



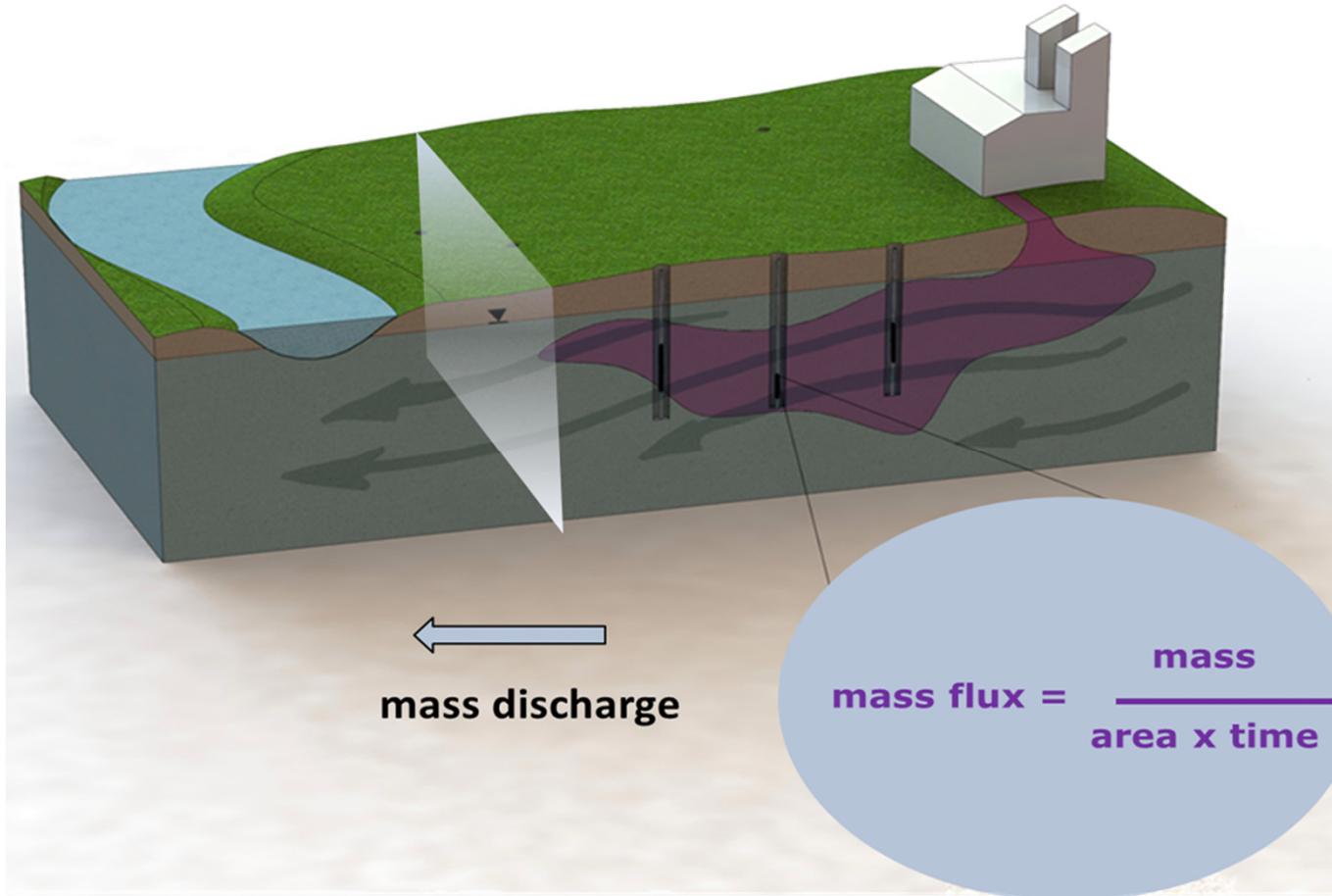
# FLUX metingen voor inzicht in verspreiding van verontreinigingen in dynamisch milieu

15 September 2022





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= Concentration x Darcy velocity  
= C x q

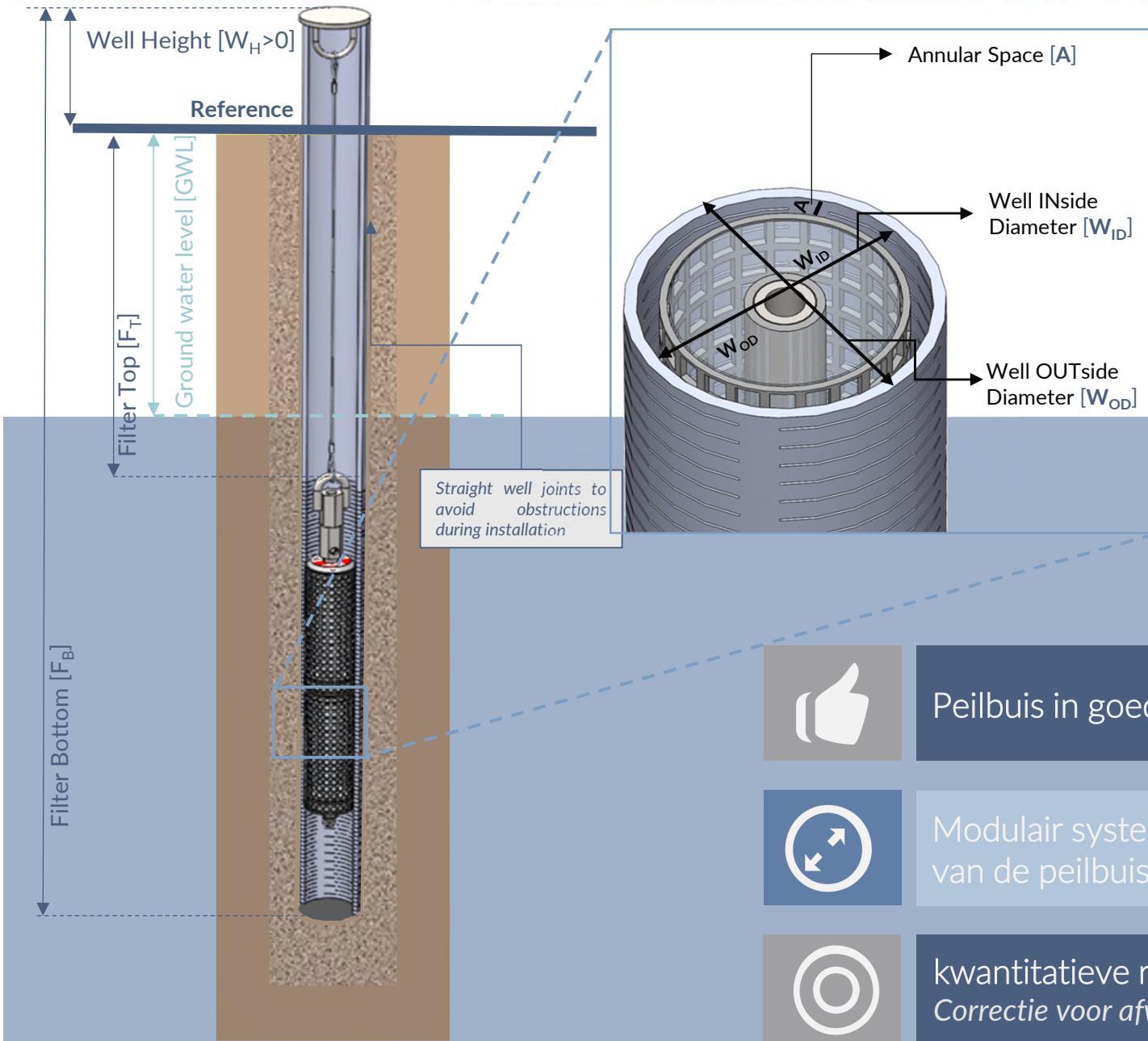
<https://www.itrcweb.org/GuidanceDocuments/MASSFLUX1.pdf>

[https://www.crccare.com/files/dmfile/CRCCARETechReport37\\_Fluxbasedgroundwaterassessmentandmanagement\\_FINAL2.pdf](https://www.crccare.com/files/dmfile/CRCCARETechReport37_Fluxbasedgroundwaterassessmentandmanagement_FINAL2.pdf)

