | | | | | |
| GROUNDWATER | | | | | | | | | | |

Reversed half time of a water active nation

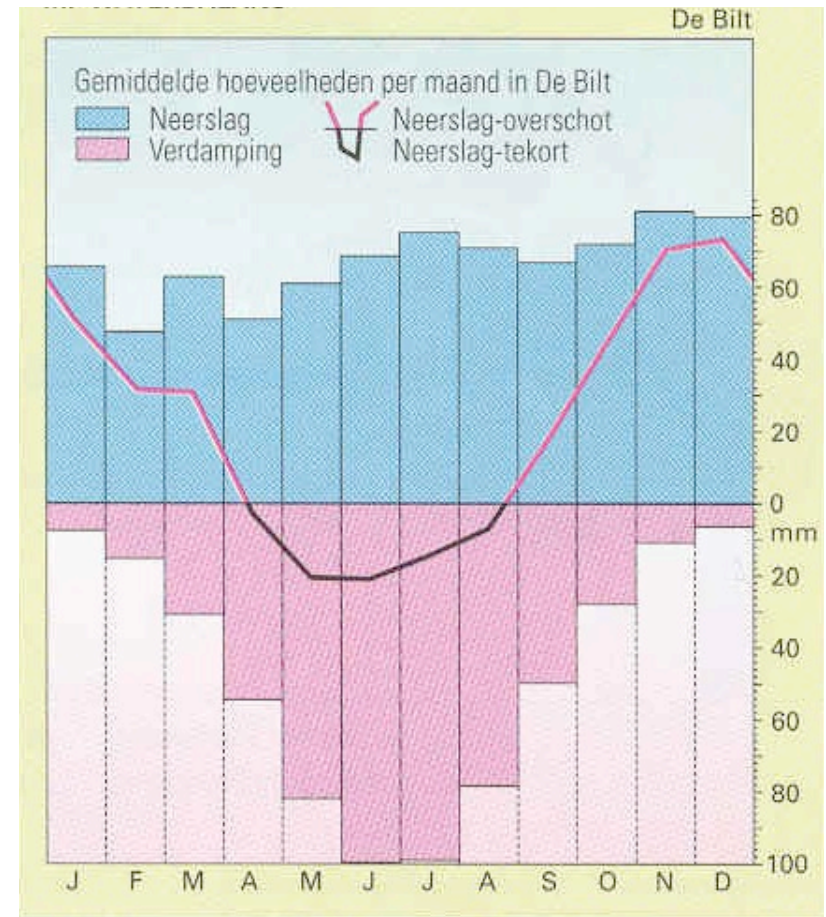
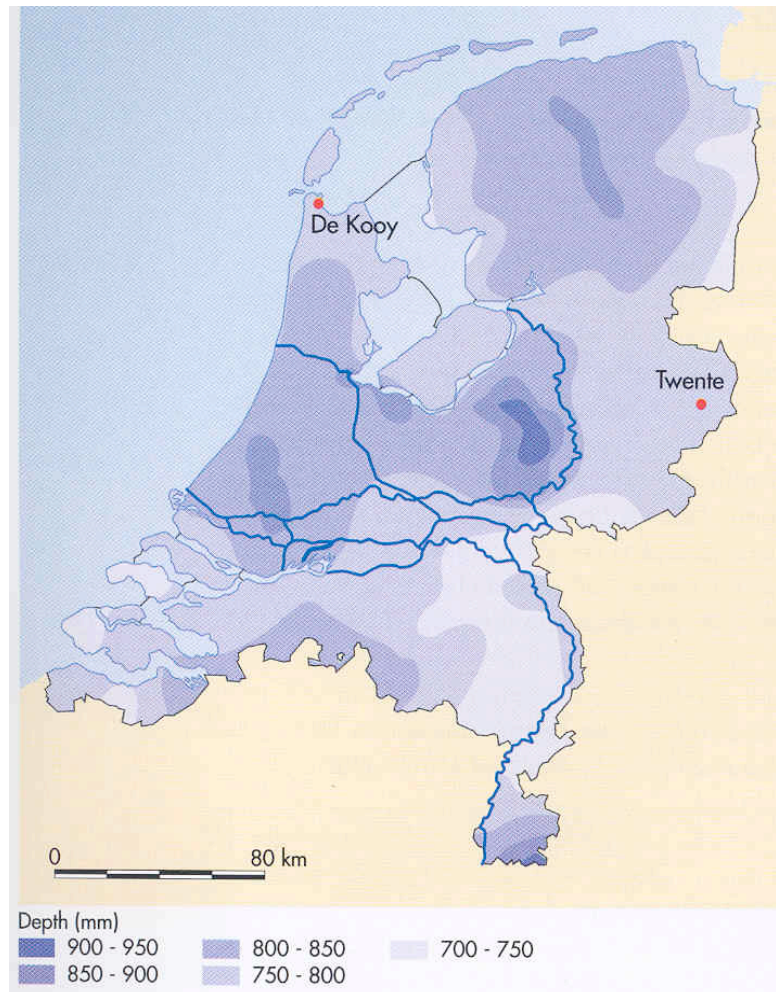
| Duration | Period | Issue |
|-------------|-------------|--|
| | | x <i>new approaches determined by disasters</i> |
| 1000 | 100 - 1100 | settlement ancestors |
| 500 | 1100 - 1600 | x Erection dikes, confined contours |
| 250 | 1600 - 1850 | x Waterlogging control, developing drainage |
| 125 | 1850 - 1975 | x Riverworks (regulation, normalisation canalisation) |
| 62 | 1920 - 1982 | x Zuiderzee works |
| 32 | 1955 - 1987 | x Delta works |
| 16 | 1975 - 1991 | x Major purification plants |
| 8 | 1985 - 1993 | x Policy documents tuned (RO, WHH, Trprt, Milieu) |
| 4 | 1993 - 1997 | Pilot schemes, integrated approaches |
| 2 | 1997 - 1999 | Evaluation RWS-200 year |
| 1 | 1999 - 2000 | New water Policy 21 st century |

National documents

| | RO spatial | WHH water | SVV transp. | NMP environ. | ? |
|-------|---------------|--------------|----------------|-----------------|---|
| → '60 | 1 | | | | |
| → '70 | 2 | 1 | | | |
| → '80 | 3 | 2 | 1 | | |
| → '90 | 4 | 3 | 2 | 1 | |
| → '00 | 5 | 4 | 3 | 2 | 1 |
| ↓ | | | | | |

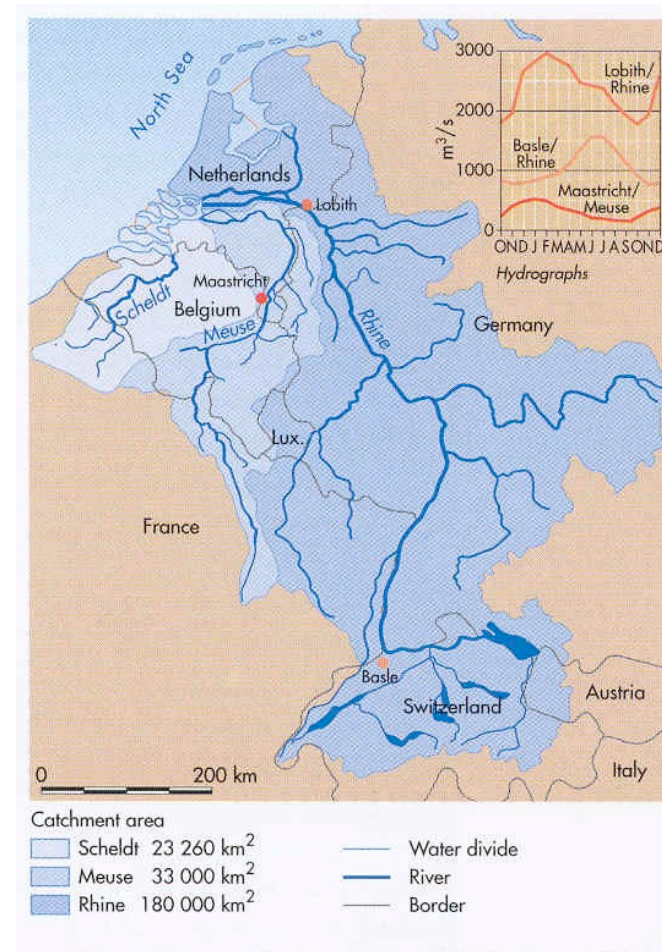
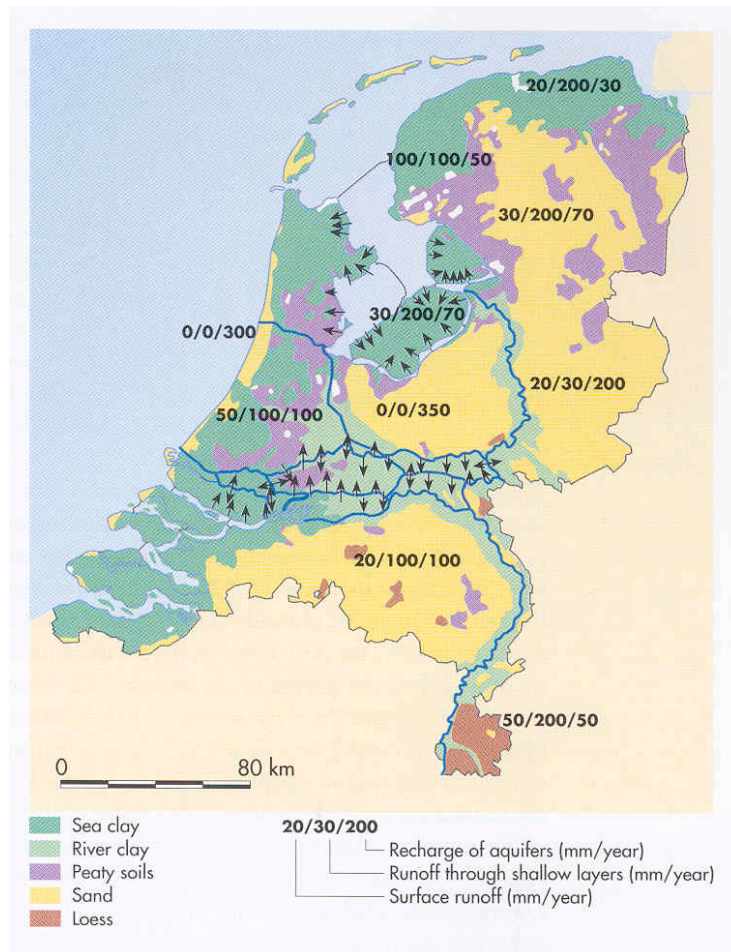
| | |
|--------------|----------|
| REVISION | 10 YEAR |
| PLAN HORIZON | 25 YEAR |
| IMPACT | 250 YEAR |

