BUFFERtech

Intelligent Buffer Zones (IBZ) as filters for nitrogen and phosphorus from tile drainage water and surface runoff – experiences from BufferTech

DOMINIK ZAK, CARL C HOFFMANN, BRIAN KRONVANG, JOACHIM AUDET, HENNING JENSEN, SARA EGEMOSE & CHARLOTTE A JORGENSEN

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

Workshop, Slagelse 2017

BUFFERtech

The Problem

A pipe like this (draining ca. 30 ha) might charge a stream with SEVERAL

100 kg N/year

having concentrations up to 50 mg Nitrate/L)

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

The consequences

are highly evident:

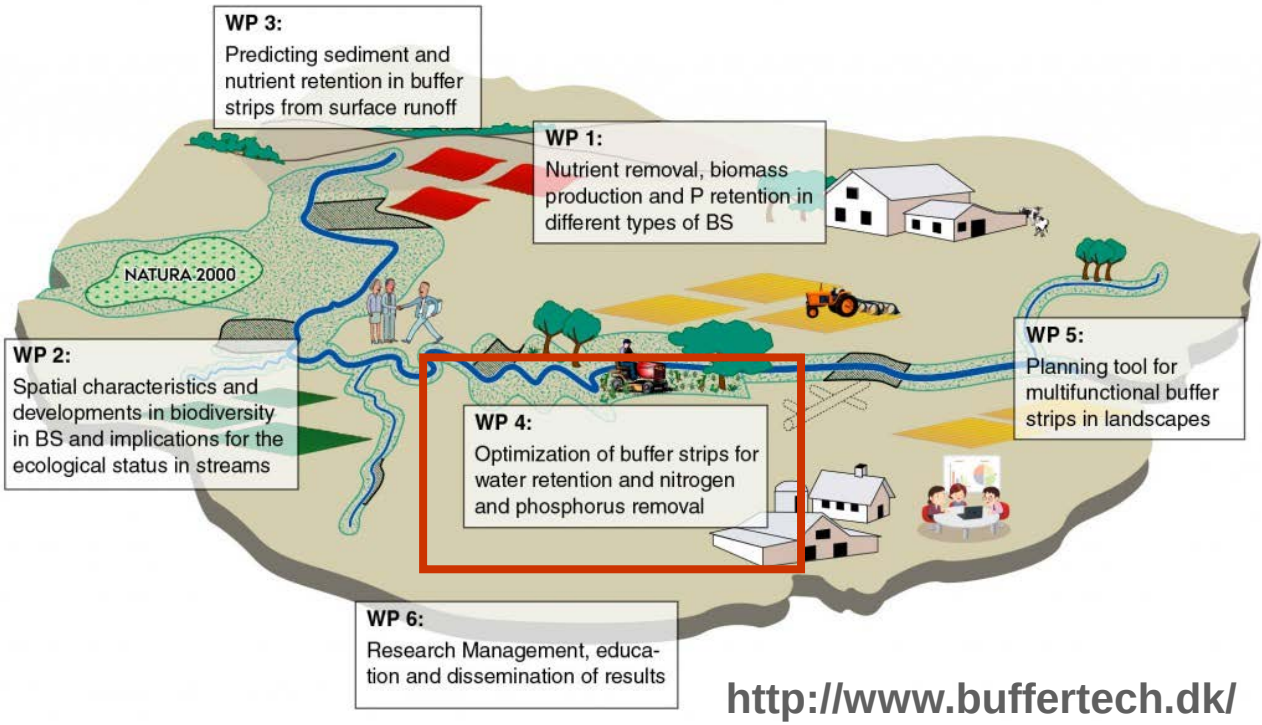
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The
Danish Council for
Strategic Research

BUFFERtech

IBZ: A solution of the problem?

1. How much nitrogen and phosphorus become filtered by IBZ?



http://www.buffertech.dk/

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

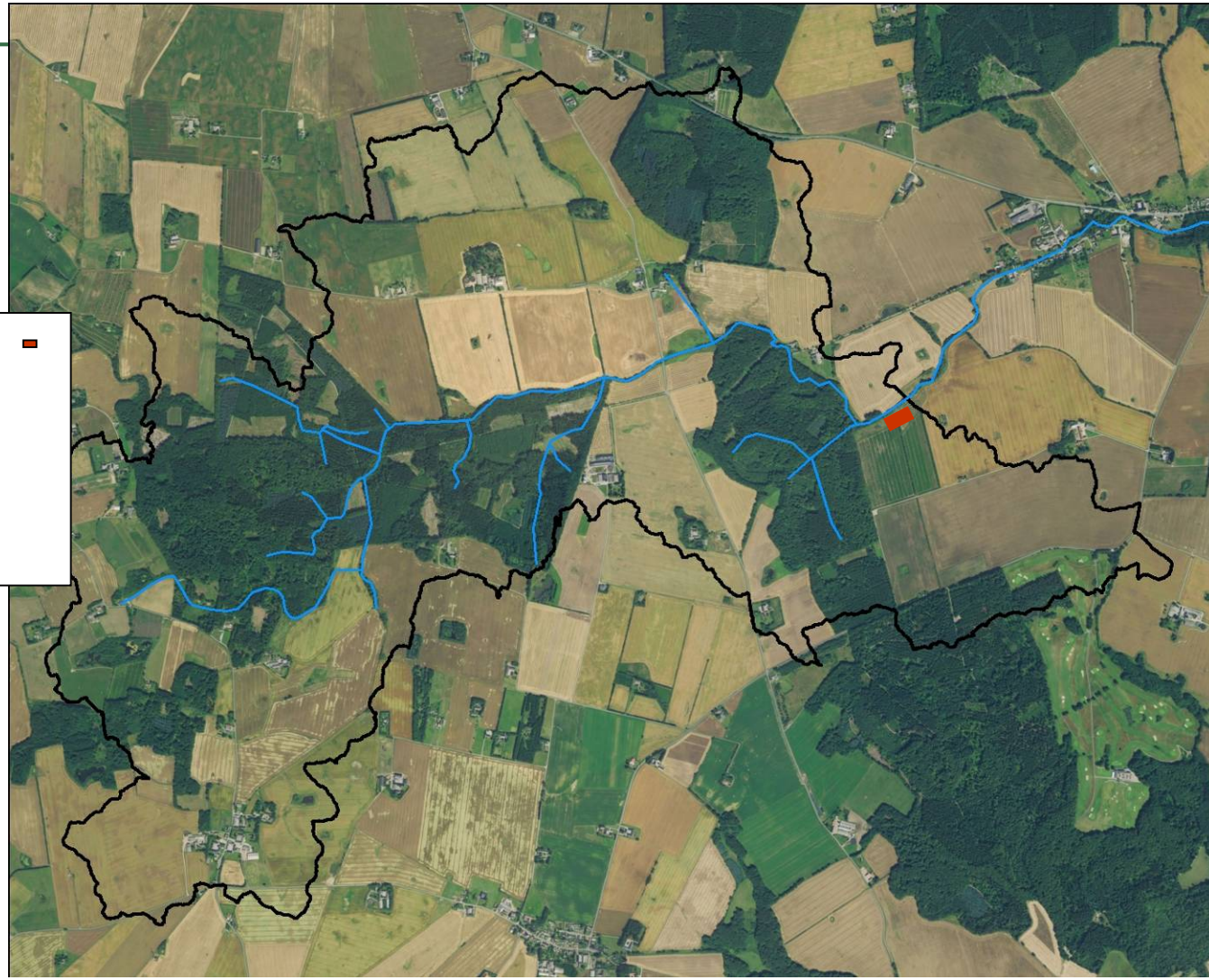
Sampling Pilot Site(s)