<https://www.hamburg.de/contentblob/3343384/92b476047d2d5aaaffca9975272a3501/data/d-gefaehrdungsbeurteilung-grundwasser.pdf>



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Peilbuis in goede staat



Modulair systeem aanpasbaar aan de diameter van de peilbuis (1"- 6") en verschillende dieptes



kwantitatieve resultaten:  
Correctie voor afwijking stroombanen



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# Gevalideerde analyses

## WATERFLUX

Traceralcohols

## BTEX-N-S-MTBE

Benzene  
Toluene  
Ethylbenzene  
O-Xylene  
M,p-Xylenes  
Naphthalene  
Styrene  
MTBE

## MINERAL OILS

Fraction C-10 - C-12  
Fraction C-12 - C-20  
Fraction C-20 - C-30  
Fraction C-30 - C-40  
Mineral oils (GC)

## CHLORINATED SOLVENTS

Dichloromethane  
1,1-Dichloroethane  
1,2-Dichloroethane  
Cis-1,2-dichloroethene  
Trans-1,2-dichloroethene  
Trichloromethane  
Trichloroethene  
1,1,1-Trichloroethane  
1,1,2-Trichloroethane  
Tetrachloromethane  
Tetrachloroethene  
Vinylchloride

## CHLOROBENZENES

Monochlorobenzene  
1,2-Dichlorobenzene  
1,3-Dichlorobenzene  
1,4-Dichlorobenzene  
1,2,3-Trichlorobenzene  
1,2,4-Trichlorobenzene  
1,3,5-Trichlorobenzene

## CHLOROTOLUENES

2-Chlorotoluene  
4-Chlorotoluene

## TRIMETHYLBENZENES

1,2,3-trimethylbenzene  
1,2,4-trimethylbenzene  
1,3,5-trimethylbenzene

## POLYAROMATIC HYDROCARBONS

Naphthalene  
Acenaphthylene  
Acenaphtene  
Fluorene  
Fenanthrene  
Anthracene  
Fluoranthene  
Pyrene  
Benzo(a)anthracene  
Chrysene  
Benzo(b)fluoranthene  
Benzo(k)fluoranthene  
Benz(a)pyrene  
Dibenzo(ah)anthracene  
Benzo(ghi)perylene  
Indeno(123cd)pyrene

## POLYCHLORINATED BIPHENYLS

PCB 28  
PCB 52  
PCB 101  
PCB 118  
PCB138  
PCB153  
PCB180

## VOLATILE ORGANIC COMPOUNDS SPECIFIC

1,1,1,2-Tetrachloroethane  
1,1,2-Trichloro-1,2,2-trifluoroethane  
1,1-Dichloroethene  
1,1-Dichloropropane  
1,1-Dichloropropene  
1,2,3-Trichloropropane  
1,2-Dibromoethane  
1,2-Dichloropropane  
1,3-Dichloropropane  
2,2-Dichloropropane  
2,3-Dichloropropene  
2-Chloro-1,3-butadiene  
2-Ethyltoluene  
3-Chloro-1-propene  
(allylchloride)  
3-Ethyltoluene  
4-Ethyltoluene  
Bromobenzene  
Bromochloromethane  
Bromodichloromethane  
Bromomethane  
Chloroethane  
cis-1,3-Dichloropropene  
Cumene  
Dibromochloromethane  
Dibromomethane  
Diisopropylether  
ETBE (Ethyl tert-butyl ether)  
Ethylether  
Hexachlorobutadiene  
Iodomethane  
TAME (Tert-Amyl Methyl Ether)  
trans-1,3-Dichloropropene  
Tribromomethane  
(Bromoform)  
Trichloromonofluormethane

## HEAVY METAL

Cadmium  
Chromium  
Copper  
Lead  
Nickel  
Zinc

## METAL SPECIFIC

Calcium  
Iron  
Potassium  
Magnesium  
Manganese  
Sodium

## NUTRIENT CATIONIC

Ammonium-N

## HEAVY METAL SPECIFIC

Mercury  
Arsenic

## NUTRIENT ANIONIC

Nitrate-N  
Sulfate

## DIOXANE

1,4-Dioxane

## PFAS

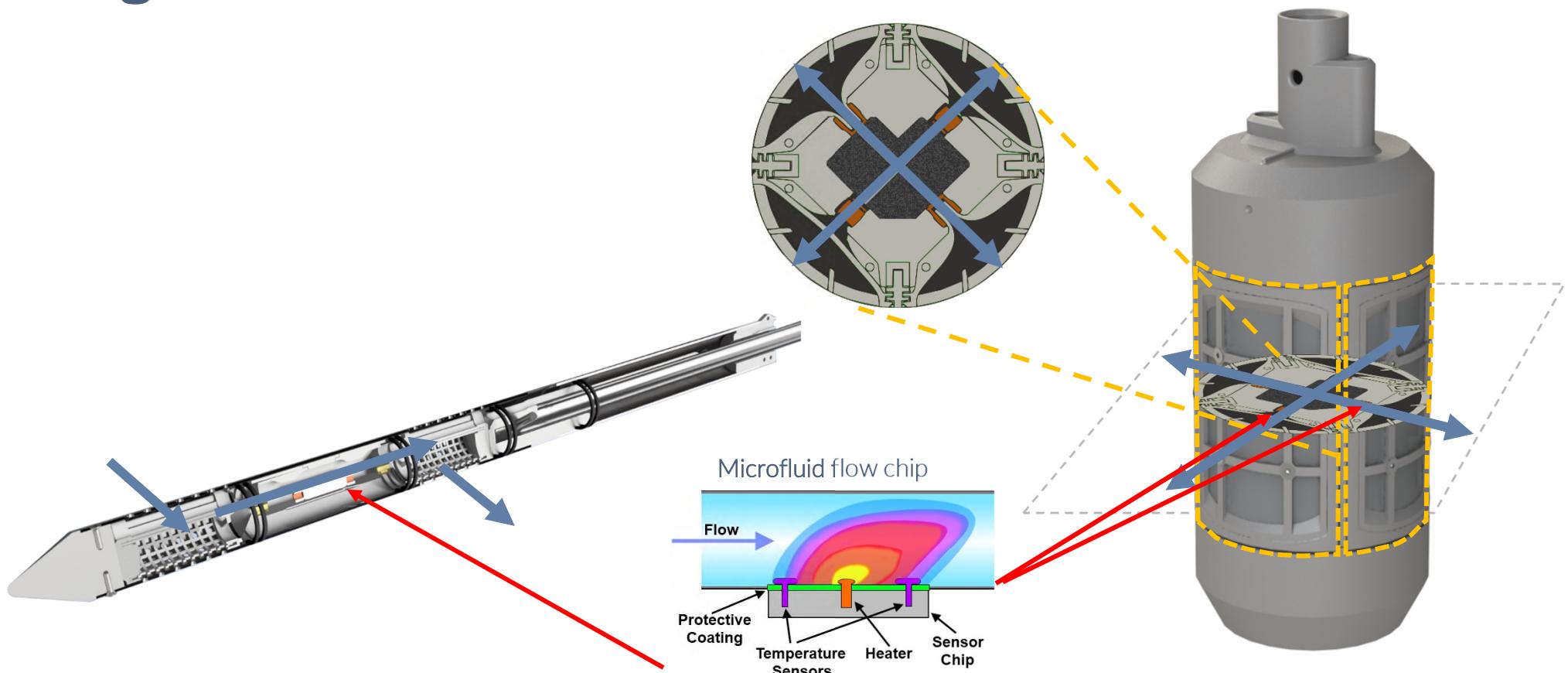
Perfluorohexanoic acid  
(PFHxA)  
Perfluoroheptanoic acid  
(PFHpA)  
Perfluoroctanoic acid  
(PFOA)  
Perfluorononanoic acid  
(PFNA)  
Perfluorodecanoic acid  
(PFDA)  
Perfluoroundecanoic acid  
(PFUdA)  
Perfluorododecanoic acid  
(PFDoA)  
Perfluorobutanesulfonic acid  
(PFBS)  
Perfluorohexanesulfonic acid  
(PFHxS)  
Perfluooctanesulfonic acid  
(PFOS)  
Perfluooctanesulfonamide  
(PFOSA)