Precipitation minus evaporation in The Netherlands

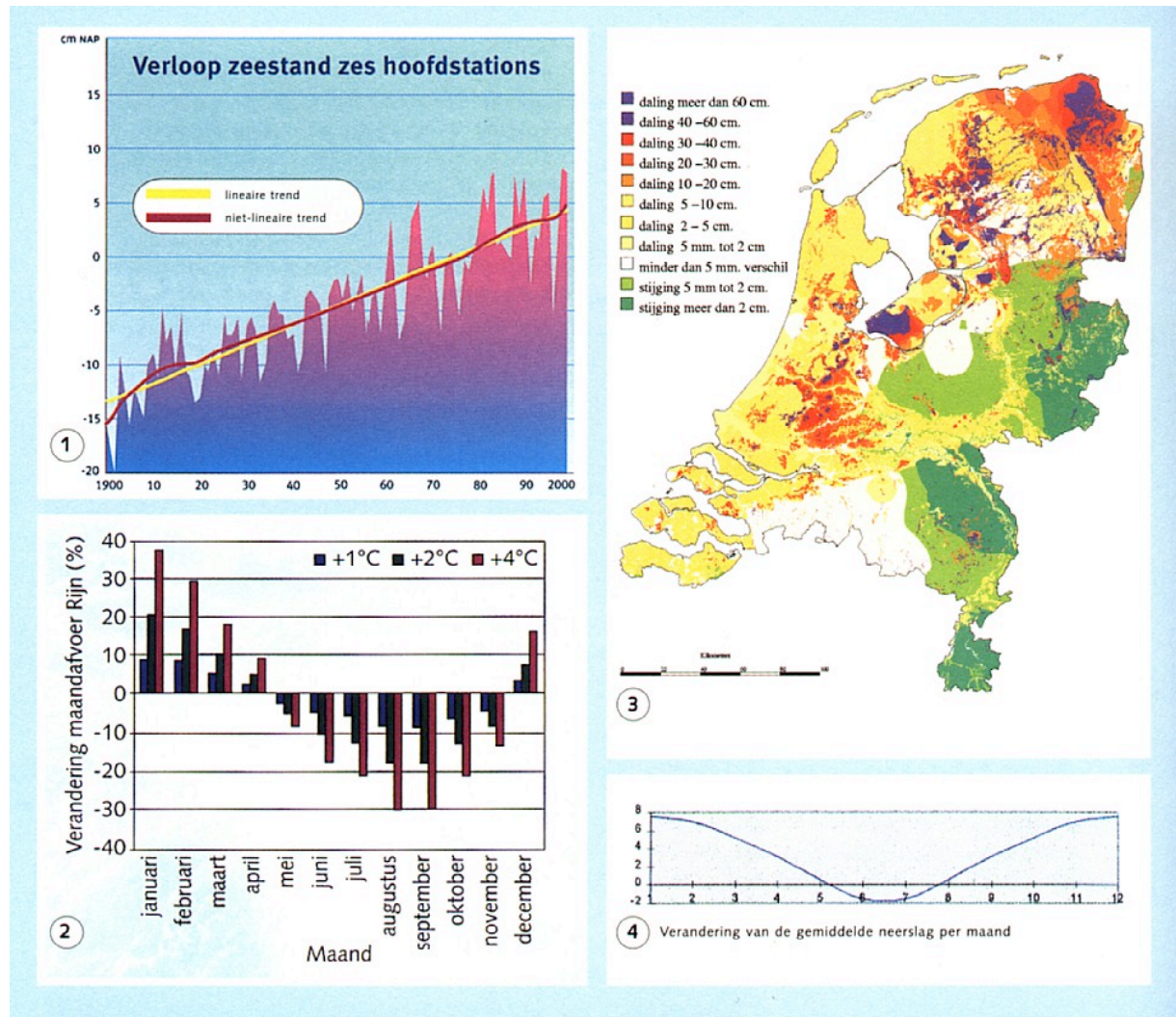


Bron: KNMI, Klimatologische Dienstverlening
© WN Atlas Productions

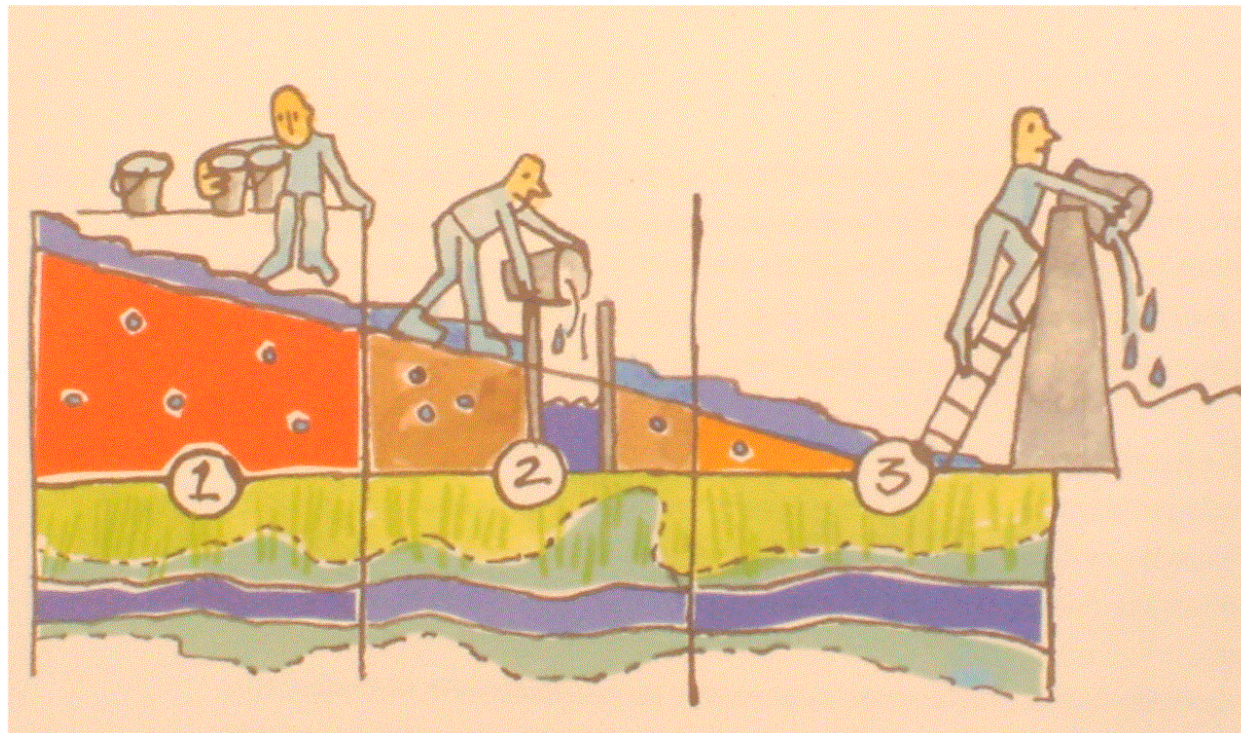
Soil types and average annual runoff



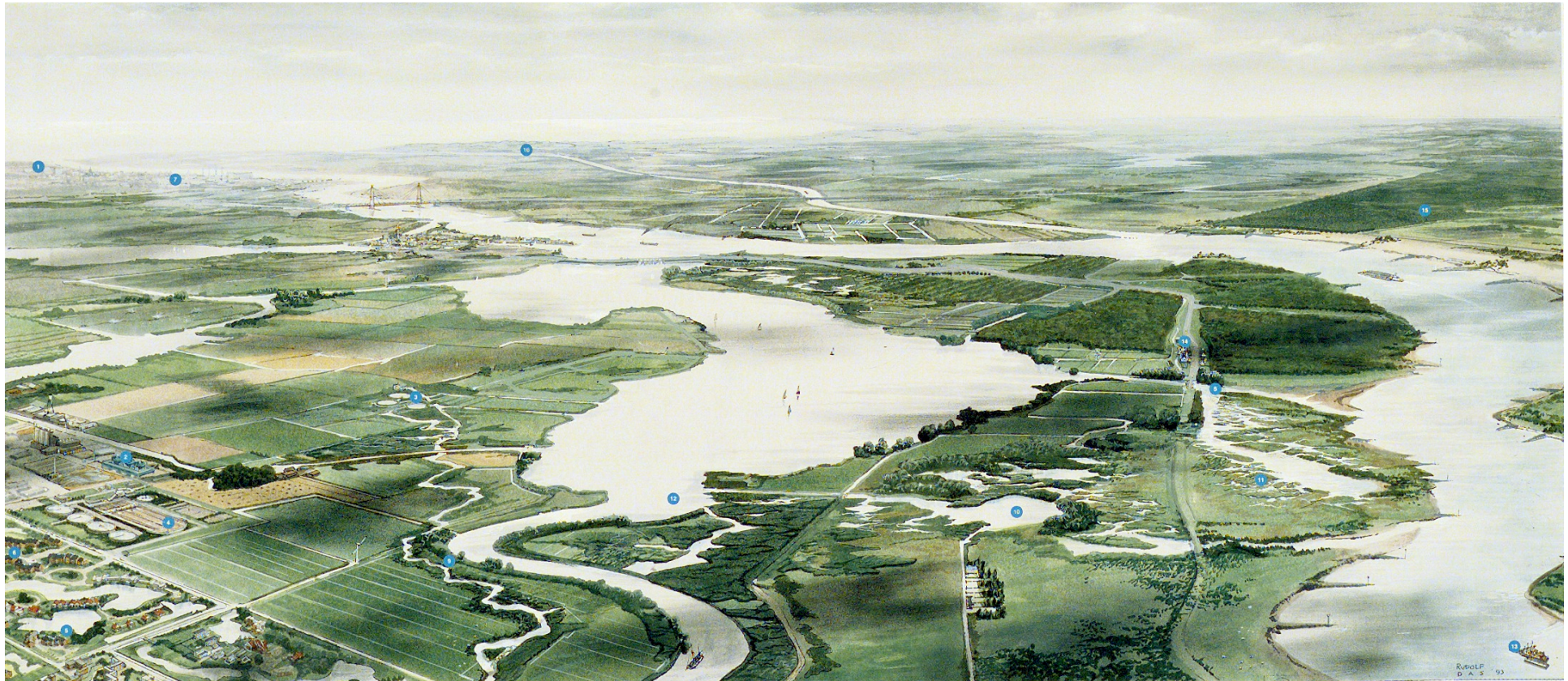
Water management and hygiene



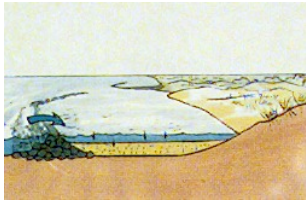
Strategies: store, drain, discharge



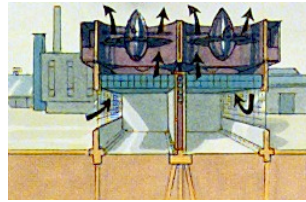
Lowlands with spots of recognisable water management