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

Catchment



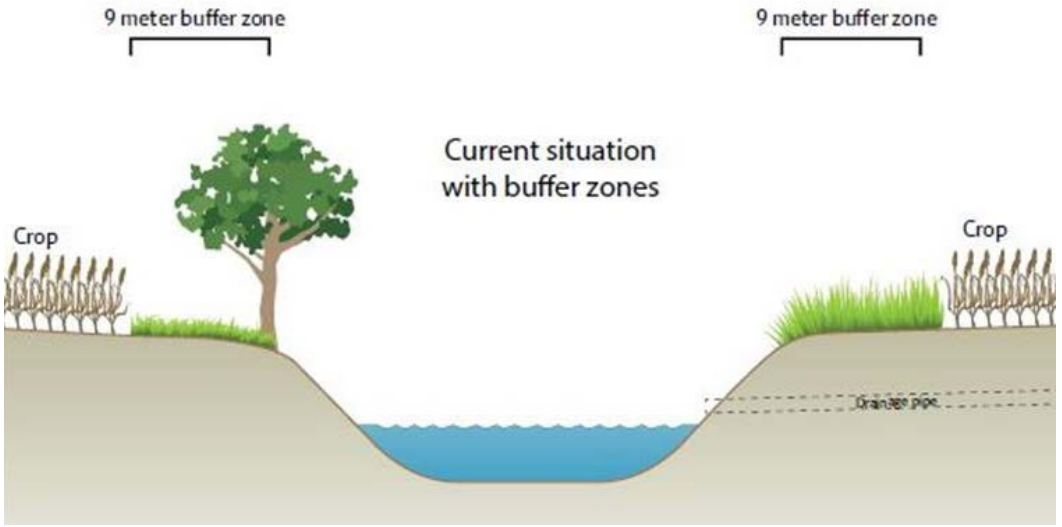
Ratio size of subcatchment/ size of IBZ: ~1000

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

How we started

with nutrient removal?



Bufferzones to trap surface runoff and purify seepage water

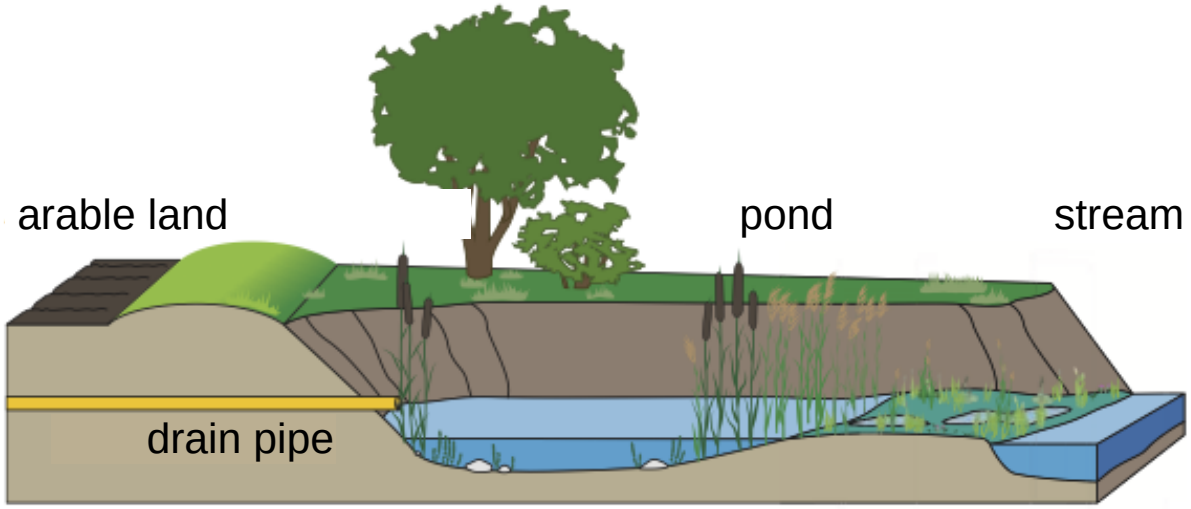
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The
Danish Council for
Strategic Research

One step forward

improving nutrient removal:

max. 60 kg/ha y



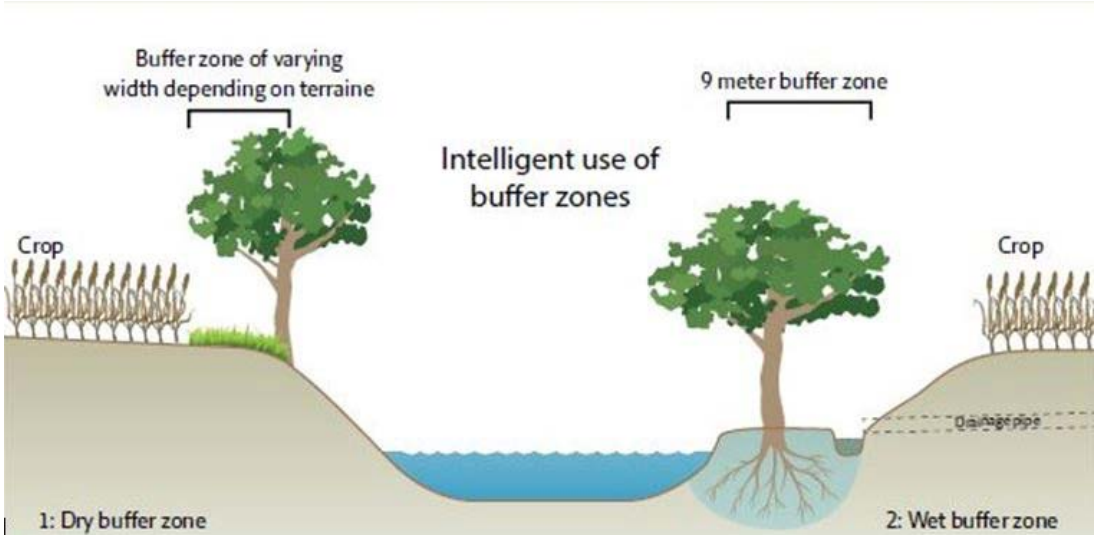
A „horseshoe wetland“ as an example of a dainage pond for nutrient retention (Peterson et al. 1992, Holsten et al. 2012)

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

What we have now

to become evaluated!



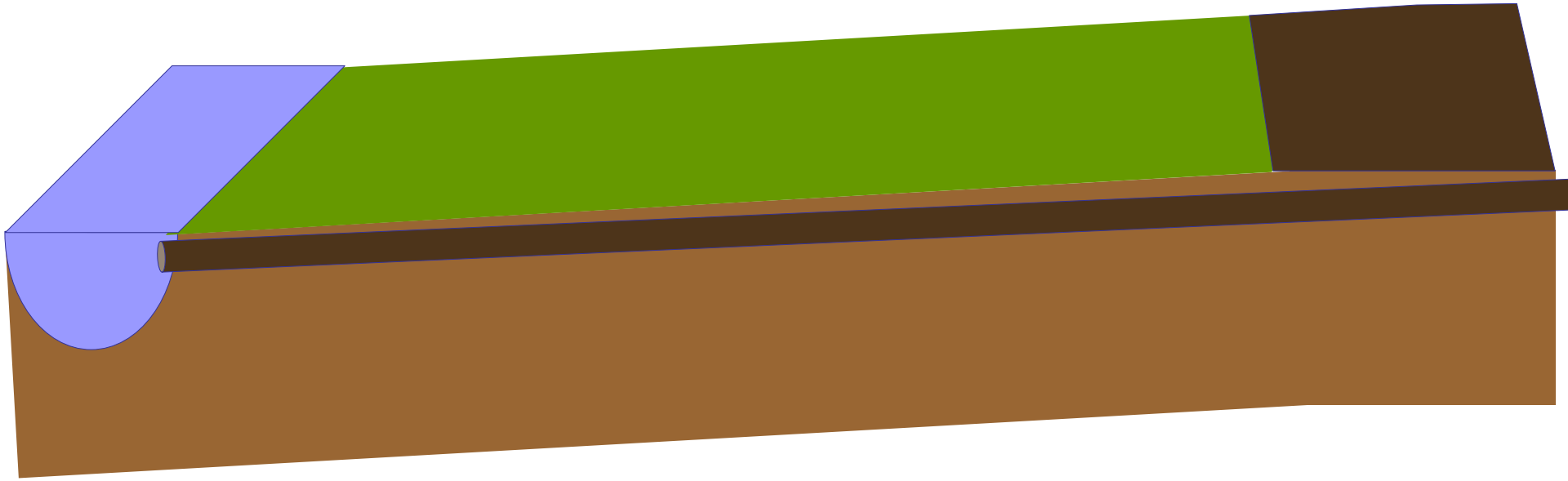
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