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# Digitale iFLUX sensor

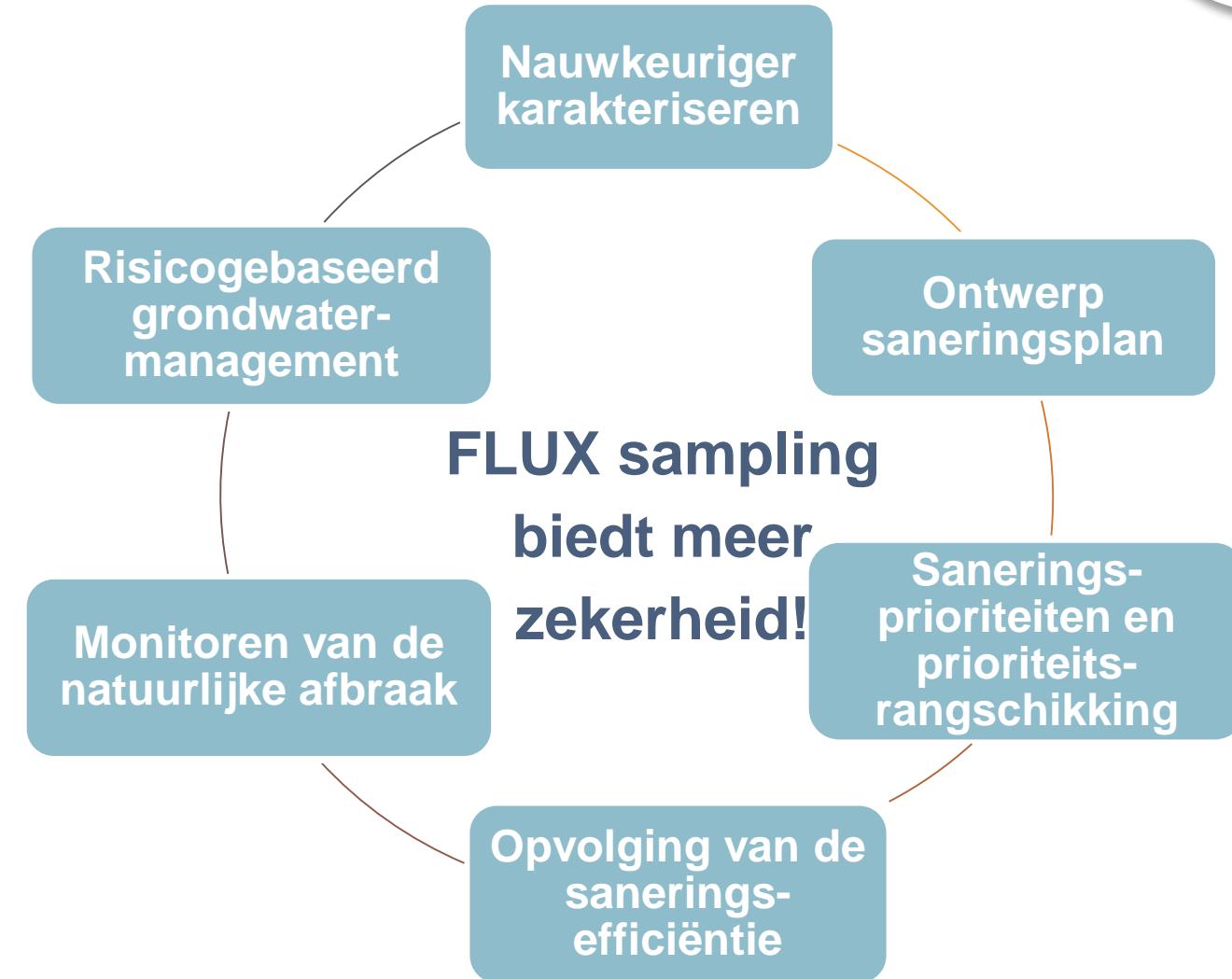


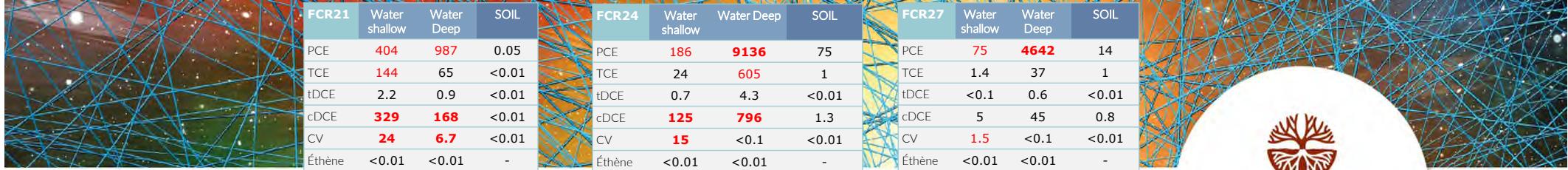
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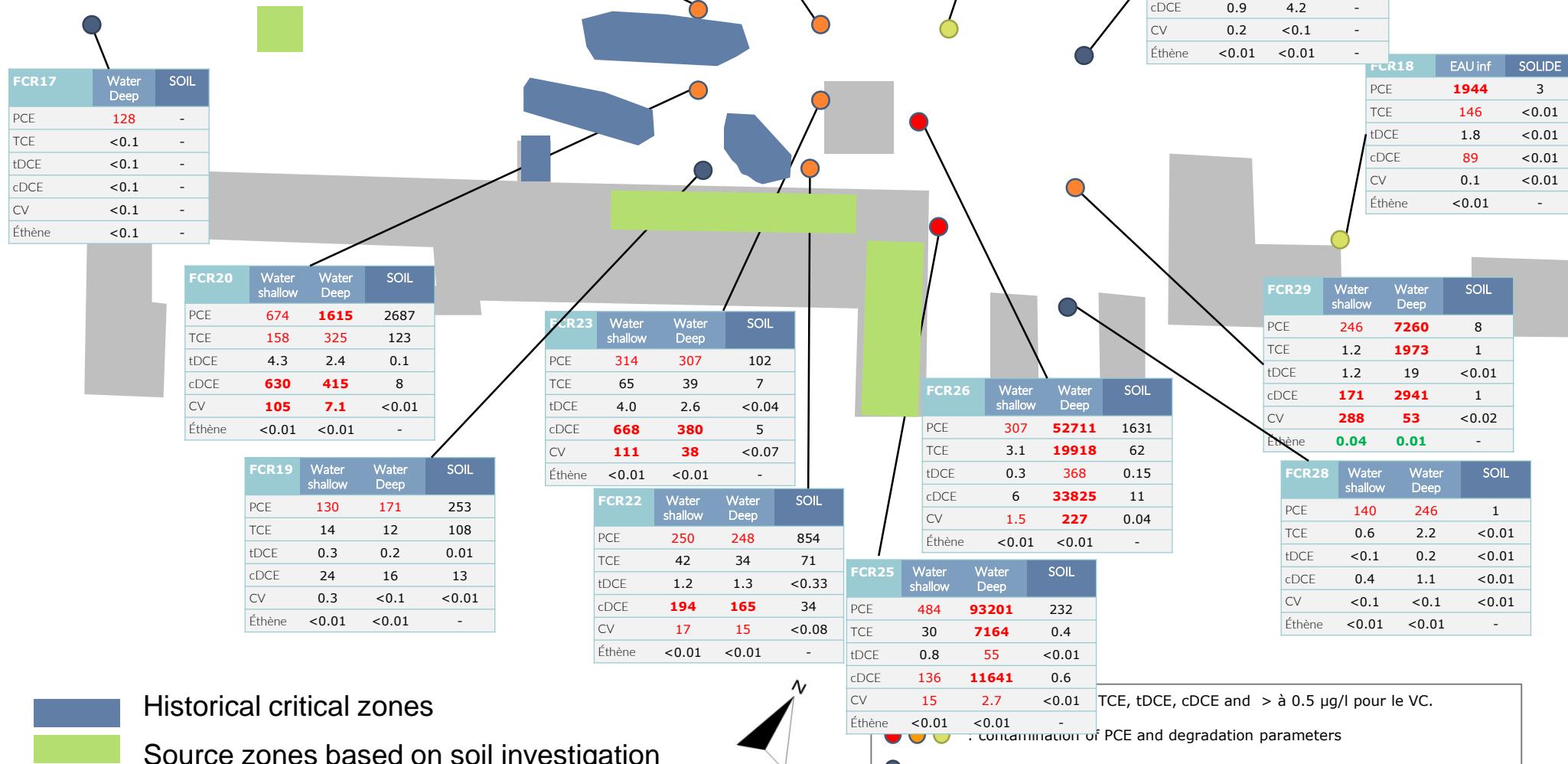
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# Toegevoegde waarde?