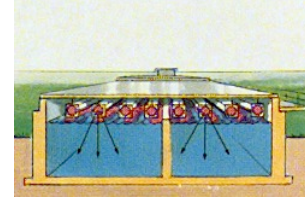
Water management tasks in lowlands



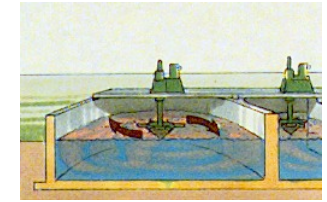
01 Water structuring



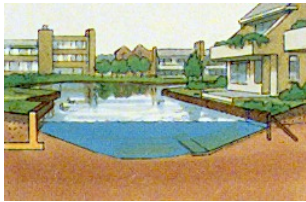
02 Saving water



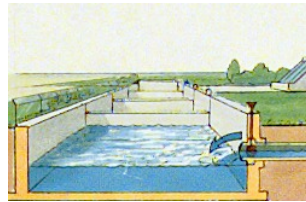
03 Water supply and purification



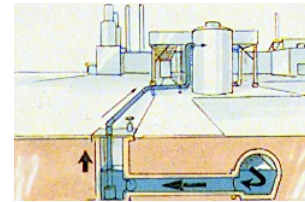
04 Waste water management



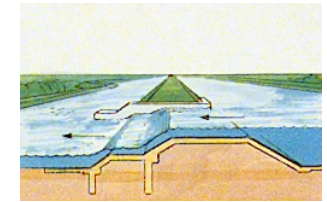
05 Urban hydrology



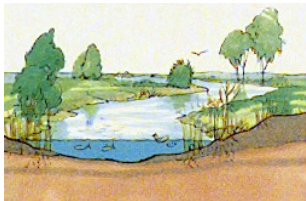
06 Sewerage



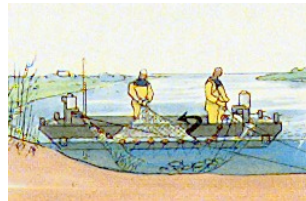
07 Re-use of water



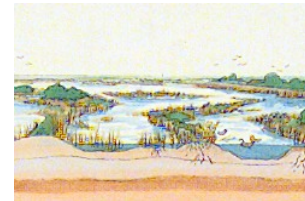
08 High tide management



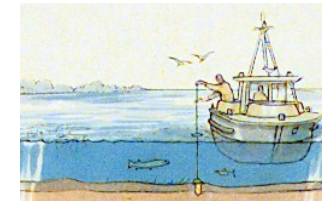
09 Water management



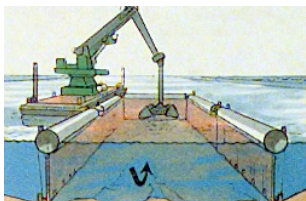
10 Biological management



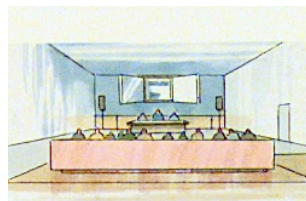
11 Wetlands



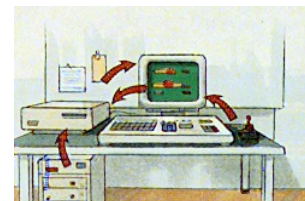
12 Water quality management



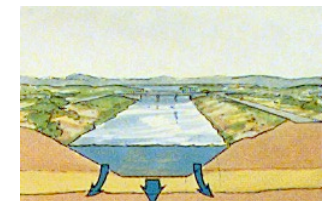
13 Bottom clearance



14 Law and organisation



15 Groundwater management

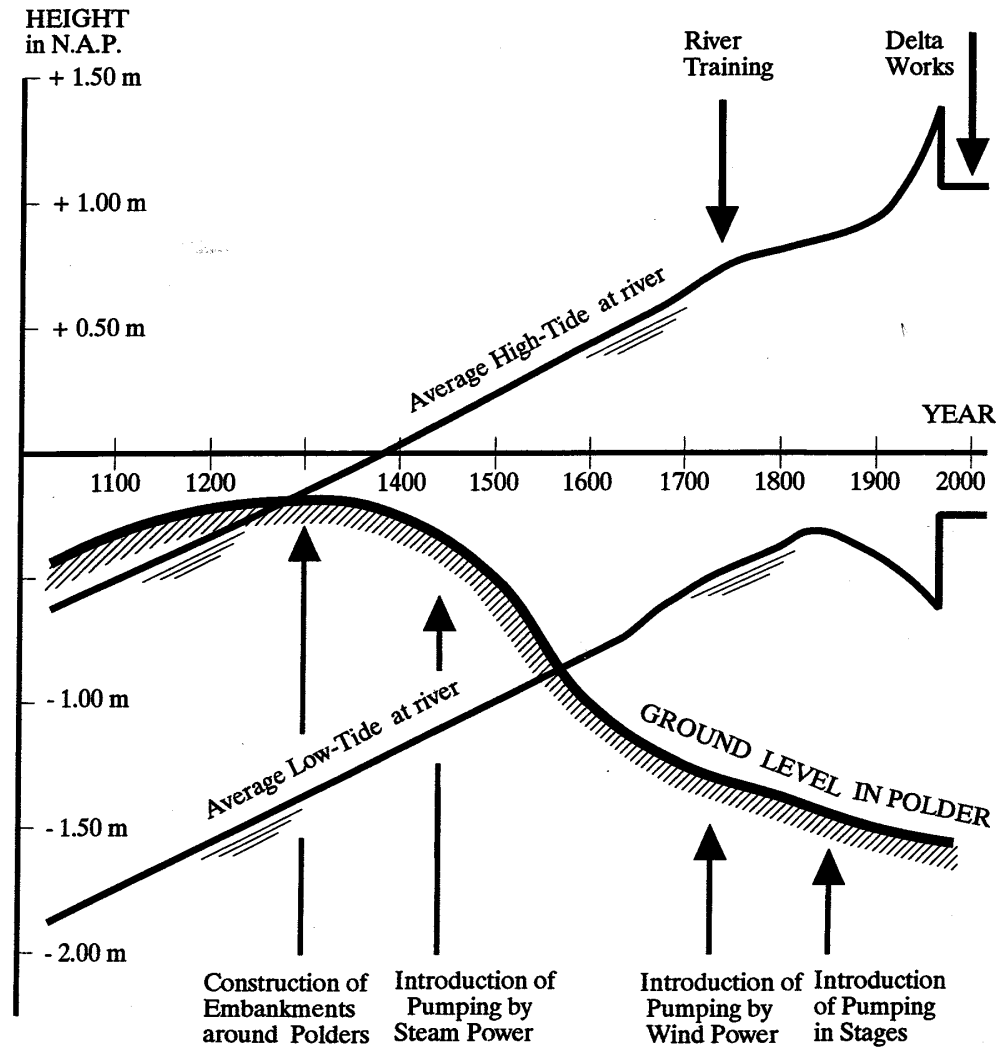


16 Natural purification

Levels in lowland



Rising water and dropping ground



Need of drainage and flood control

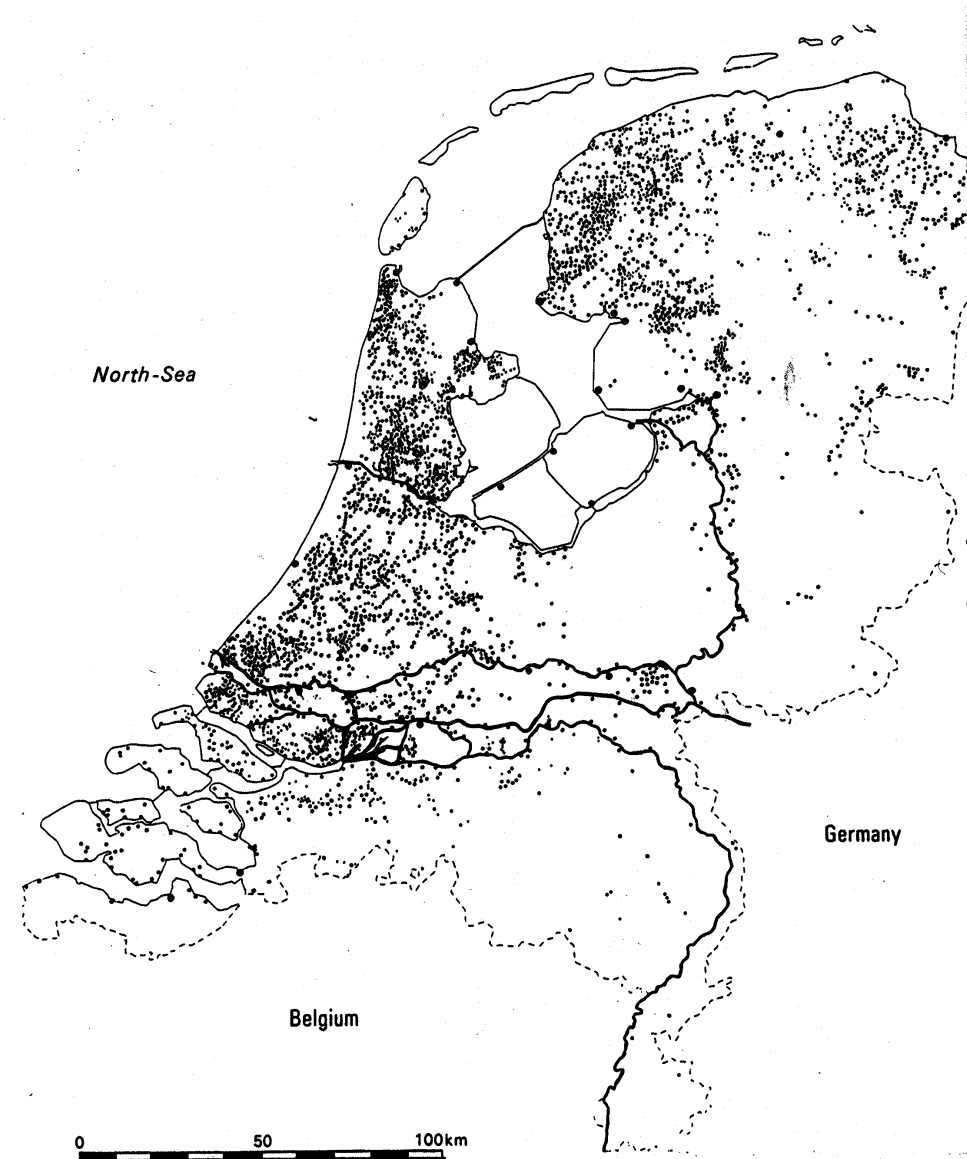


Flooding of a canal in Delft

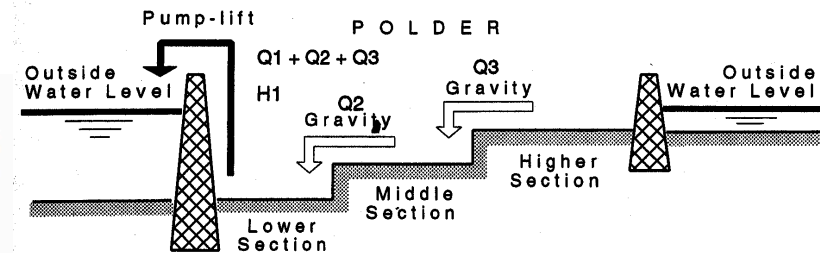
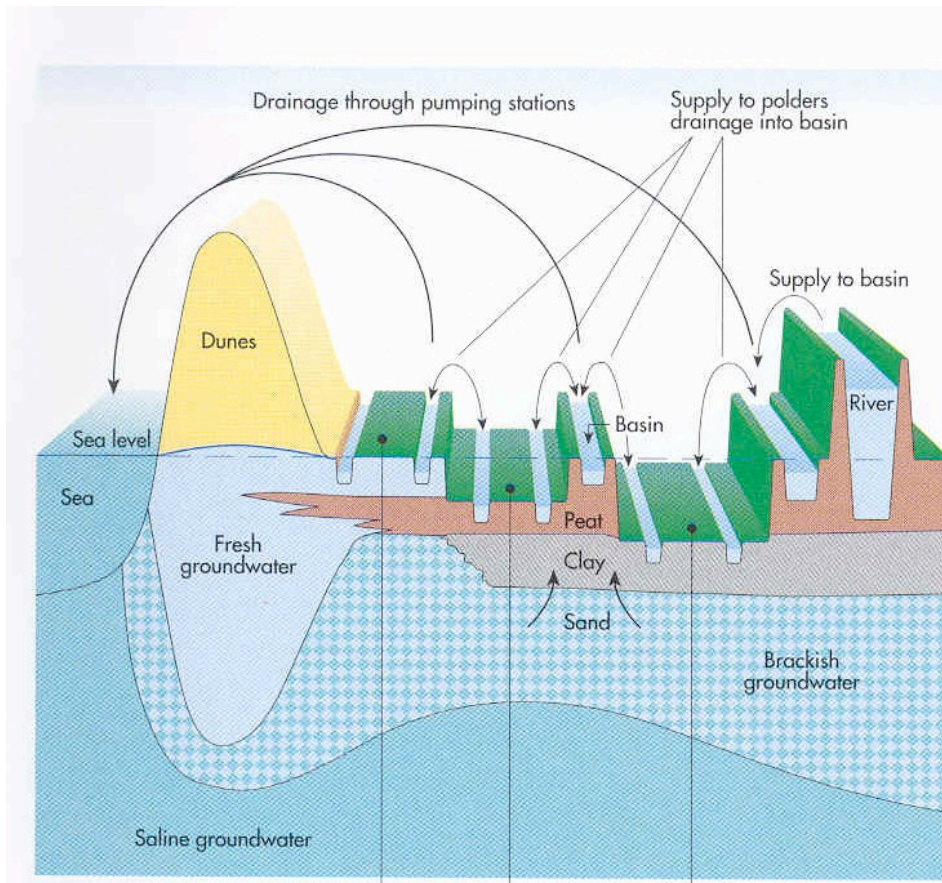


Deep canal in Utrecht

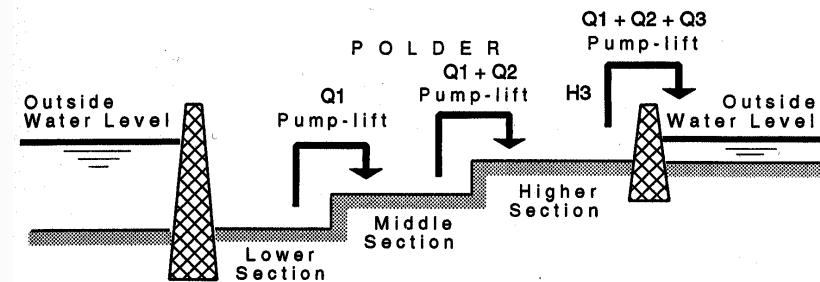
Pumping stations in The Netherlands



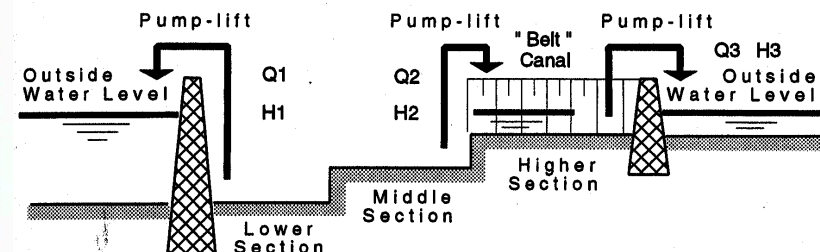
Drainage by one to three pumping stations



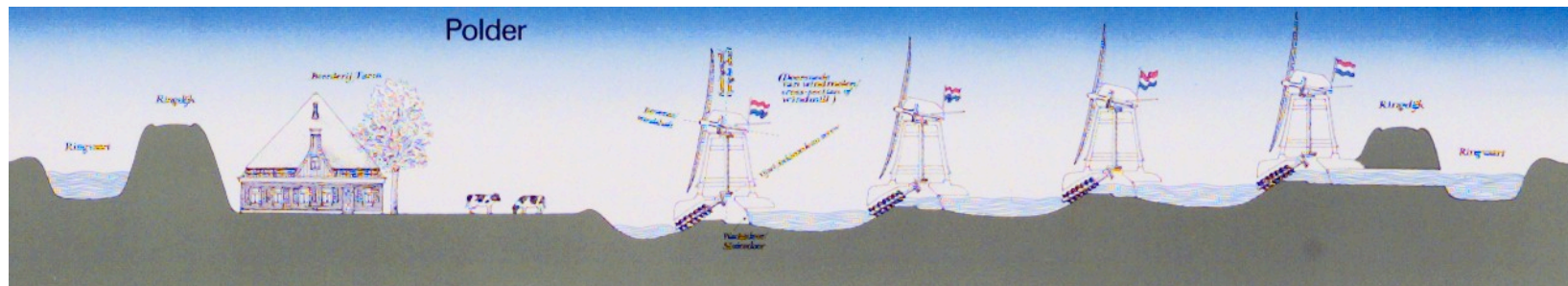
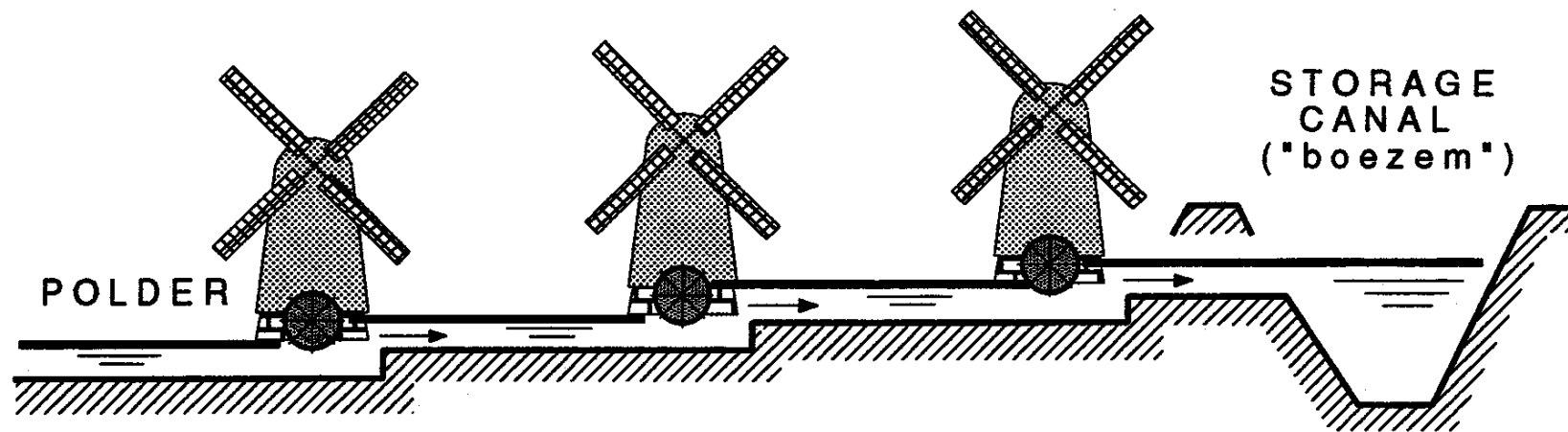
Alternative I: One pumping station (maximum energy requirements).