The IBZ(rev)olution:

in detail:



InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The
Danish Council for
Strategic Research

BUFFERtech

Find the drain pipe,

and make it shorter:

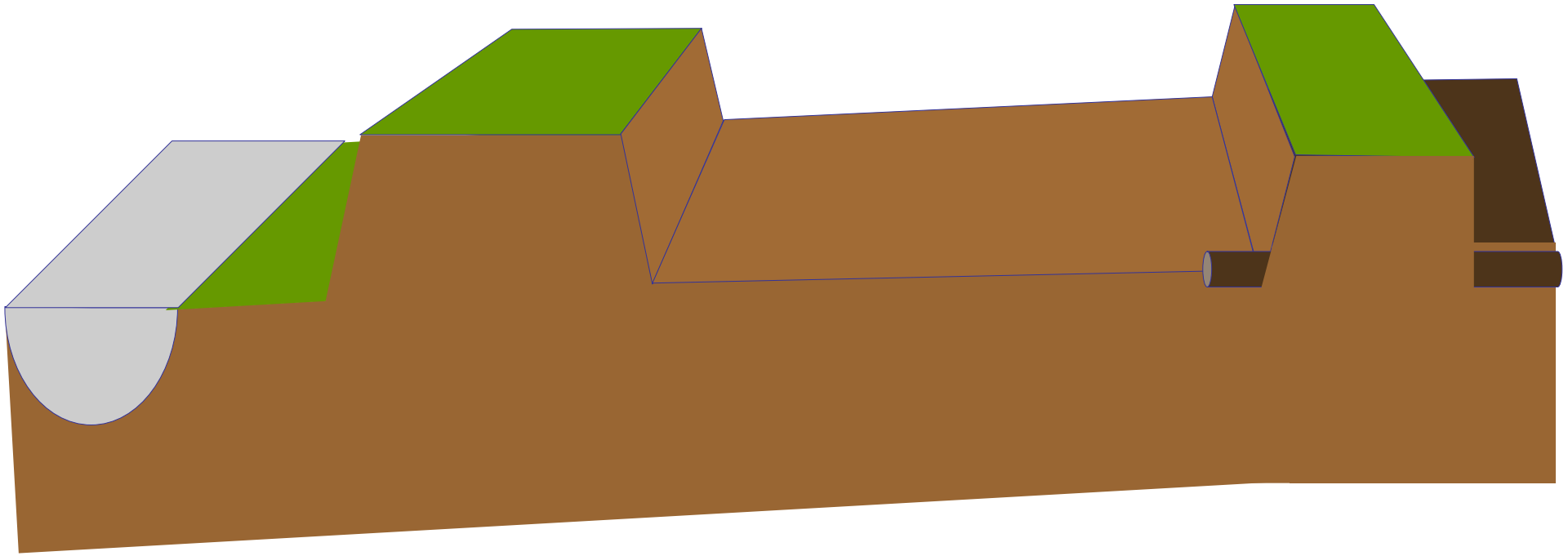
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

Embanking,

a certain area:



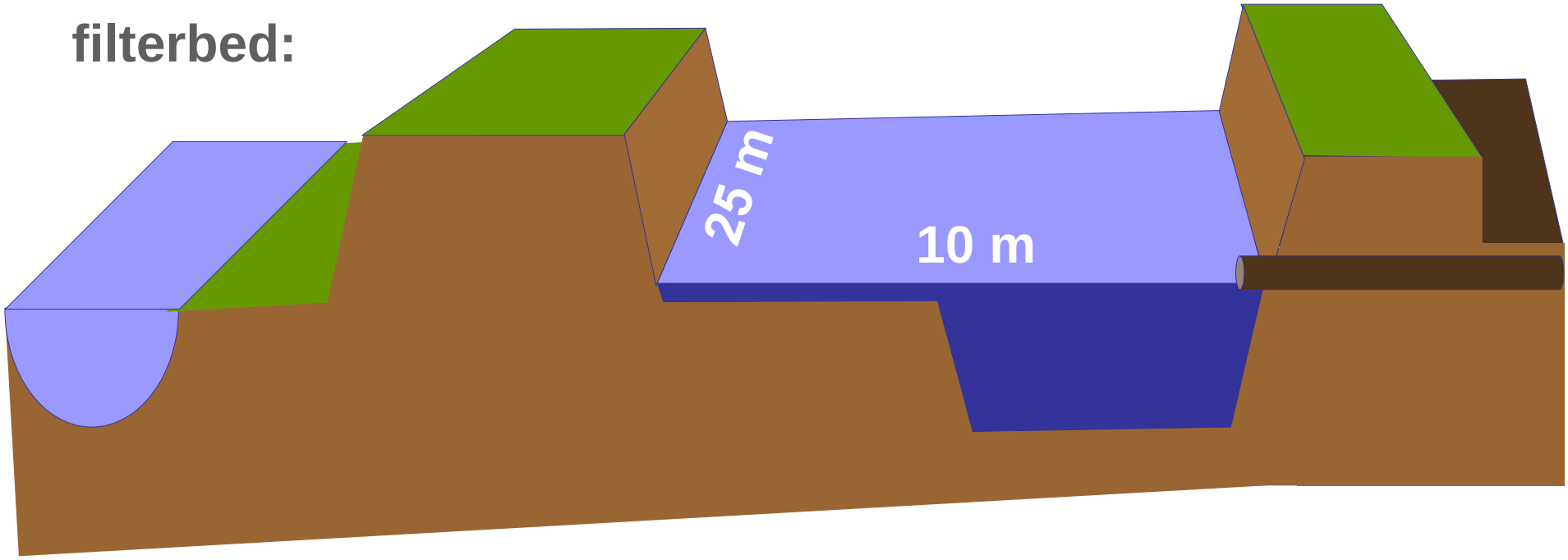
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The
Danish Council for
Strategic Research

BUFFERtech

Building the pond,

and the filterbed:



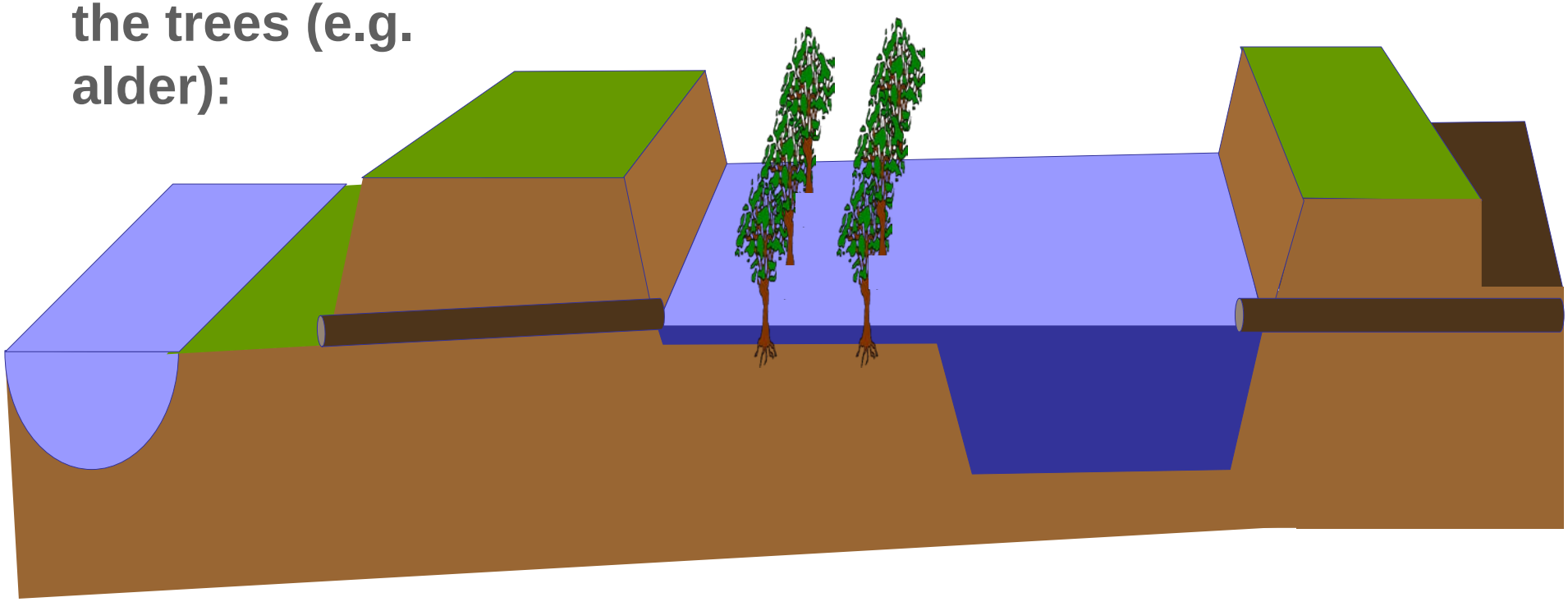
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

Do not forget,

the trees (e.g. alder):



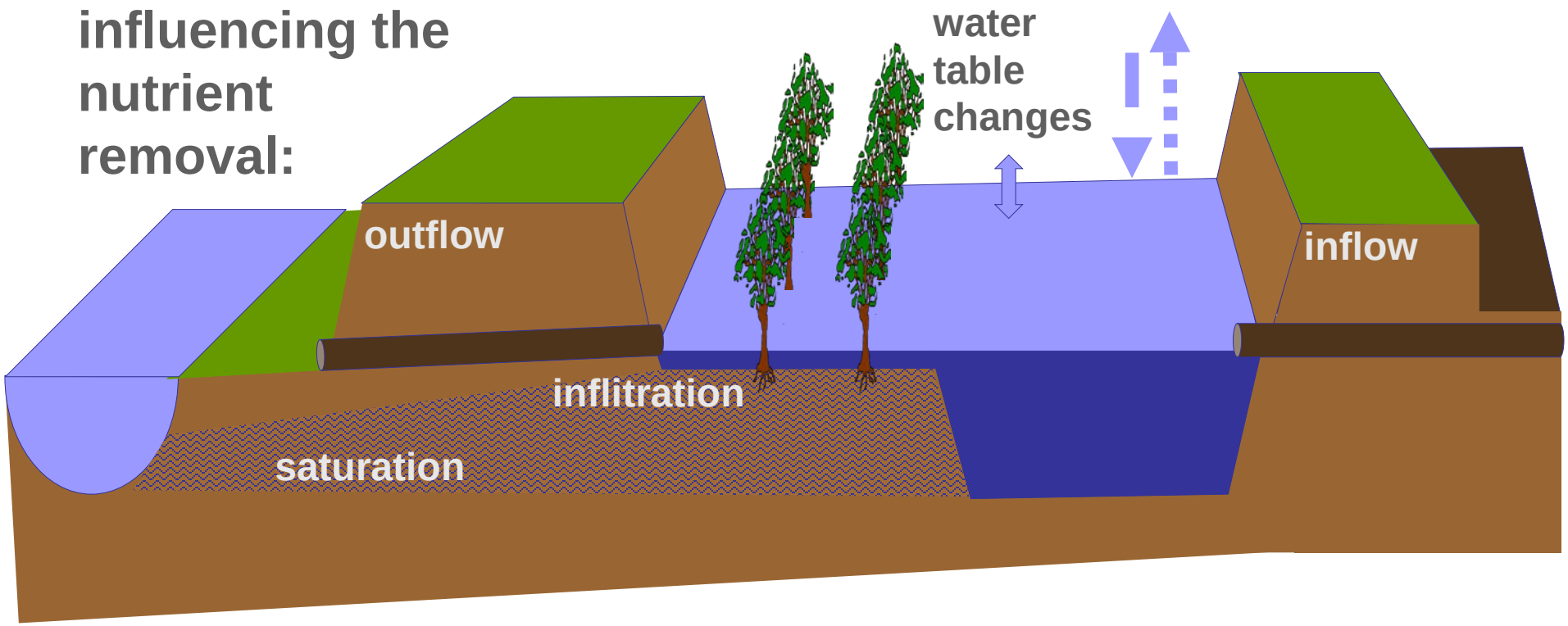
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

Hydrological processes,

influencing the nutrient removal:

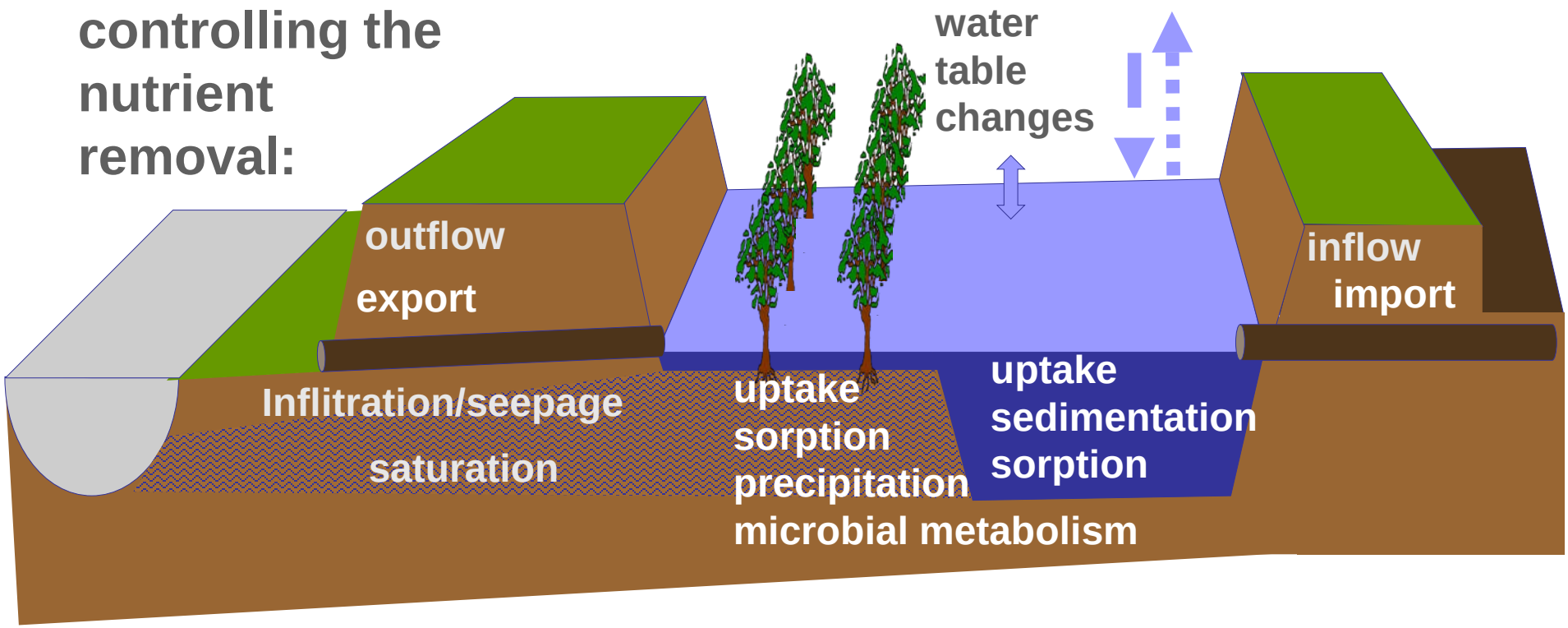


InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

Biogeochemical processes, controlling the nutrient removal:



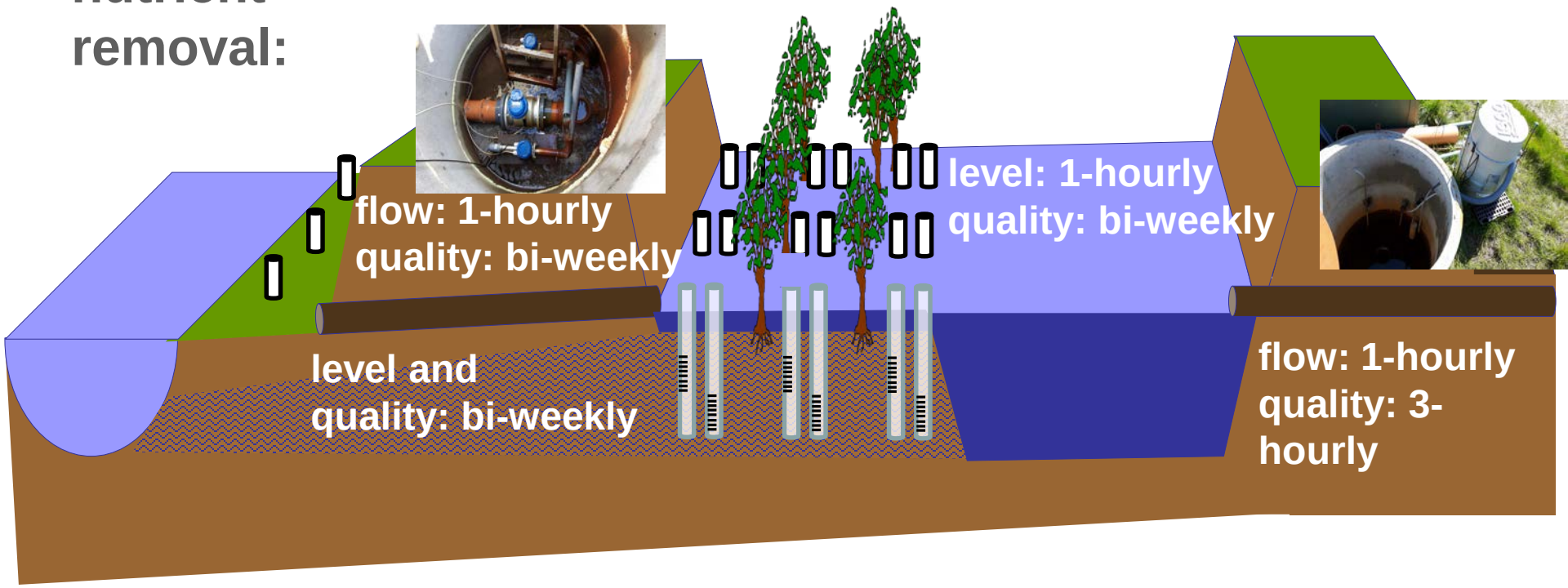
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

Our monitoring,

to calculate the nutrient removal:



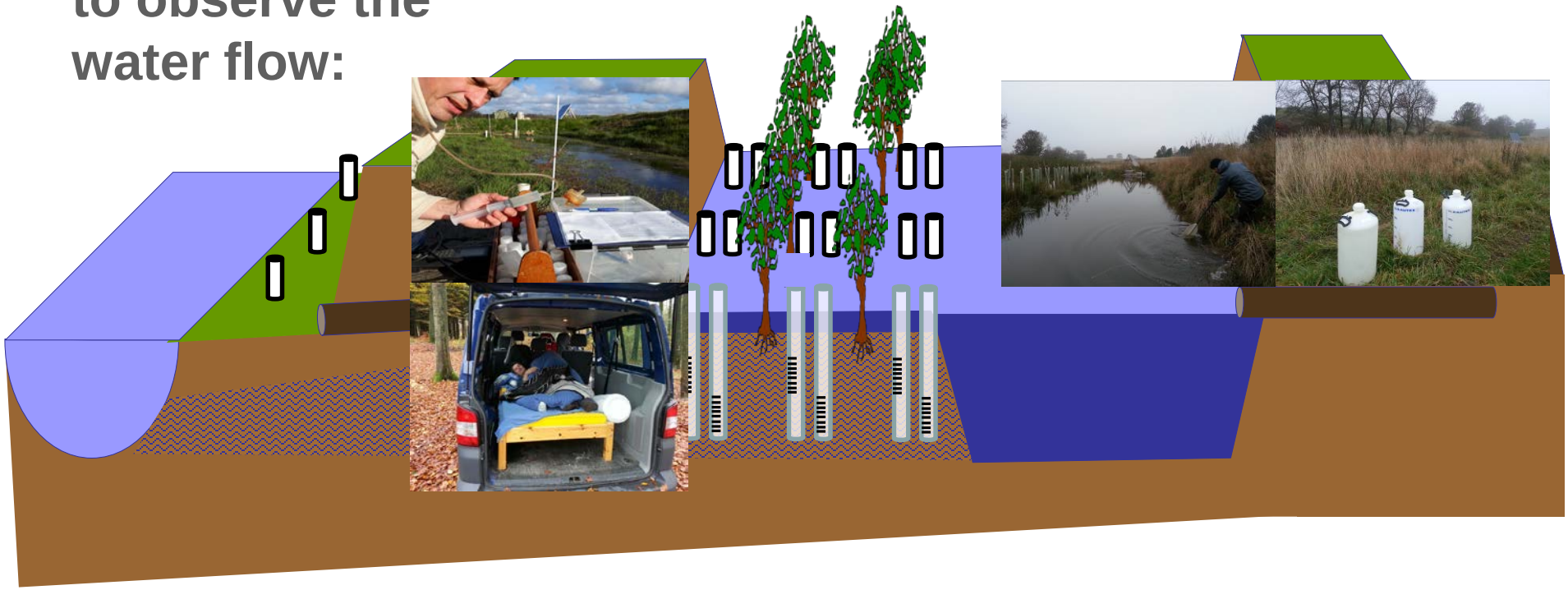
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The
Danish Council for
Strategic Research

BUFFERtech

Tracer experiment,

to observe the water flow:



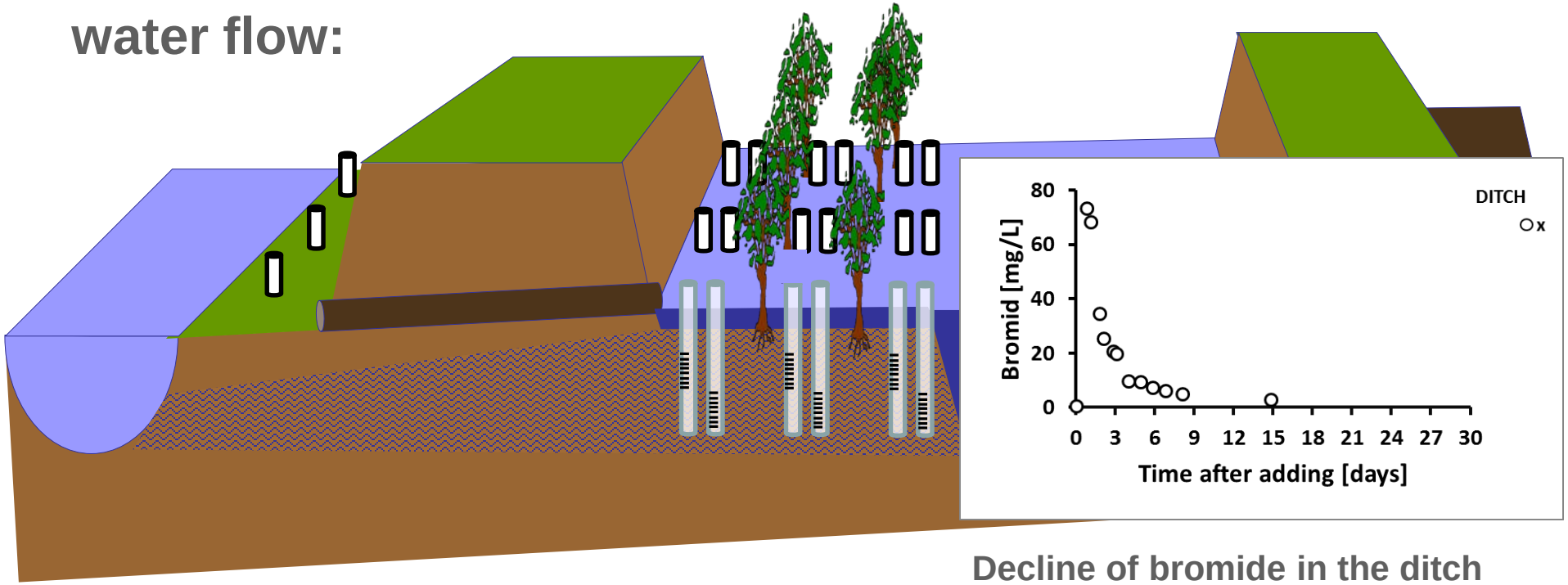
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

Results,

about the water flow:

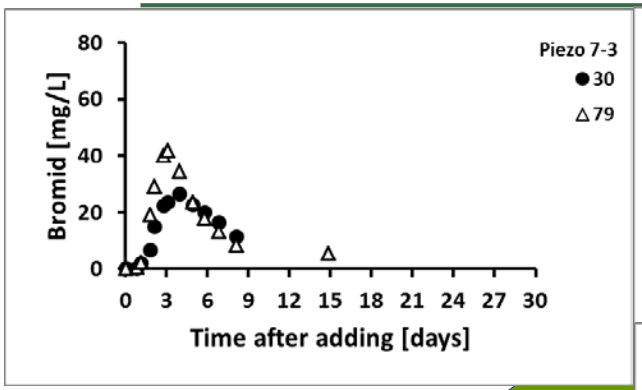


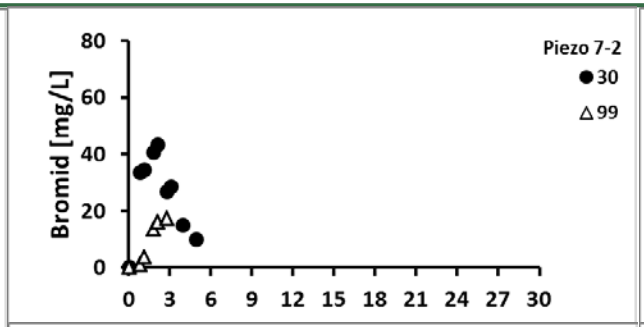
Decline of bromide in the ditch

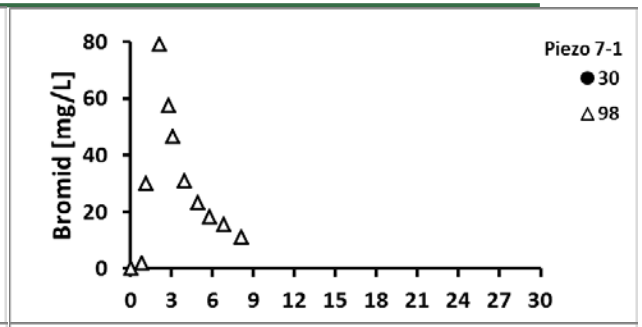
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

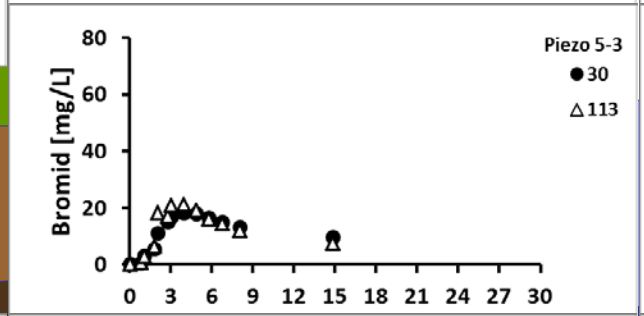
The Danish Council for Strategic Research