## Case 1 – Zwitserland: Industriële site met complexe bodemsamenstelling





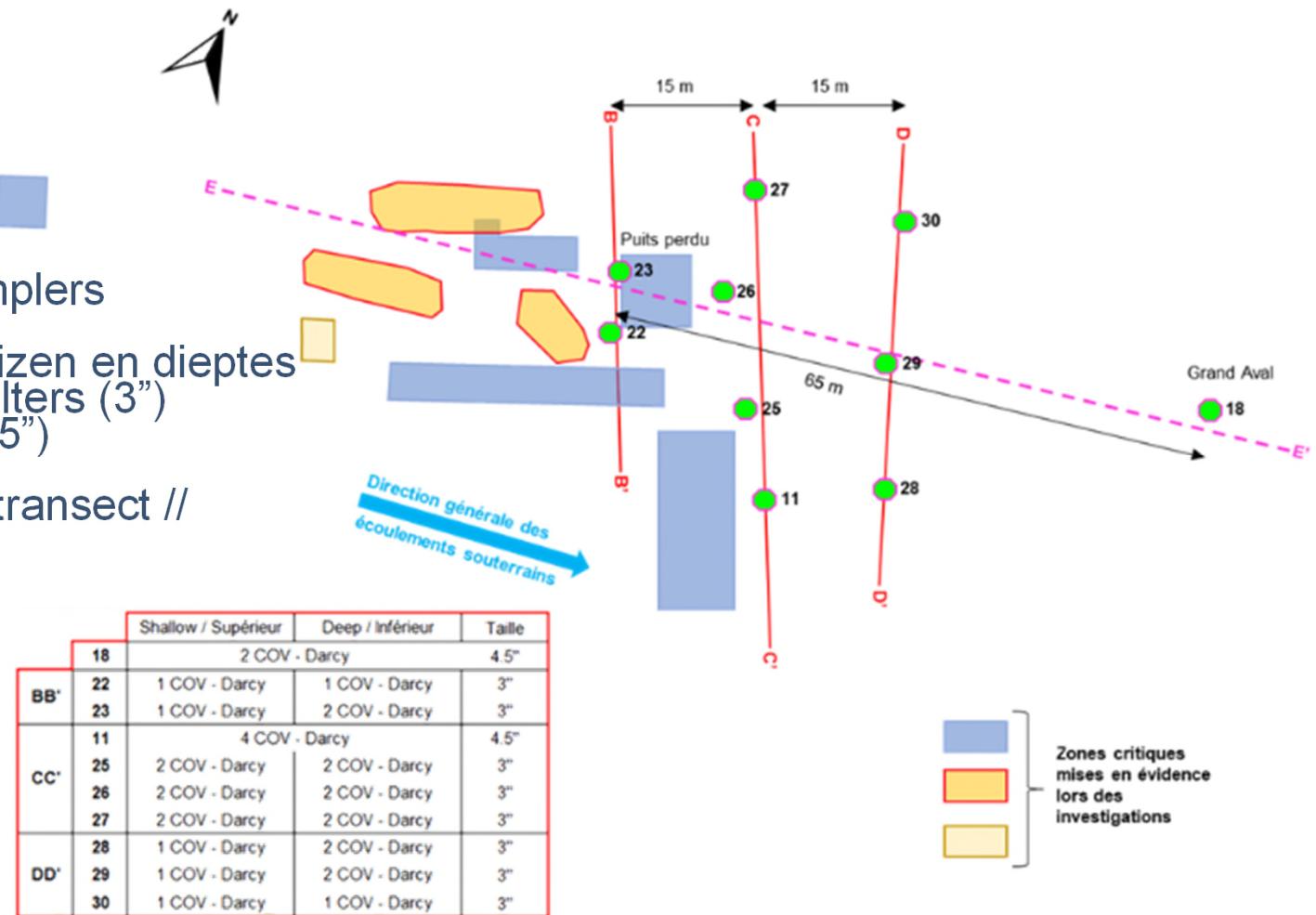
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# Case 1 – monitoringsplan iFLUX campagne

iFLUX passieve samplers

- Verschillende peilbuizen en dieptes
  - Dubbele korte filters (3")
  - Lange filters (4,5")

3 transects ⊥ and 1 transect //



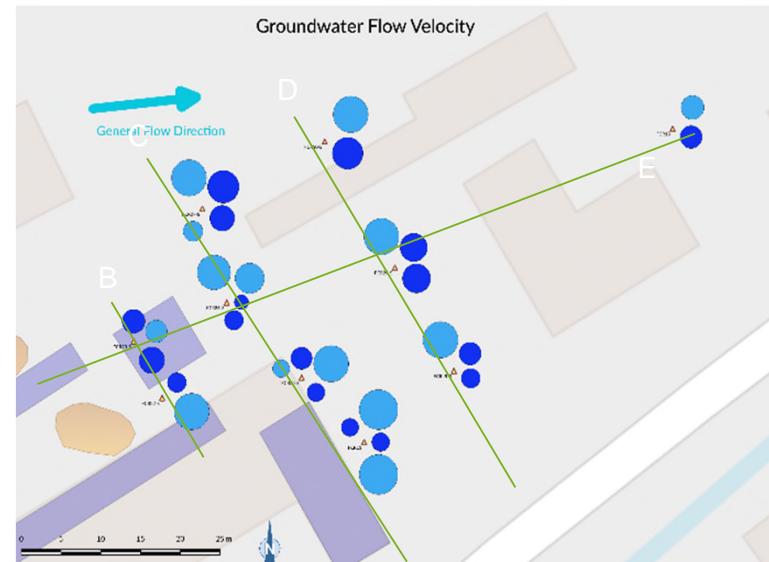
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# Case 1 – Resultaten: Grondwater flux

- Groundwater flux  
Shallow > deep



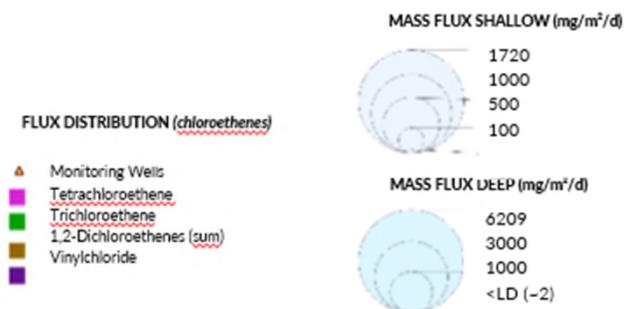
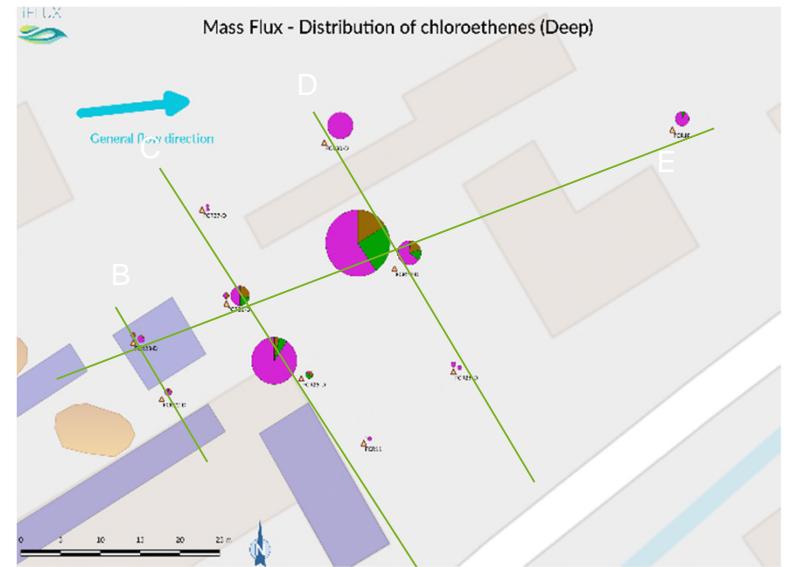
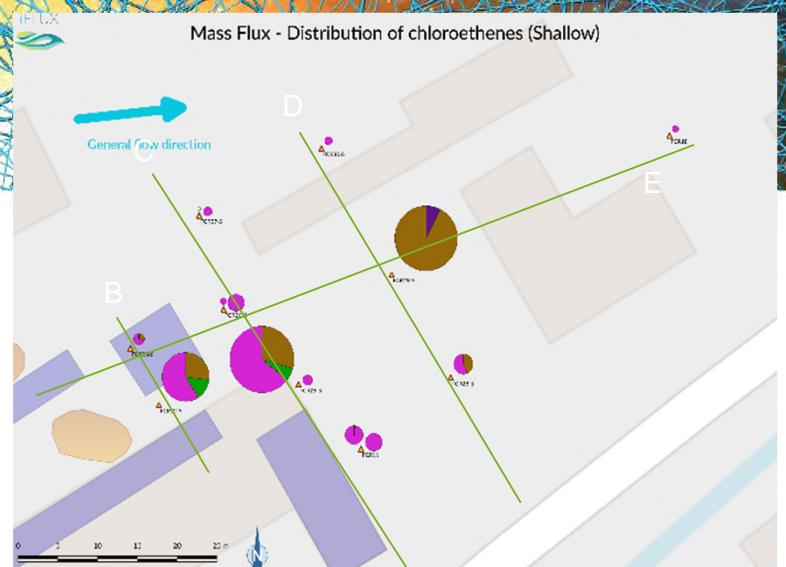
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# Case 1 – Resultaten: Massa flux (PCE, TCE, 1,2DCE, VC)