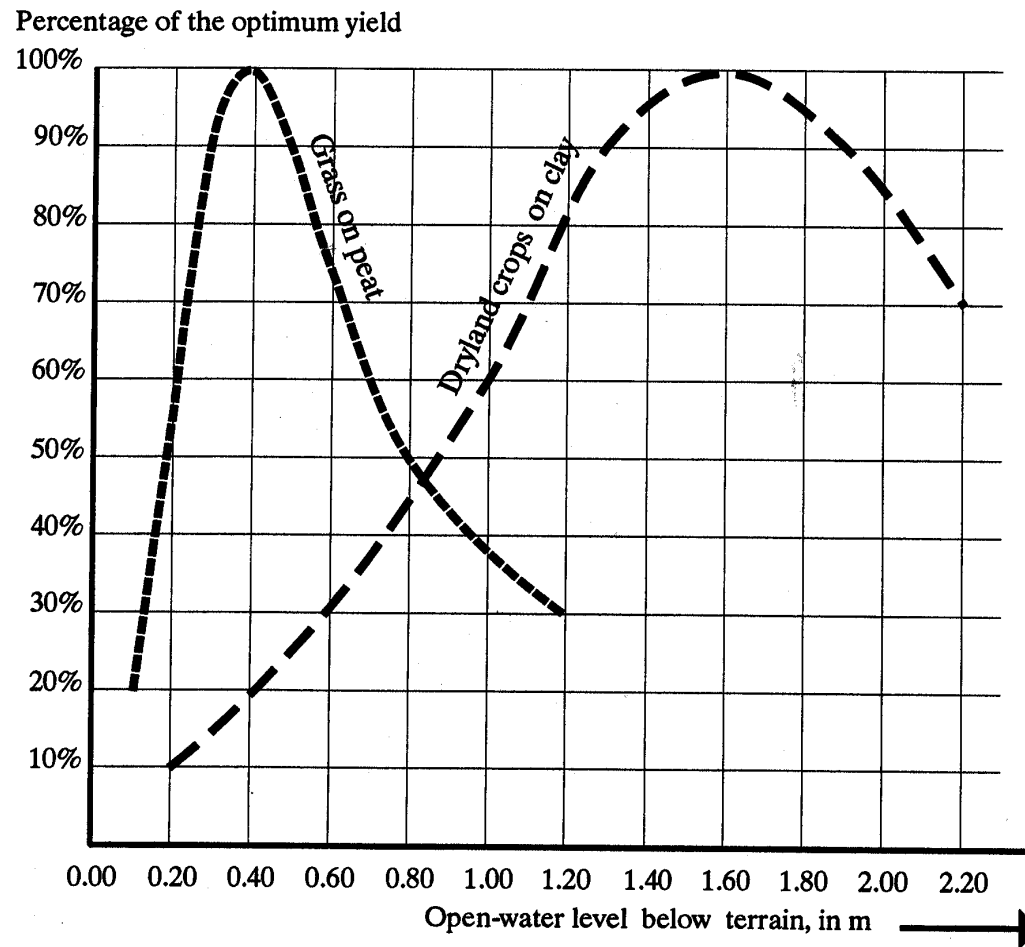
Alternative II: Three pumping stations (minimum energy requirements).



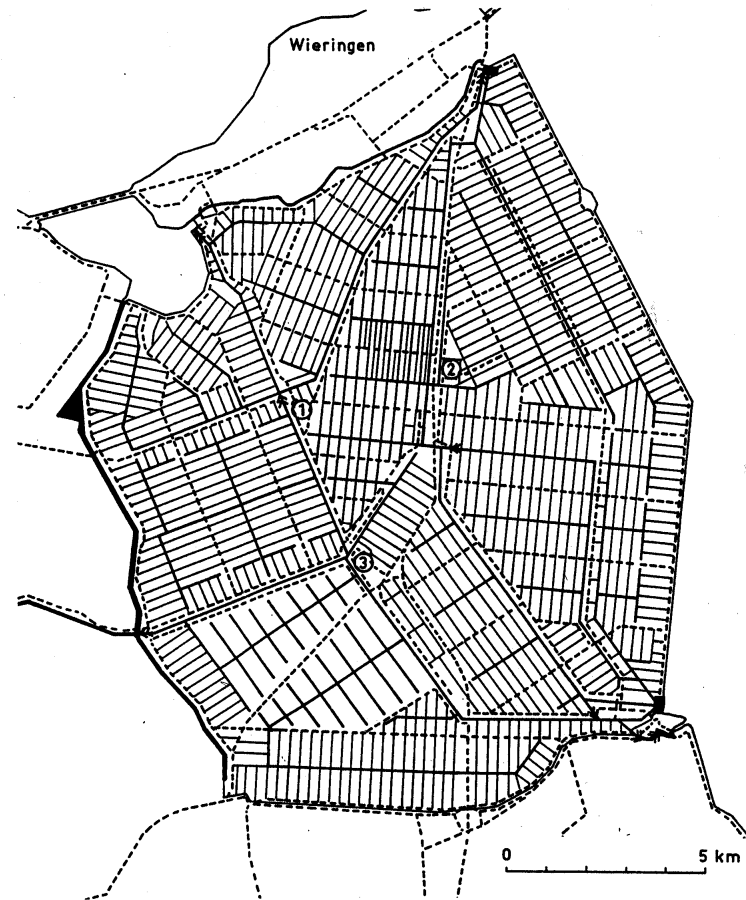
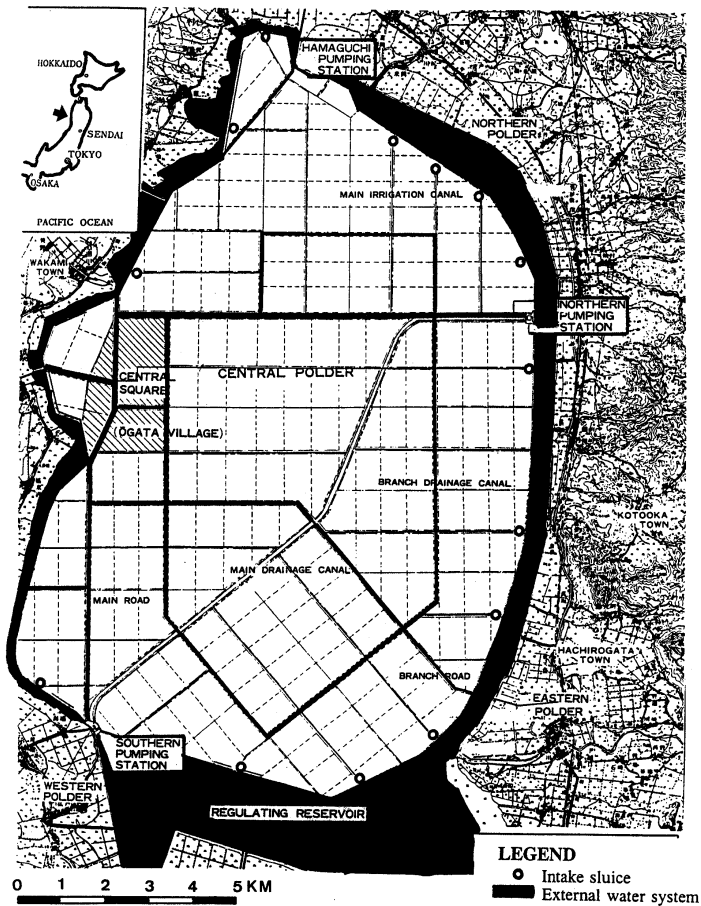
A 'row of windmills' ('molengang')



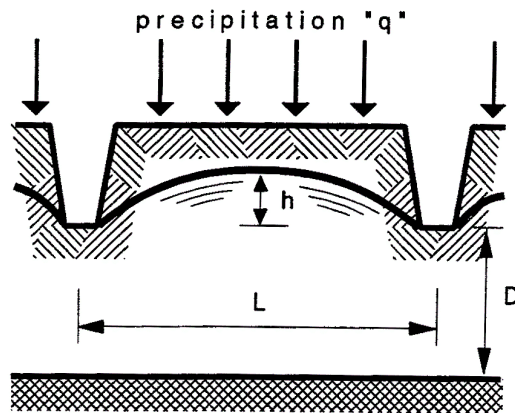
Wet and dry functions



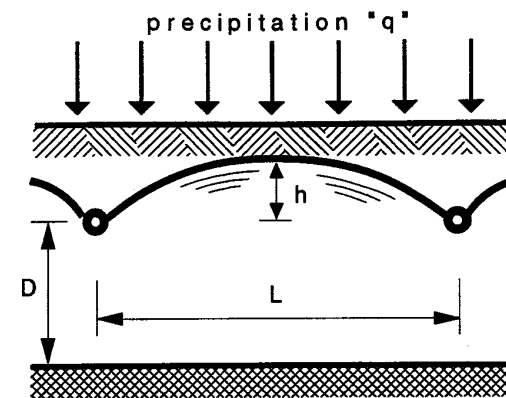
Polders



Distance between trenches



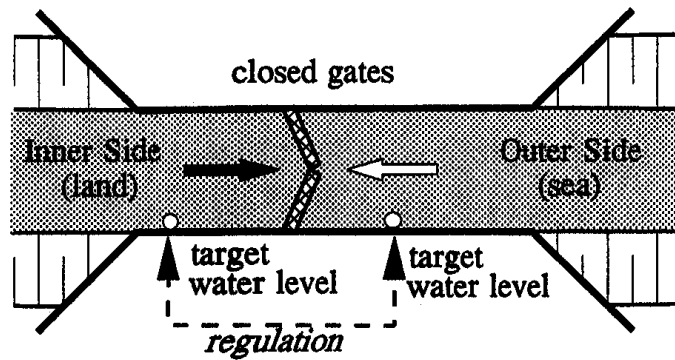
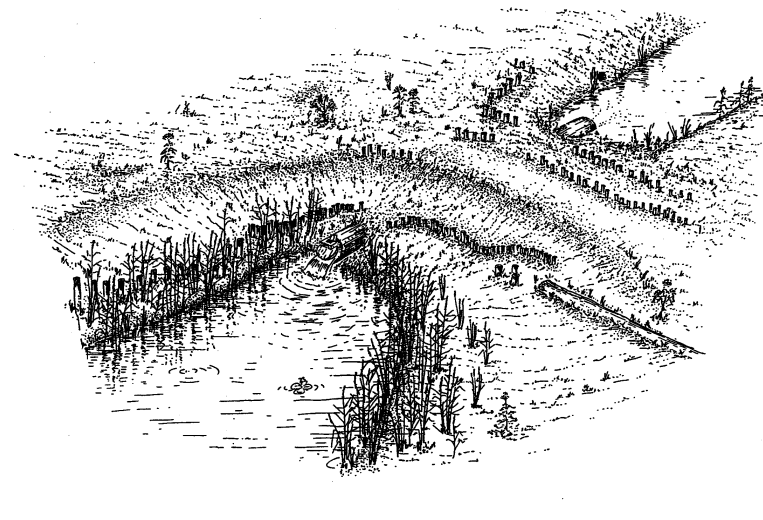
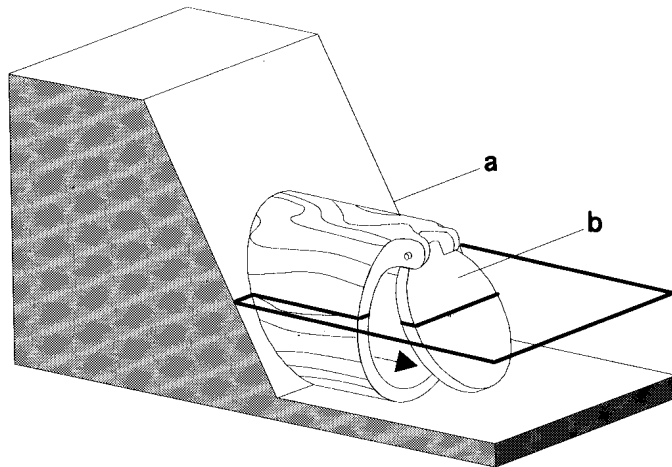
Hooghoudt Formula for Trenches



Hooghoudt Formula for Drains

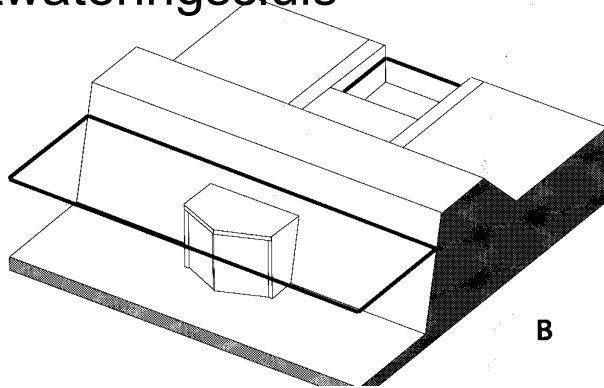
The necessary distance L between smallest ditches or drain pipes is determined by precipitation q [m/24h], the maximally accepted height h [m] of ground water above drainage basis between drains and by soil characteristics. Soil is characterised by its permeability k [m/24h]. A simple formula is $L=2\sqrt{(2Kh/q)}$.