## Massa FLUX

- hoge flux zones CC' en DD'
- diepe laag
- Preferentiële stroombanen
- Afbraak producten ondiep

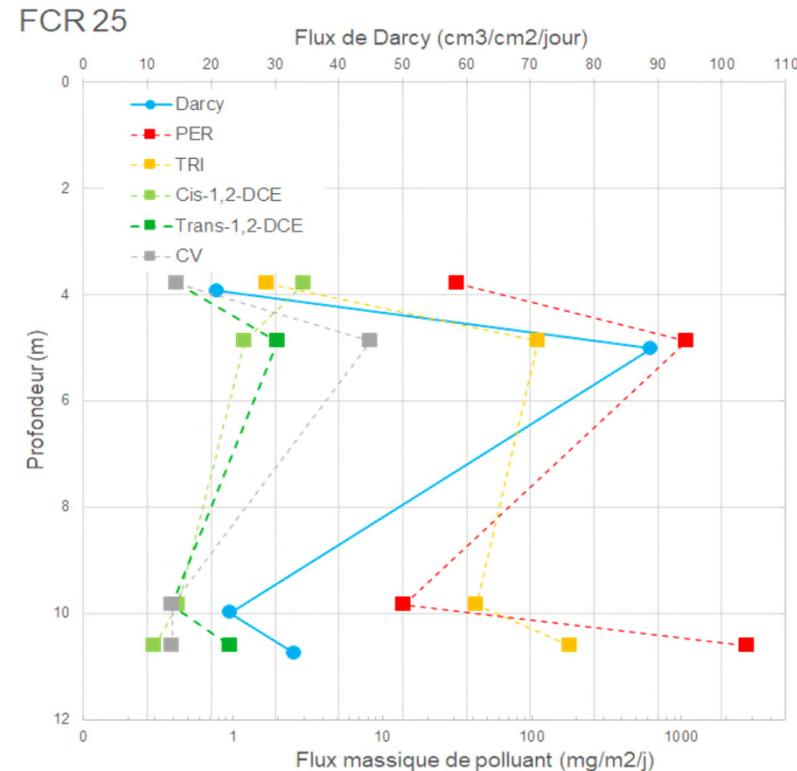
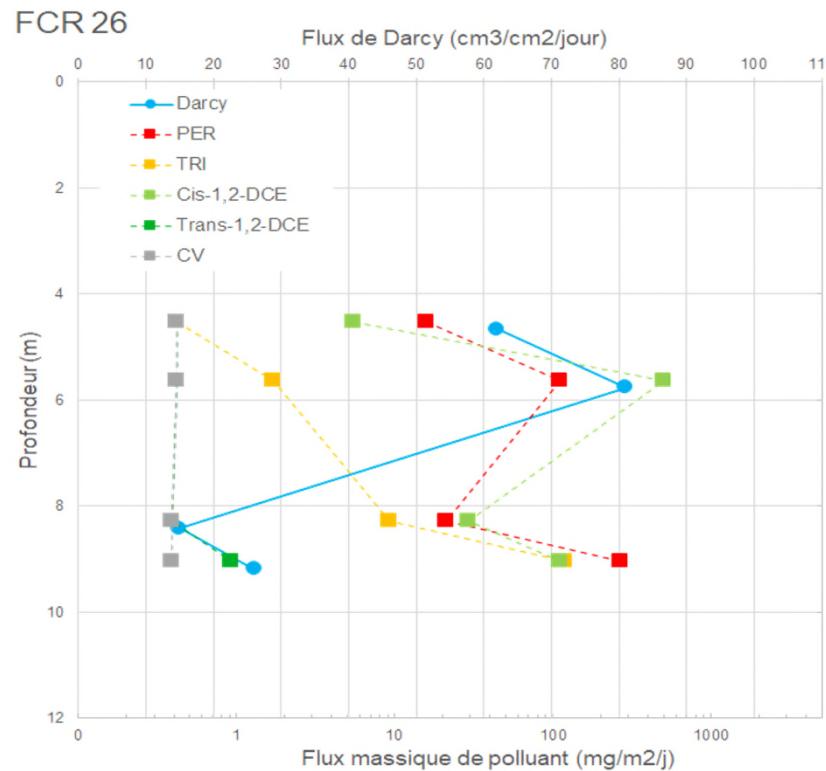


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# Case 1 – Nieuwe inzichten mbv grondwater- en massaflux