One way sluice

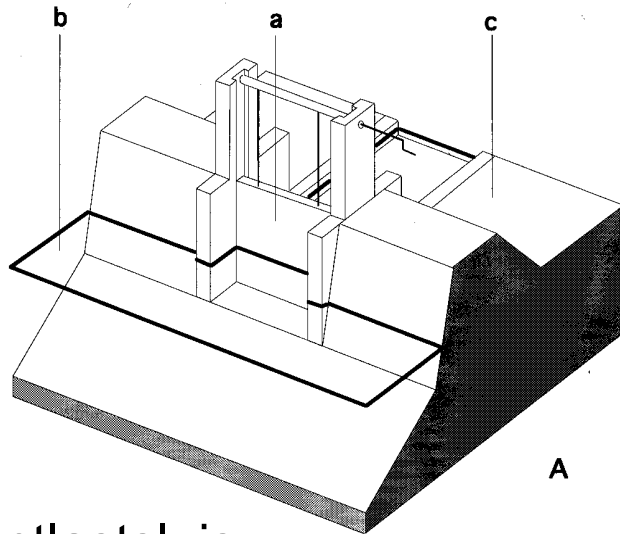
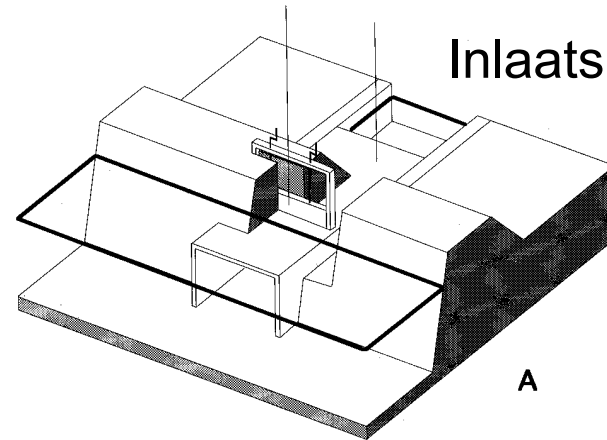


Closed sluices

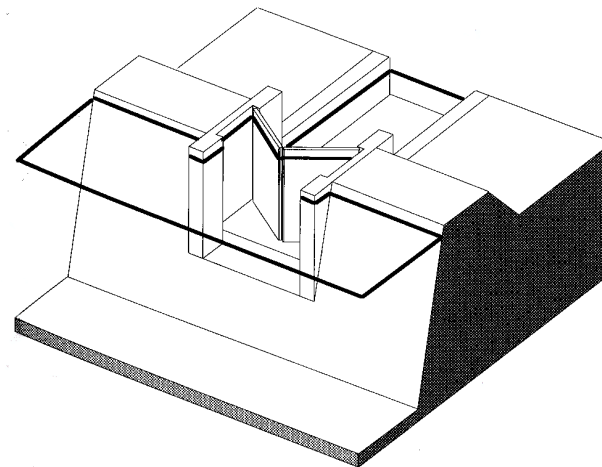
Uitwateringssluis



Inlaatsluis

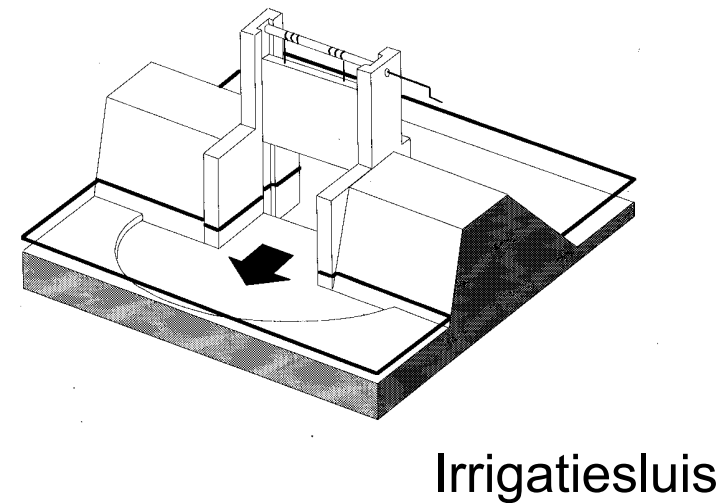
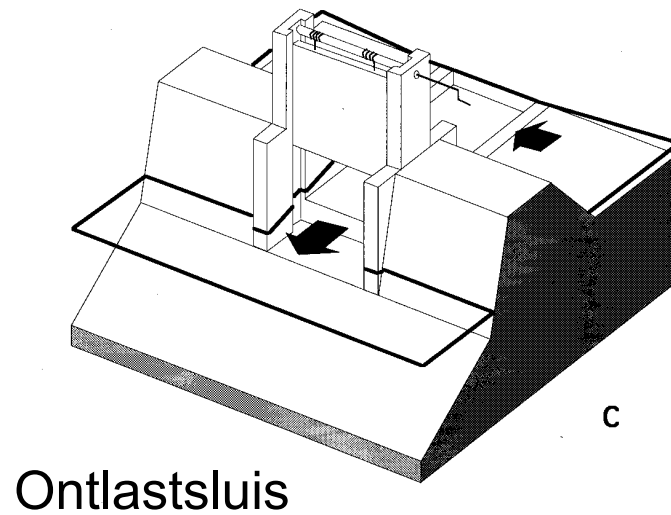
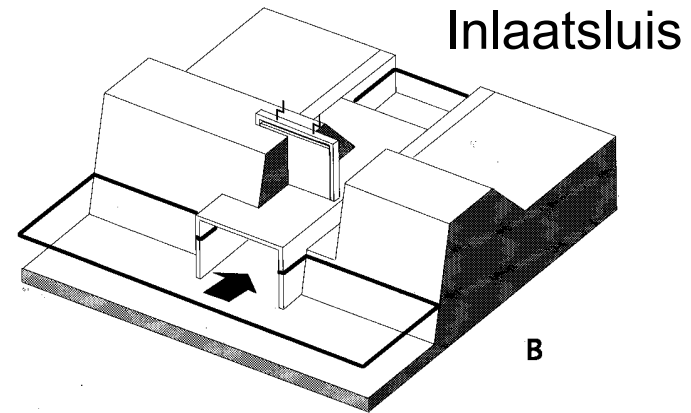
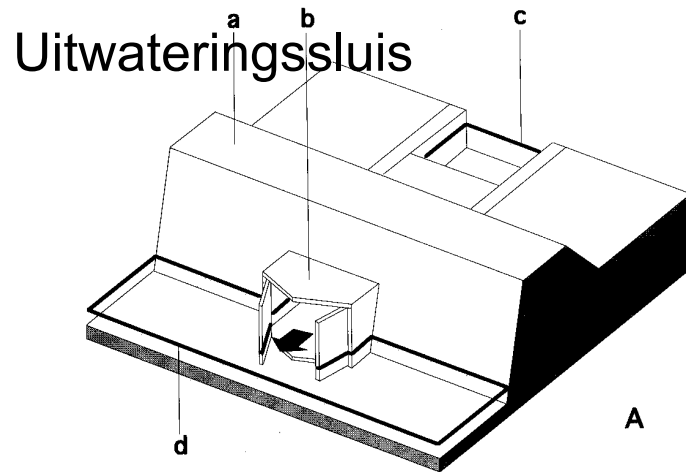


Ontlastsluis

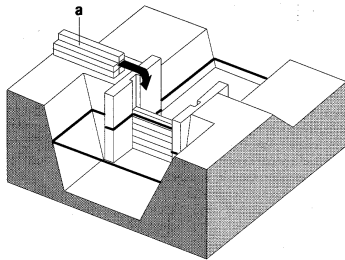


Keersluis

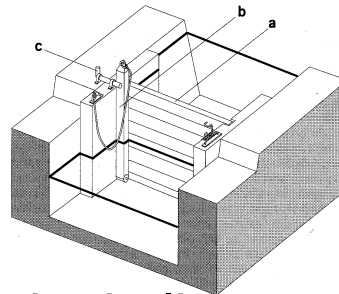
Open sluices



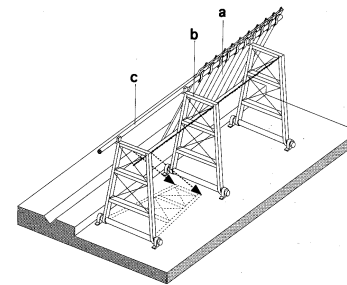
Weirs



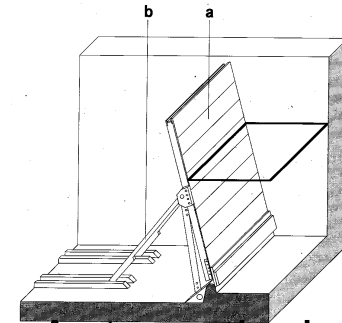
Schotbalkstuw



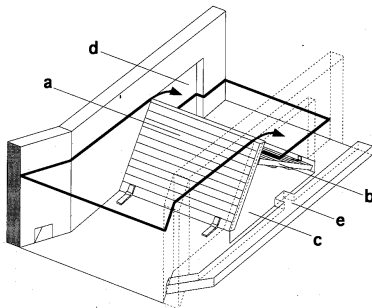
Schotbalkstuw
met wegklapbare
aanslagstijl



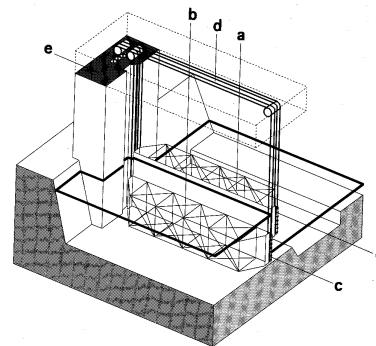
Naaldstuw



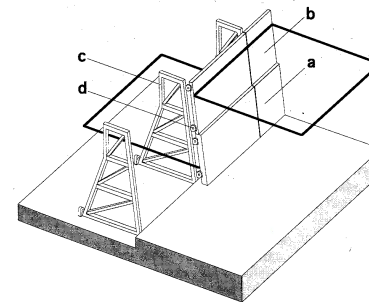
Automatische
klepstuw



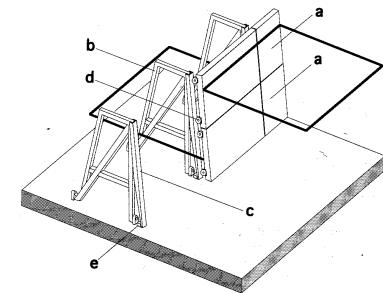
Dakstuw



Dubbele
Stoneyschuif

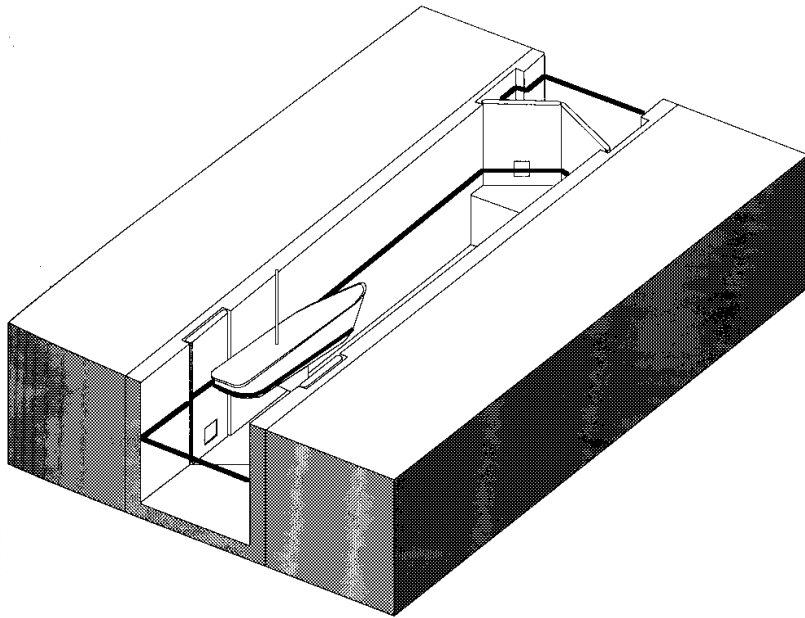


Wielschuif
rechtstreeks
ondersteund
door jukken

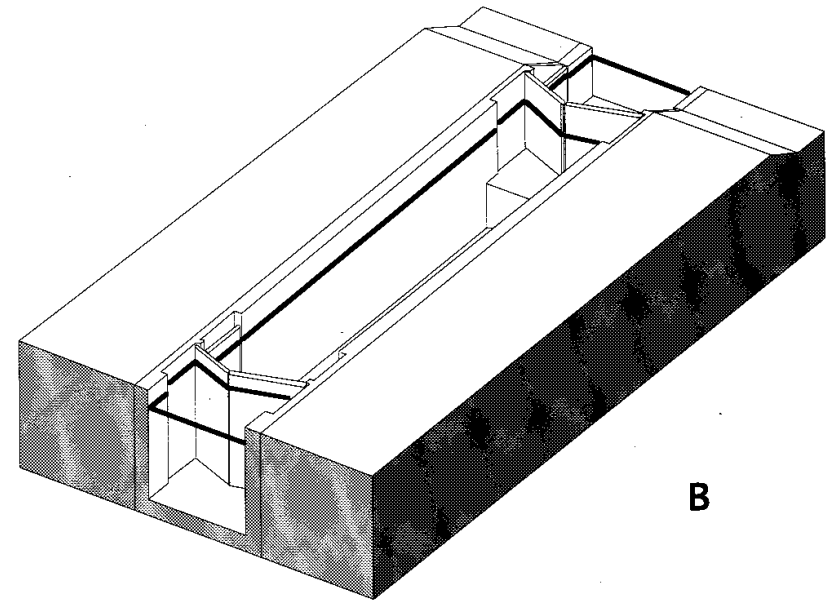


Wielschuif via
losse stijlen
ondersteund
door jukken

Locks

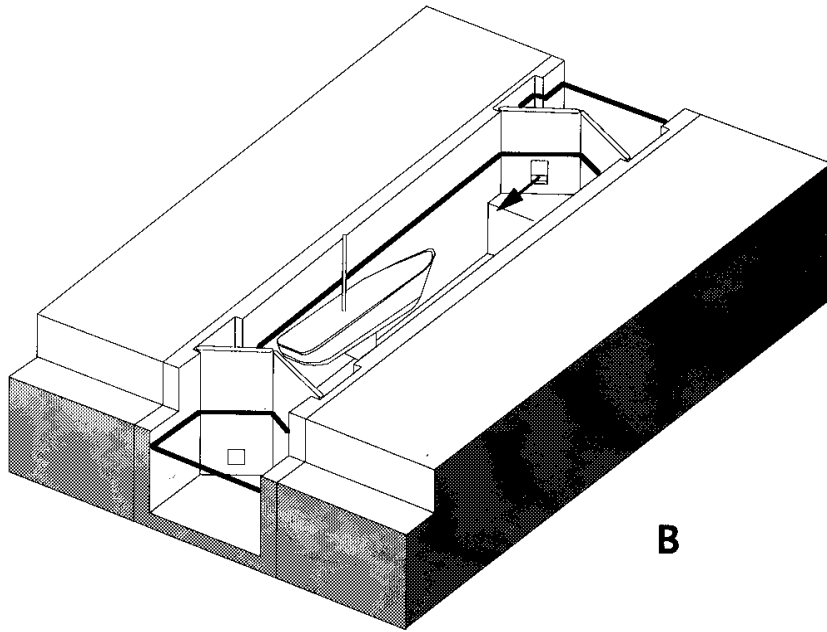


Schutsluis

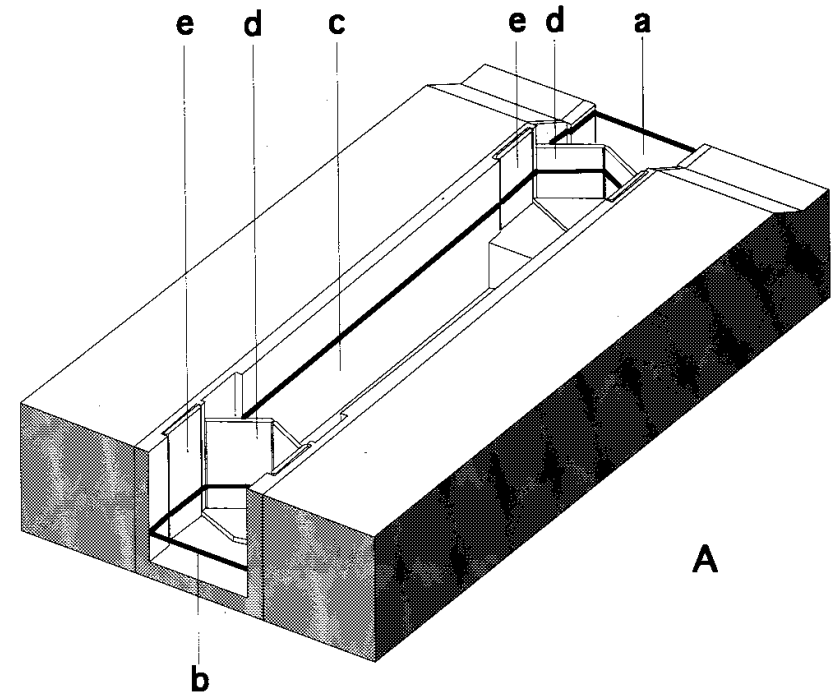


Dubbelkerende schutsluis

Locks

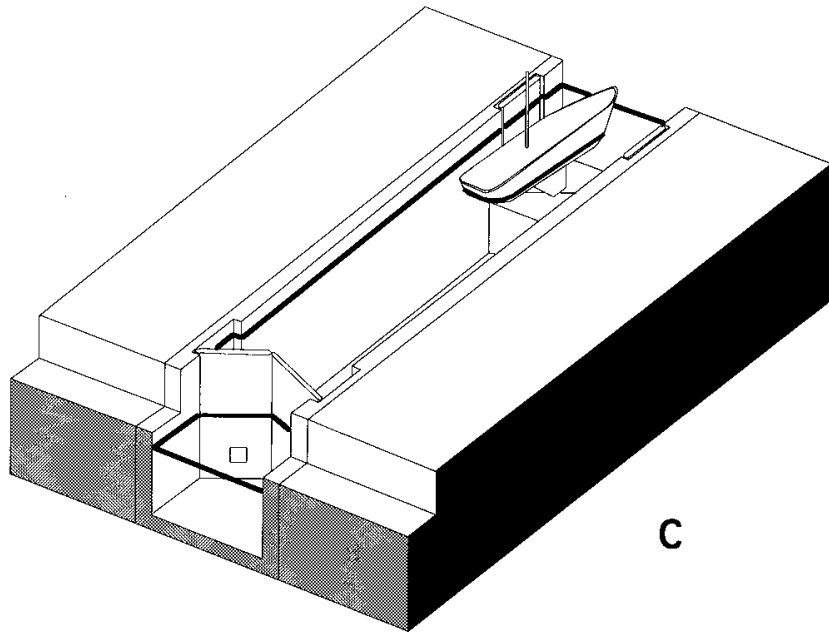


Schutsluis

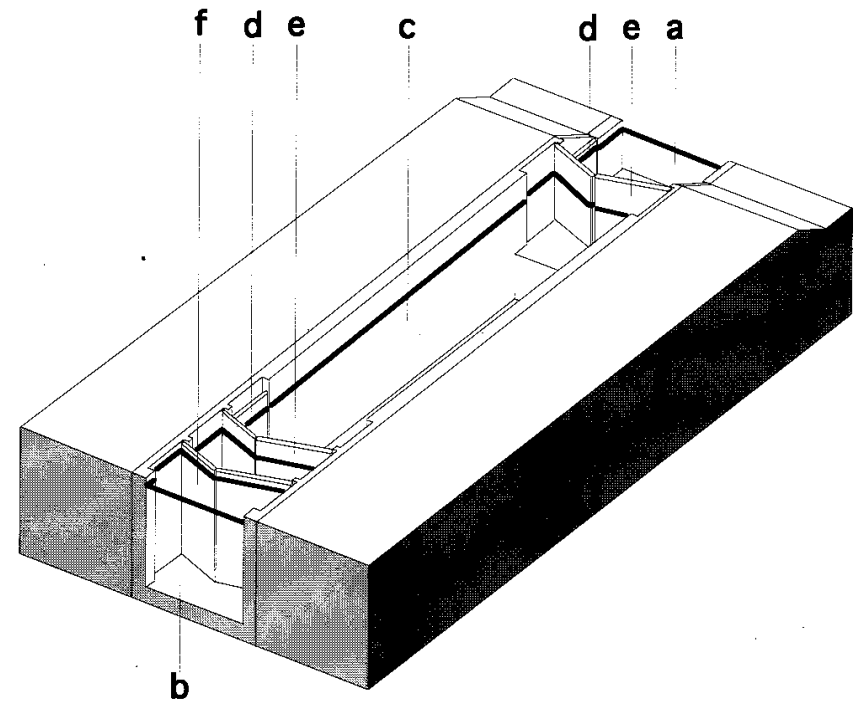