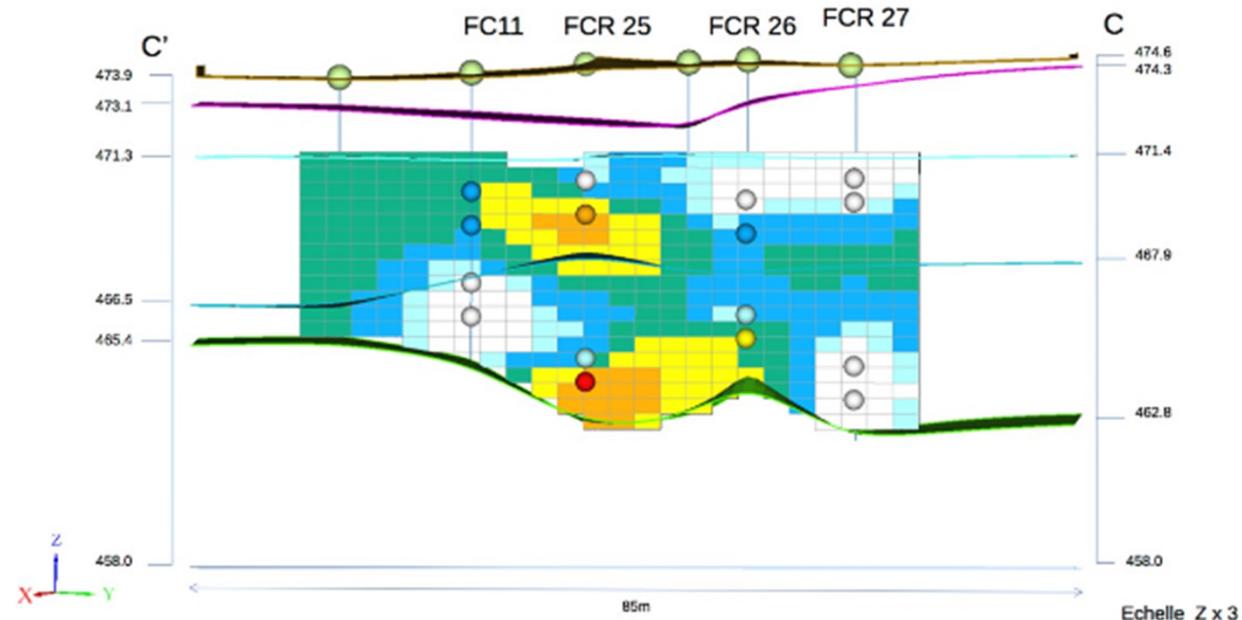


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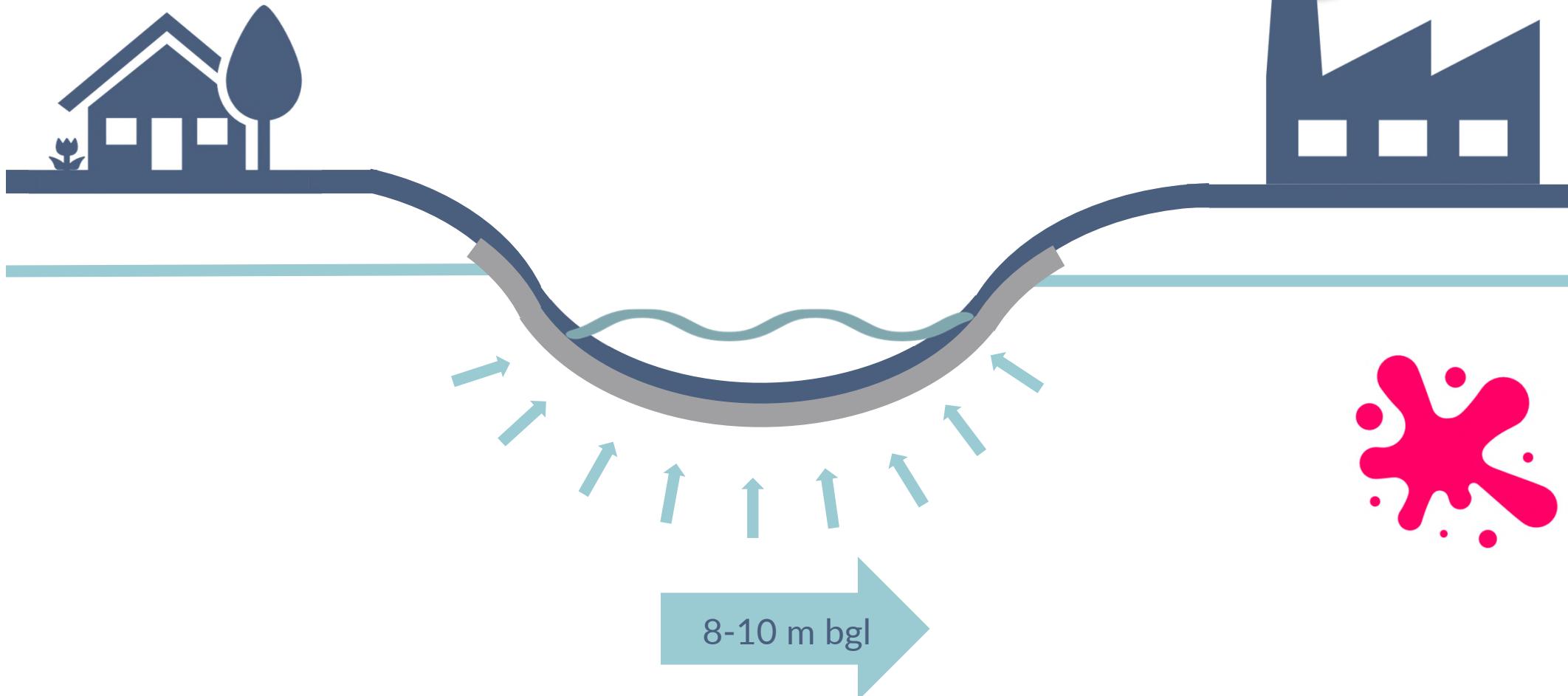
# Case 1 – Conclusie: Betere inschatting van massaflux & vracht



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## Case 2 – RESANAT: De Lieve, Gent



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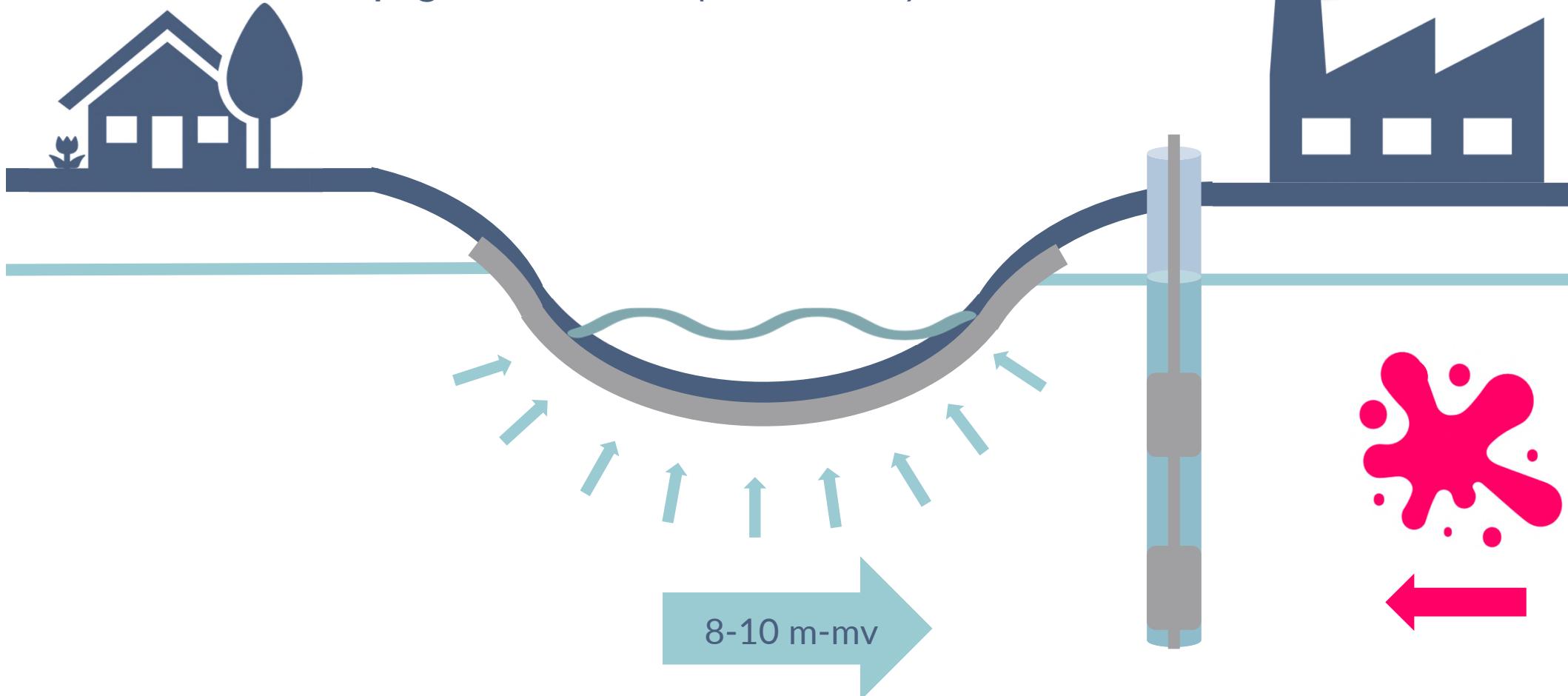
Interreg 



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# Flux measurements VOOR baggeren