Dubbelkerende schutsluis

Locks



Schutsluis



Dubbelkerende schutsluis

Water management map Amsterdam



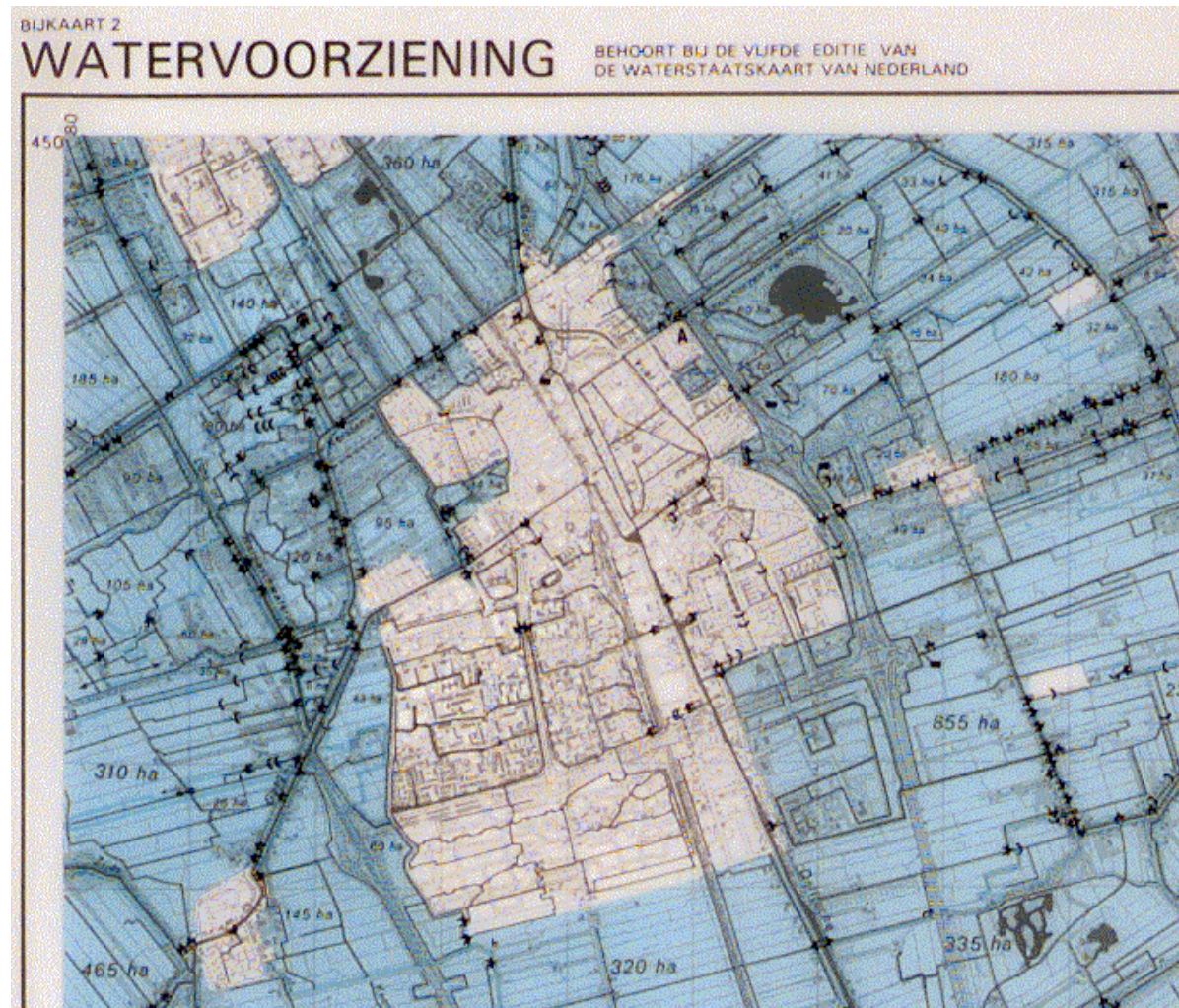
Water management map Delft



Overlay of observation points



Overlay of water supply

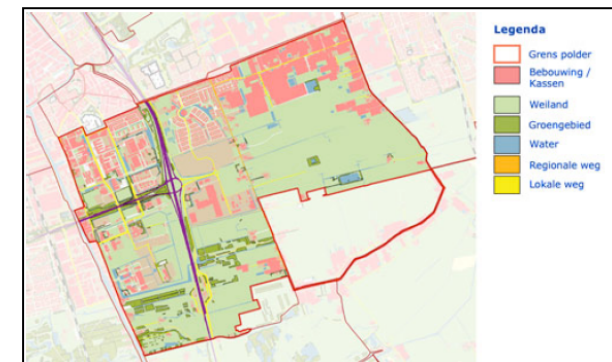
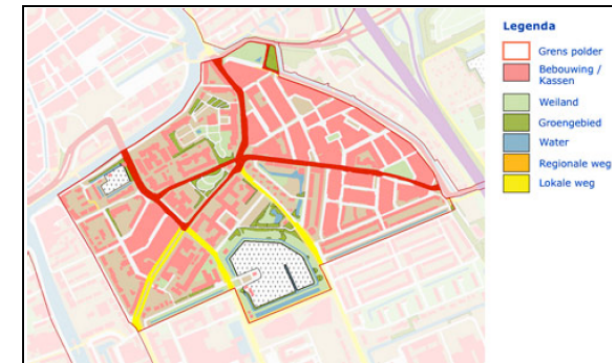
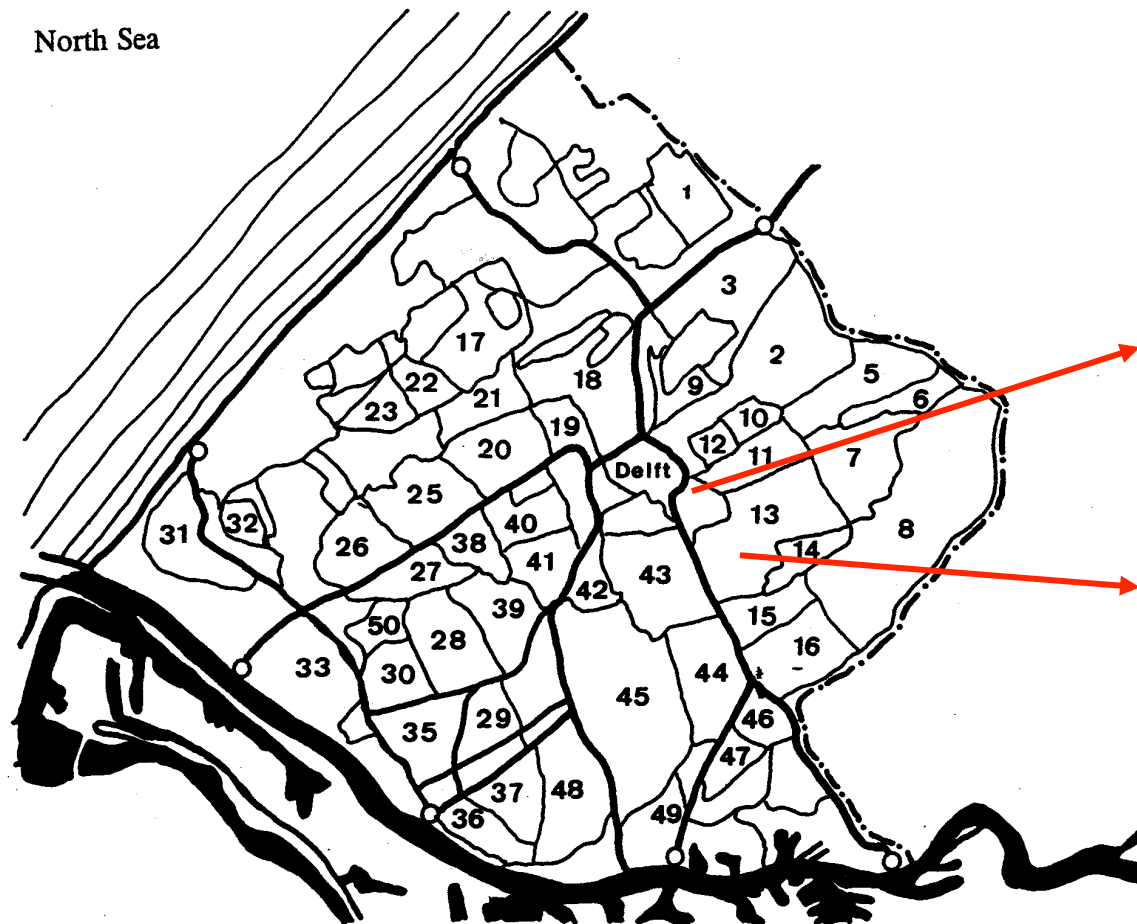


Water boards

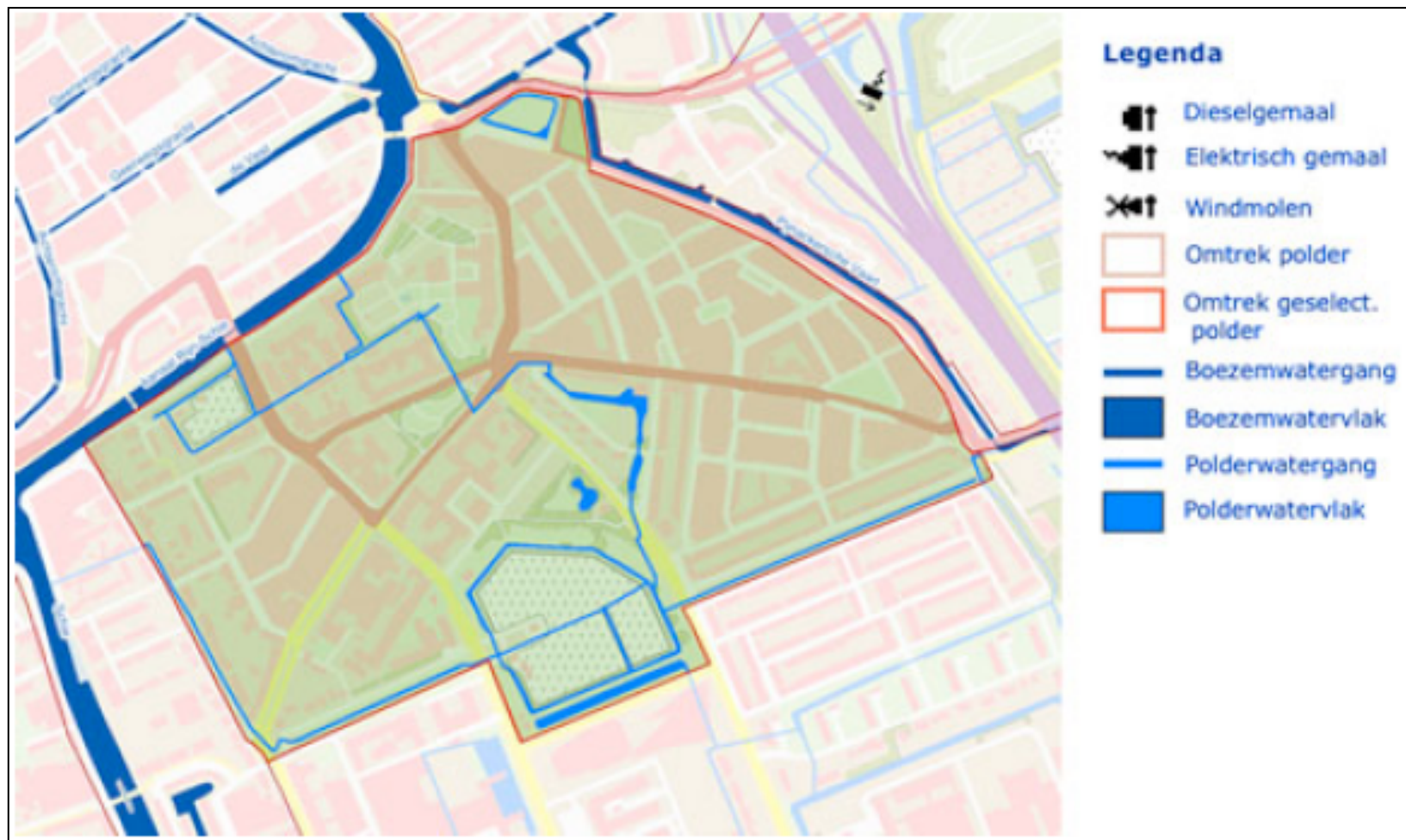


http://www.uvw.nl/pagina_6390.html

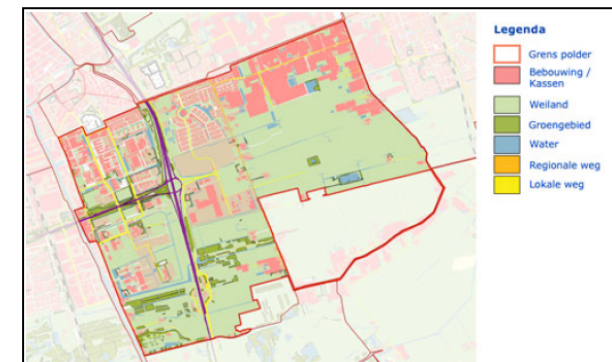
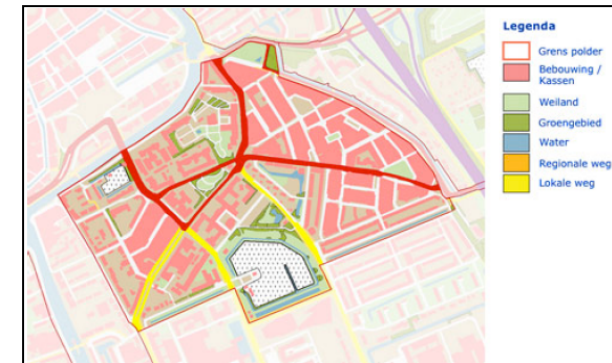
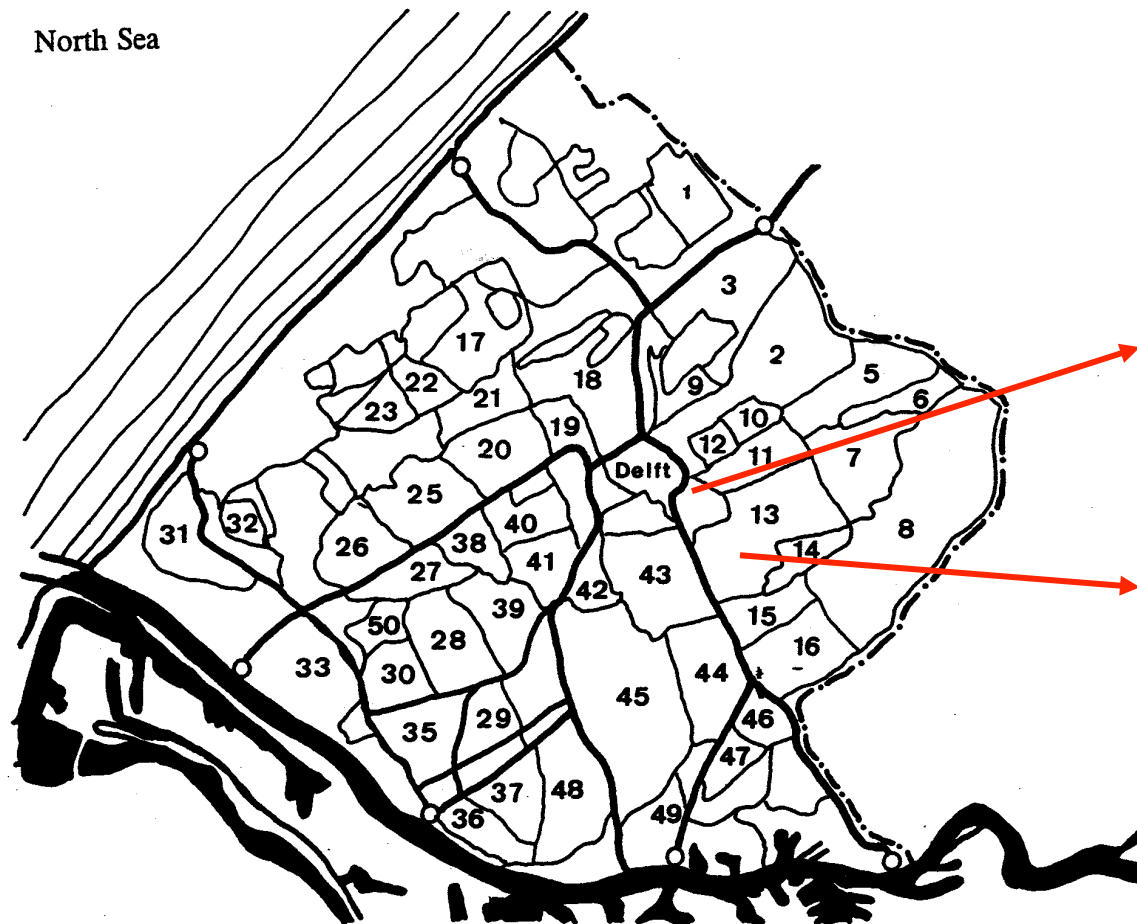
The belt ('boezem') system of Delfland



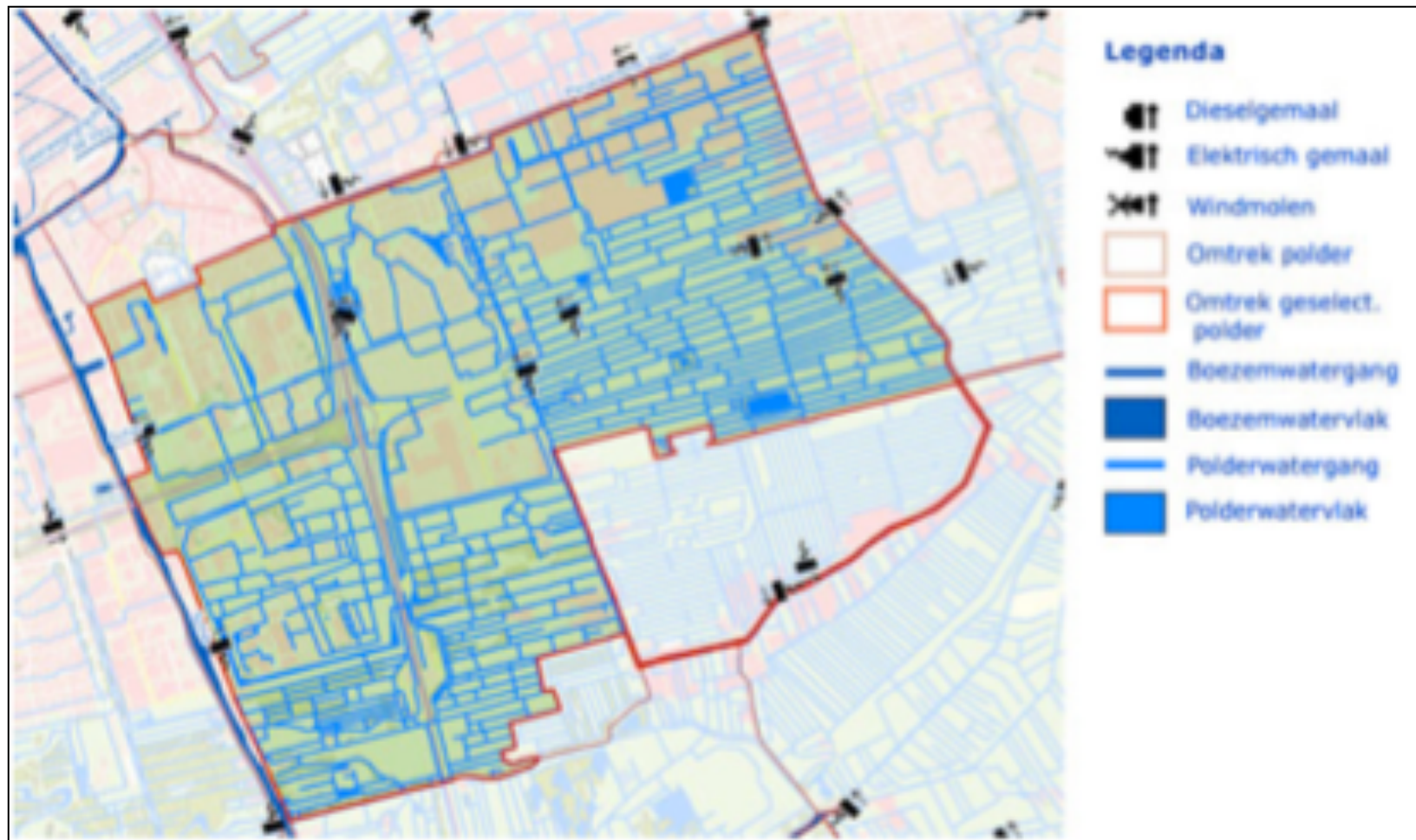
Wippolder



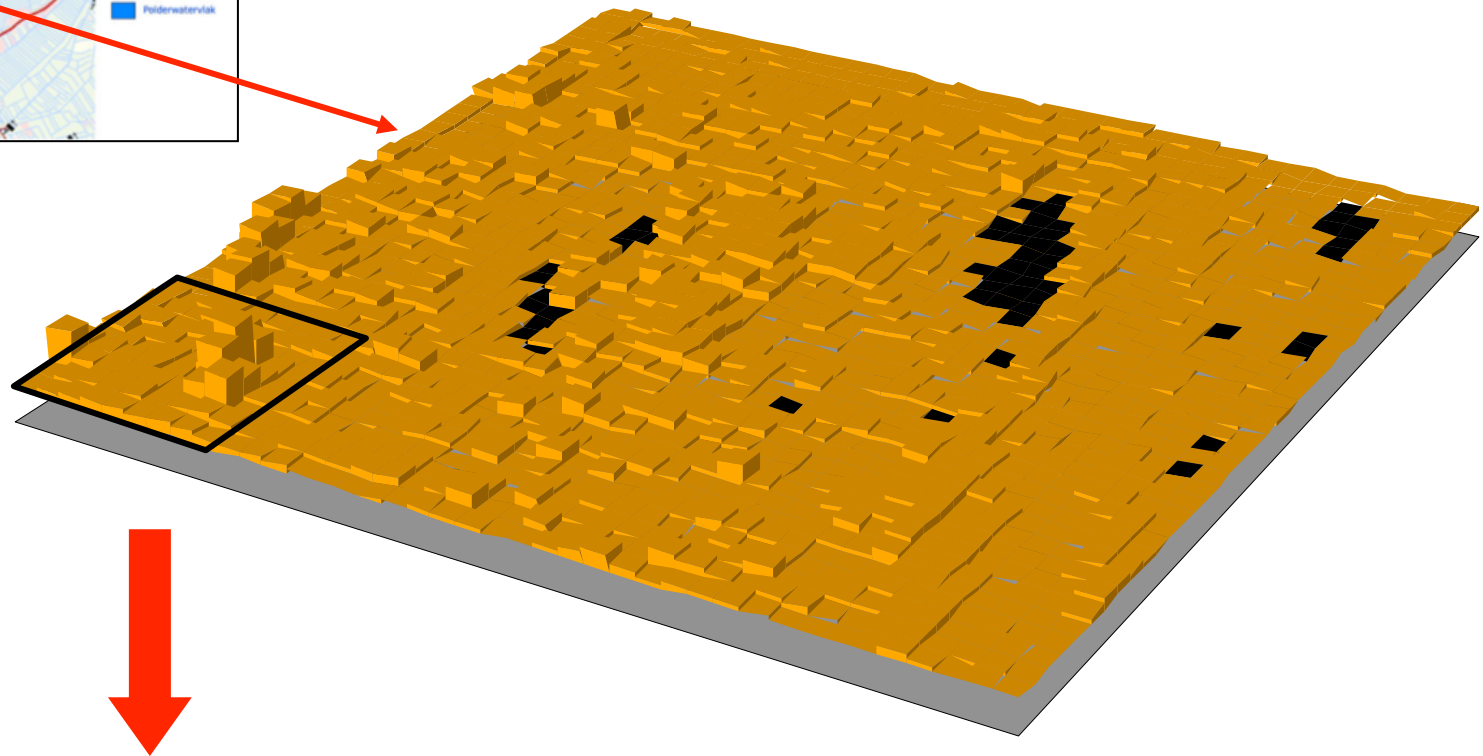
The belt ('boezem') system of Delfland



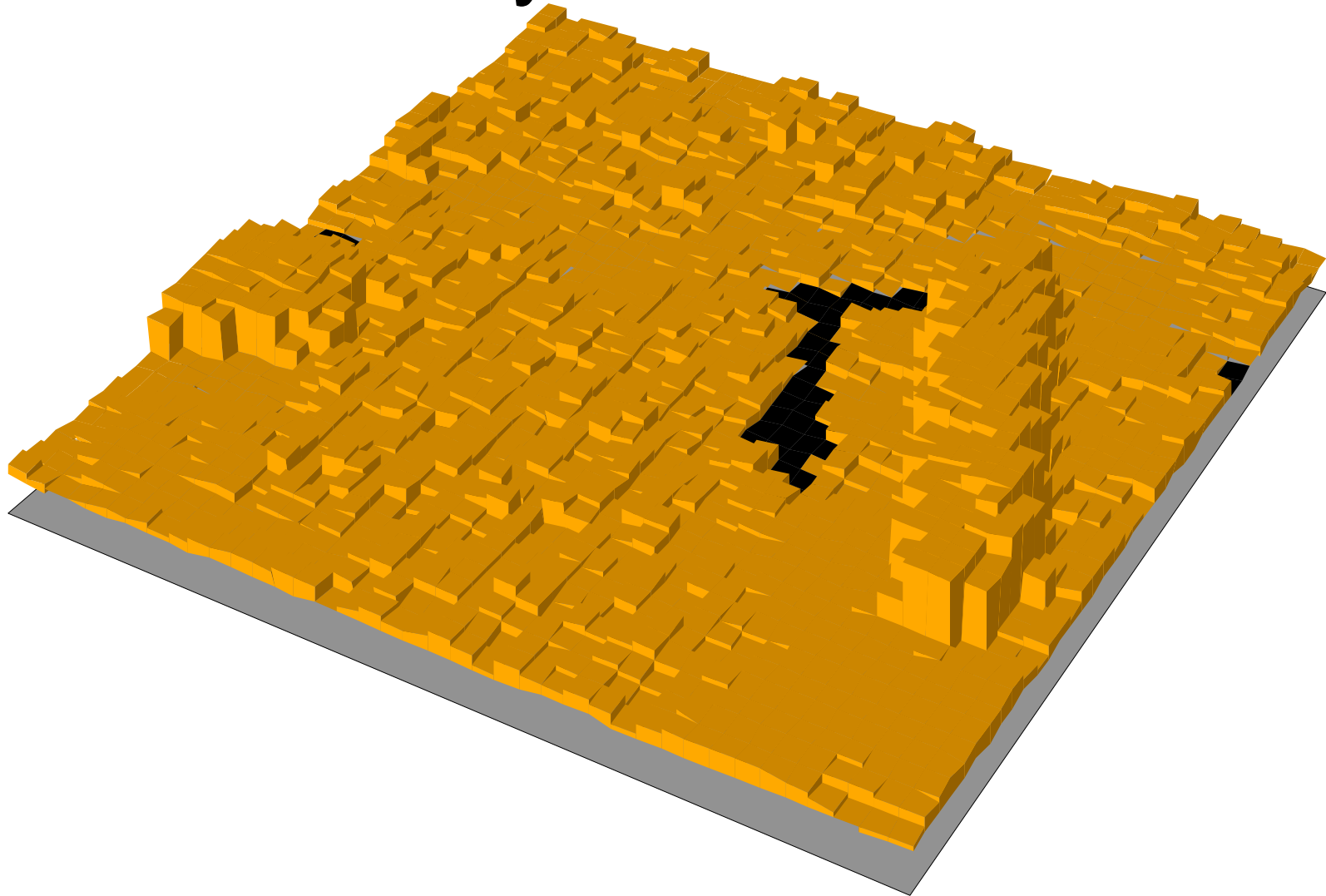
Zuidpolder



Zuidpolder detail grain 25x25



Former Faculty of Architecture 5x5m



Delfland water storage claims



<http://www.hhdelfland.nl/>

The Waterboard Delfland claims volumes of water per specific surface according to

| | m ³ /ha |
|---|--------------------|
| paved surface (housing, employment, greenhouse areas) | 325 |
| unpaved surface (grassland, nature, leisure) | 170 |
| arable land | 275 |

Rijnland water storage claims

In 2007 the Waterboard Rijnland (around Leiden) suggested keeping 6% of the overall urban area to be water surface.

<http://www.rijnland.net/>

Province water storage claims

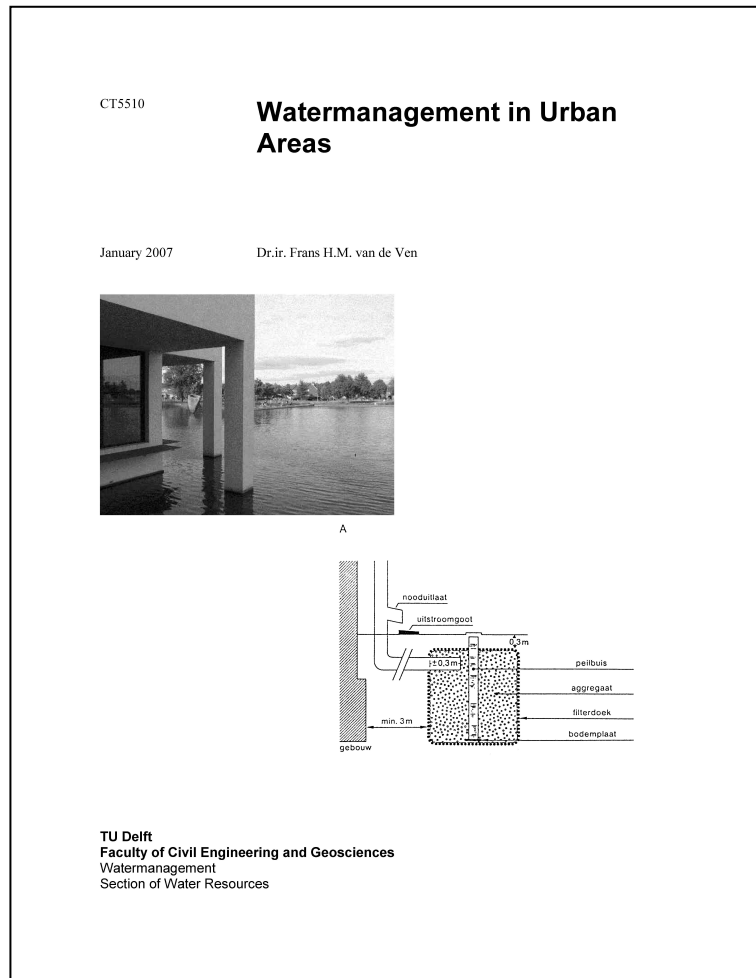
In 2007 the Province of South-Holland published indications of surface claims for water surface in zoning plans:

8,5% times the paved surface and +
1,5% x the unpaved surface.

Water storage claims per location

- However, such global norms can not be made globally.
- They should be determined per water board according to the local context.
- http://www.uvw.nl/pagina_6390.html
- <http://www.helpdeskwater.nl/watertoets>

Urban water management (Ven)



| | | |
|-----------|--|------------|
| 1. | Introduction to Water Management in the Urban Areas | 6 |
| 1.1 | Water in the urban environment | 6 |
| 1.2 | The urban water system | 7 |
| 1.3 | Urban water management as teamwork | 8 |
| 2 | Elements of the urban water system | 10 |
| 3 | Processes in the urban water system | 17 |
| 3.1 | Urban climate | 17 |
| 3.2 | Water balances | 20 |
| 3.3 | Precipitation | 23 |
| 3.4 | Evapotranspiration | 39 |
| 3.5 | Groundwater drainage | 46 |
| 3.6 | Subsidence of the ground | 58 |
| 3.7 | Stormwater runoff | 65 |
| 3.8 | Hydraulic processes in surface water | 79 |
| 3.9 | Water quality processes | 85 |
| 3.10 | Exchange with the surrounding | 116 |
| 4 | Leading principles, requirements and standards | 119 |
| 4.1 | Sustainability, eco-toxicology and health | 119 |
| 4.2 | Damage, evaluation of risk | 126 |
| 4.3 | The role of water in the urban development | 135 |
| 4.4 | Standards for input, system behaviour or output | 135 |
| 4.5 | Overview of the requirements and standards proceeded from the earlier mentioned points | 136 |
| 4.6 | Design load of the water system | 150 |
| 5 | Civil engineering design | 165 |
| 5.1 | Introduction | 165 |
| 5.2 | Soil (fill) | 165 |
| 5.3 | Sewerage | 184 |
| 5.4 | Surface water and banks | 194 |
| 5.5 | Groundwater | 228 |
| 5.6 | Disconnection techniques | 244 |
| 6 | Integrated planning and design | 294 |
| 6.1 | Policy development | 294 |
| 6.2 | Regulations and plans | 302 |
| 6.3 | Water as organizing principle | 304 |