*ondiep groundwater (3-5 m-mv)*

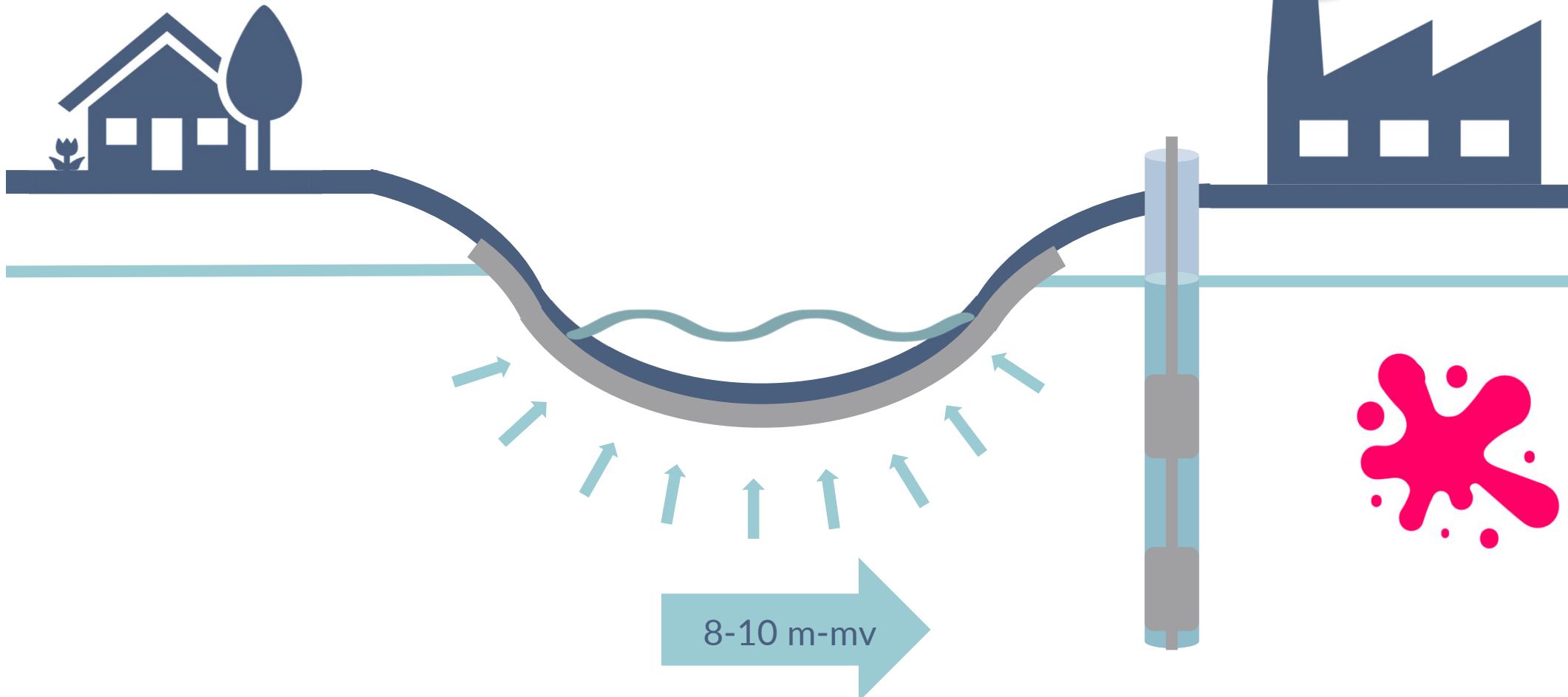


Dé plek voor bodemprofessionals

Interreg



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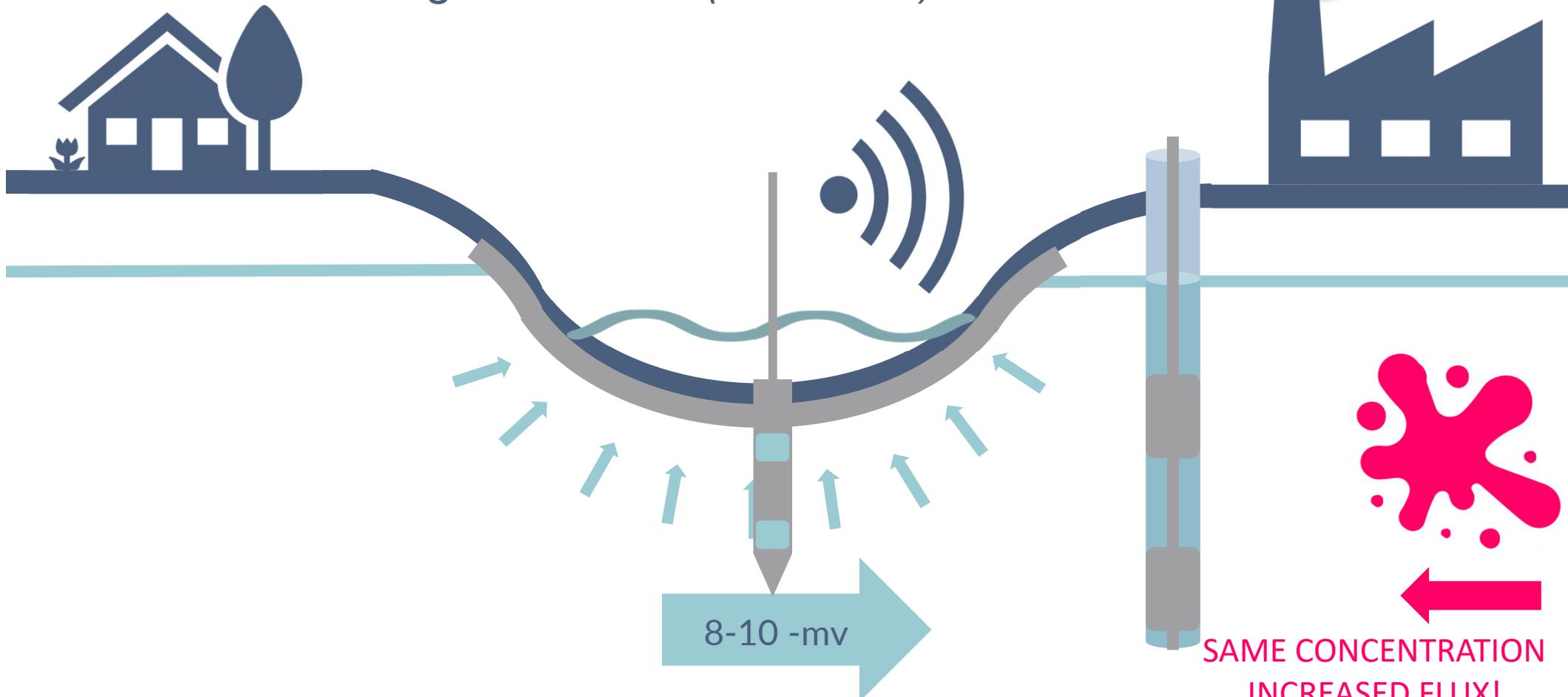
Interreg



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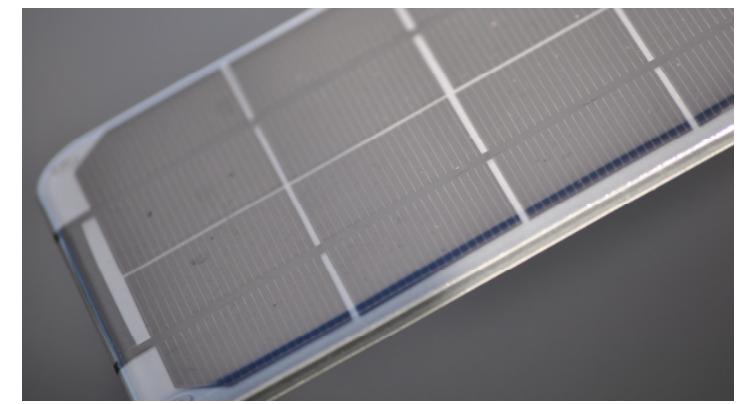
# Flux measurements NA baggeren

Shallow groundwater (3-5 m-mv)



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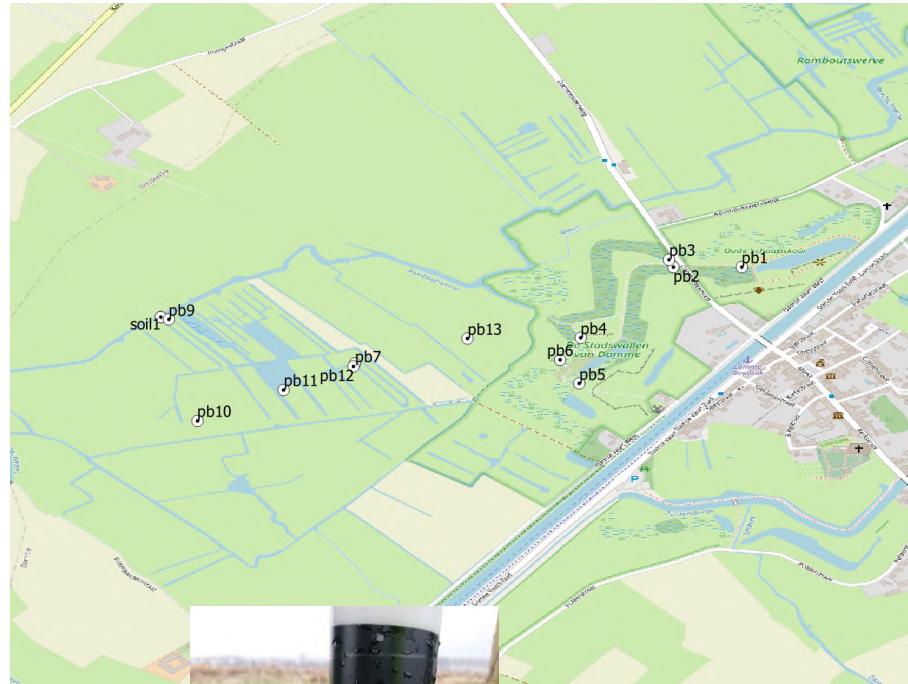


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# Case 3 – Damme: Real-time monitoring network



Vertical sensor in  
Romboutswerve



Horizontal  
sensor in  
flux well



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monitornals

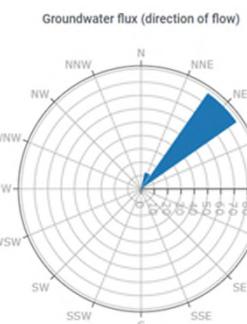
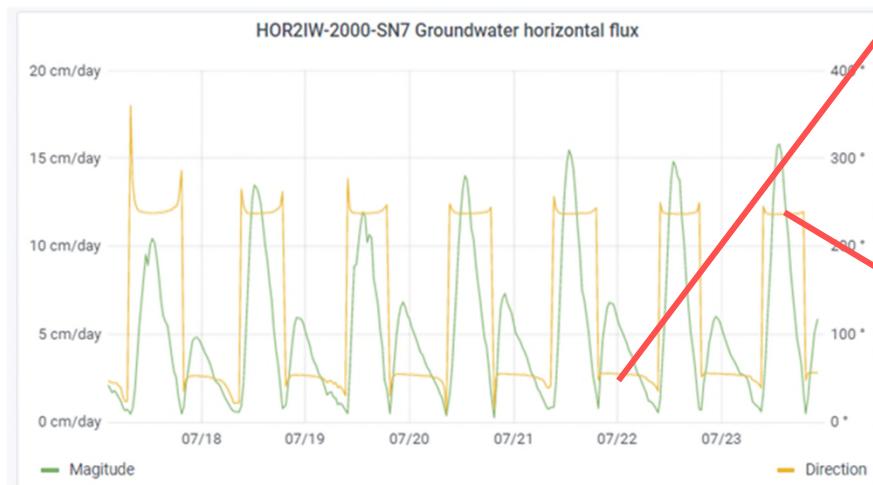


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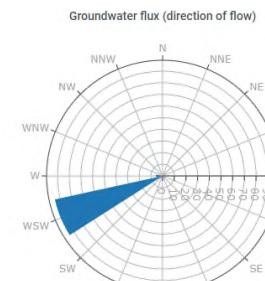
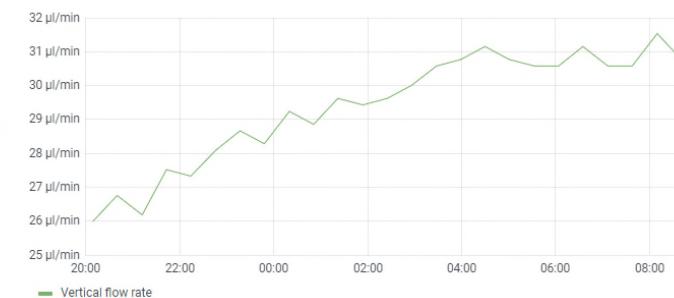
# Case 3 – Damme: Real-time monitoringssnetwerk

## Nieuwe inzichten

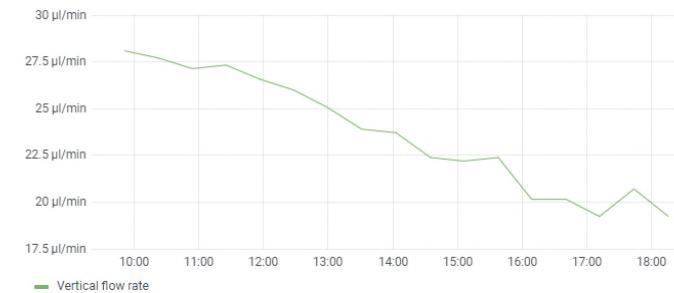
- Getijde maar ook variatie dag/nacht (richting en grootte flux)



VERT1MDL-2000-SN8 vertical sensor flow rate



VERT1MDL-2000-SN8 vertical sensor flow rate





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# Case 3 – Damme: Real-time monitoringssnetwerk



## Nieuwe inzichten

- exfiltratie met variaties
  - dag/nacht
  - neerslag

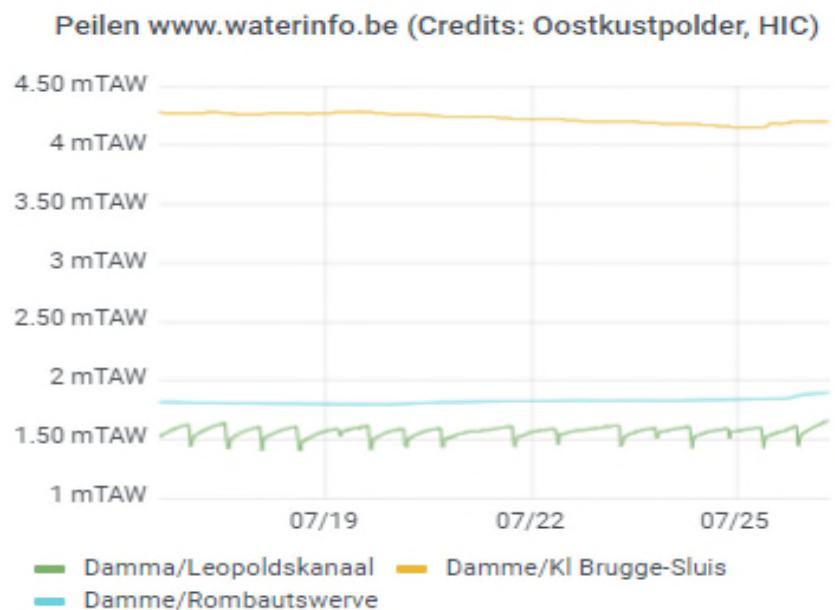
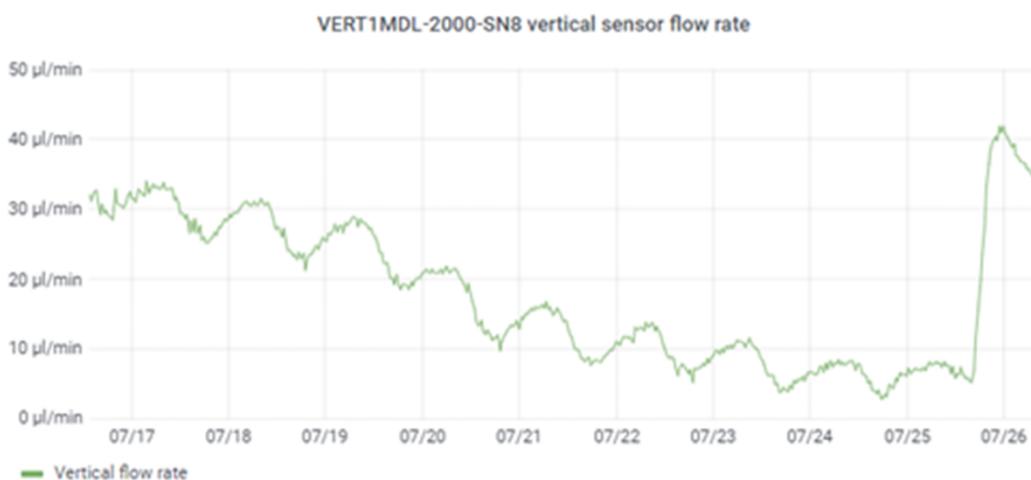


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# Case 3 – Damme: Pilot

## Nieuwe inzichten

- water niveau leopoldskanaal:
  - dag/nacht





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## Thank you! Questions?



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