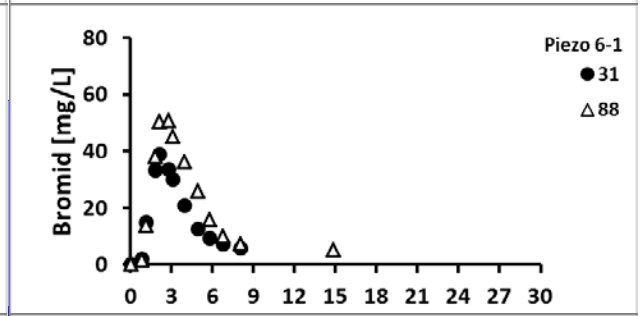
BUFFERtech

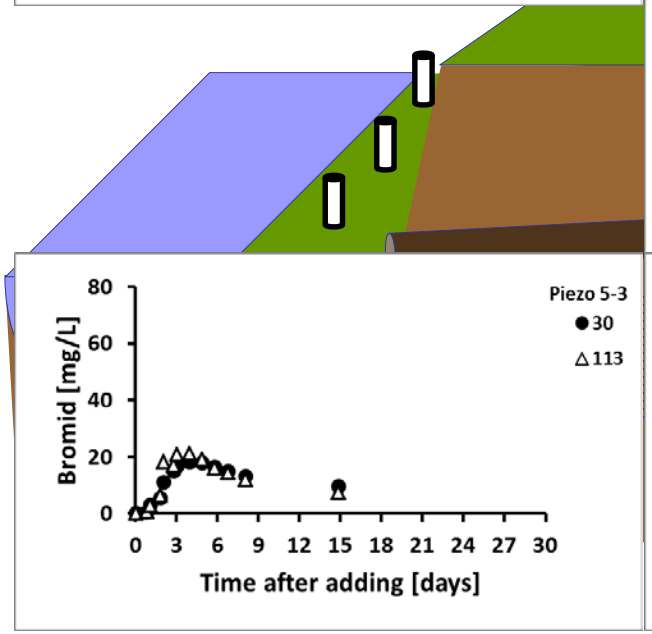


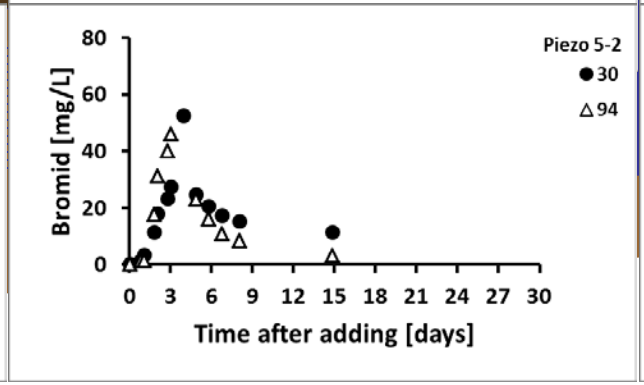


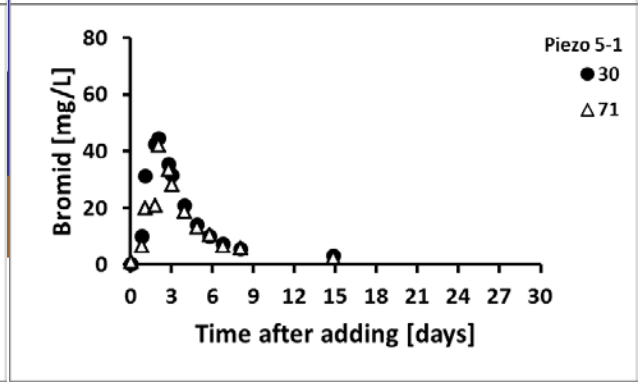












Breakthrough curves of bromide of the whole filter bed

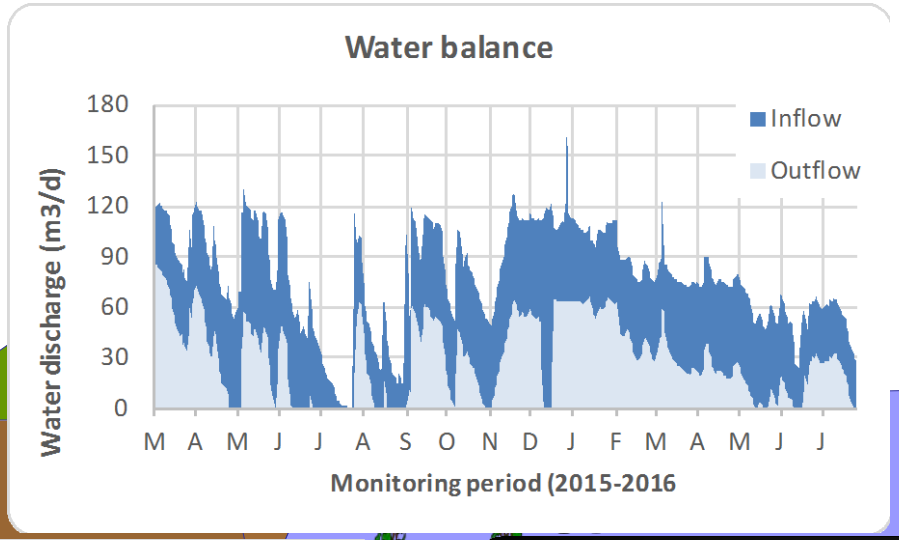
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

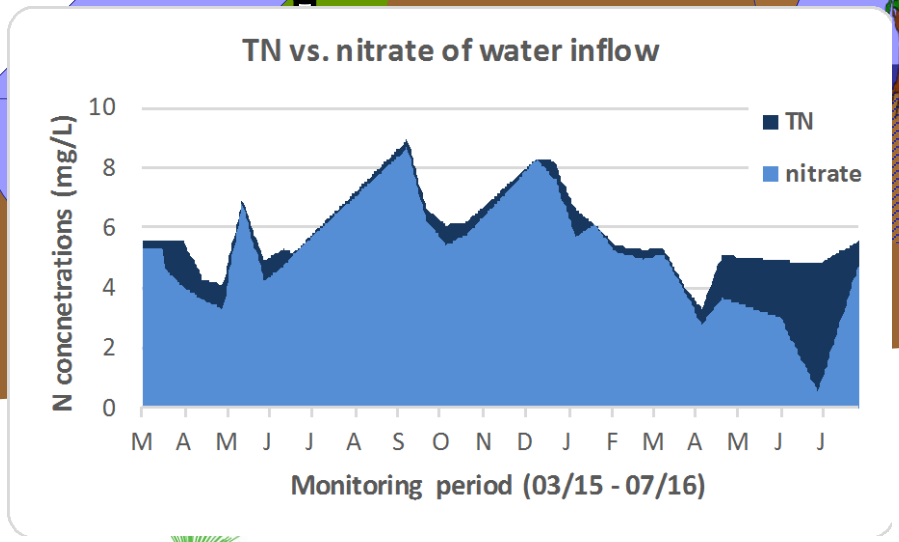
The Danish Council for Strategic Research

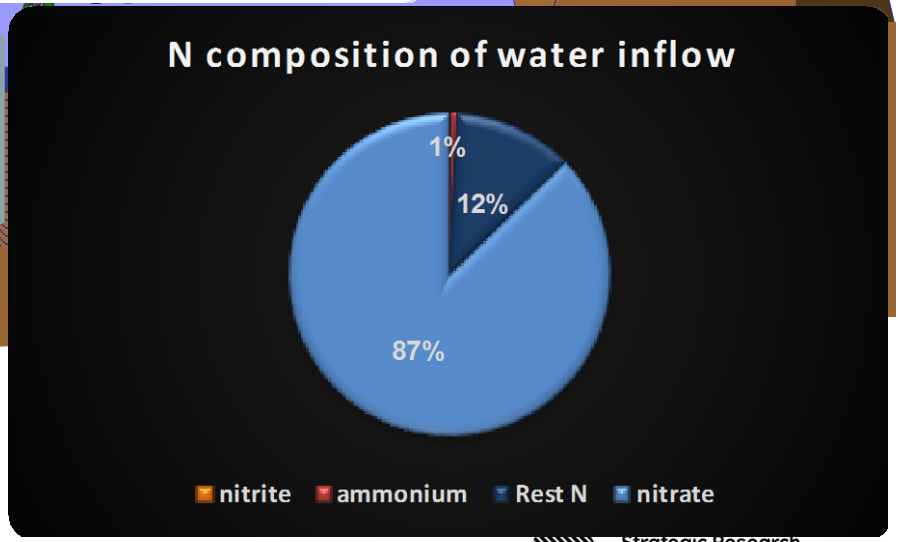
BUFFERtech

Results,

about the water flow and nitrogen import:





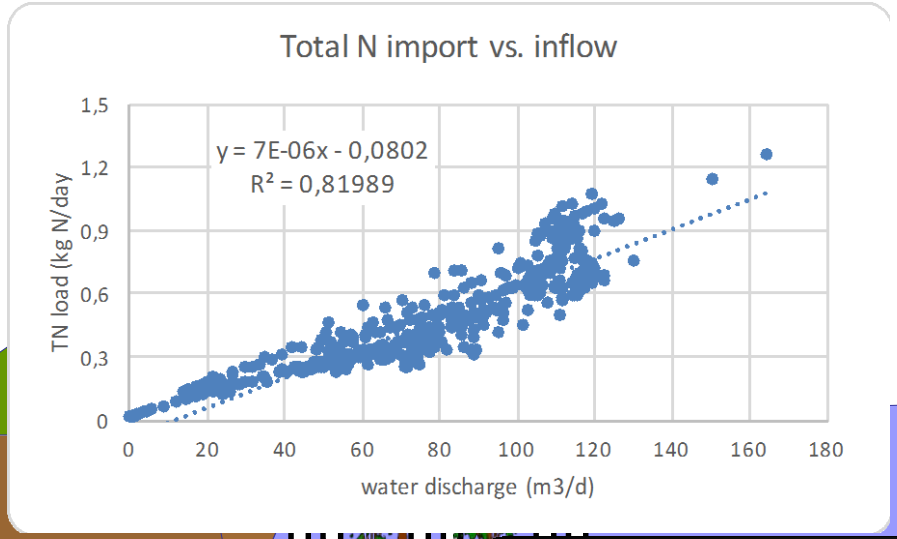


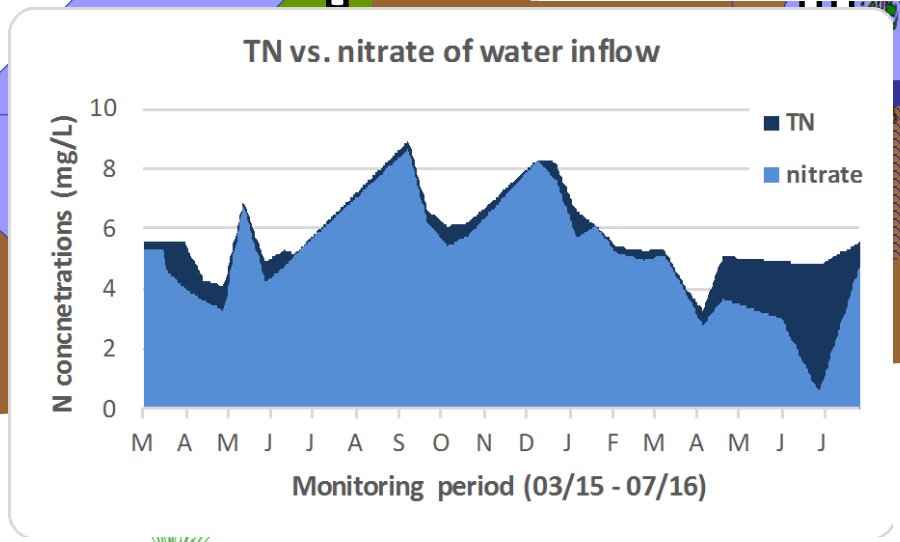
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK
Strategic Research

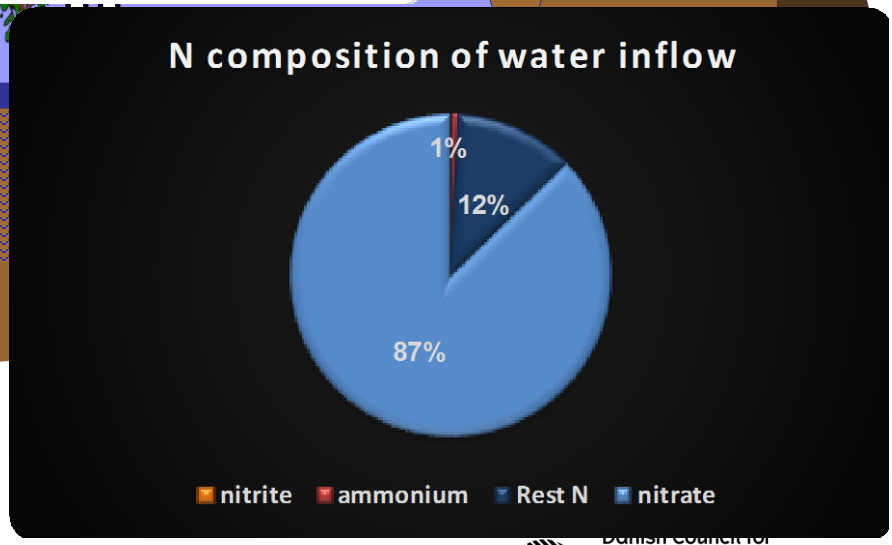
BUFFERtech

Results,

about the water flow and nitrogen import:







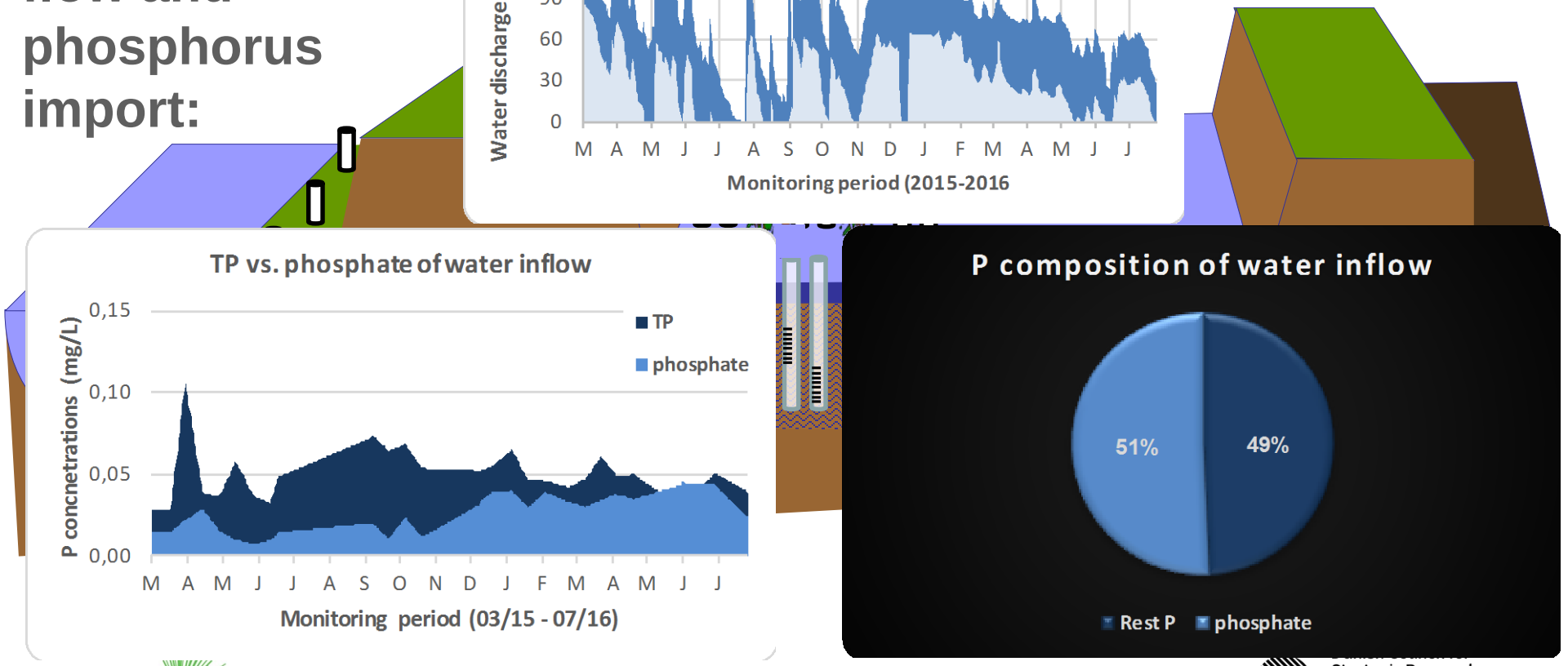
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

Danish Council for Strategic Research

BUFFERtech

Results,

about the water flow and phosphorus import:



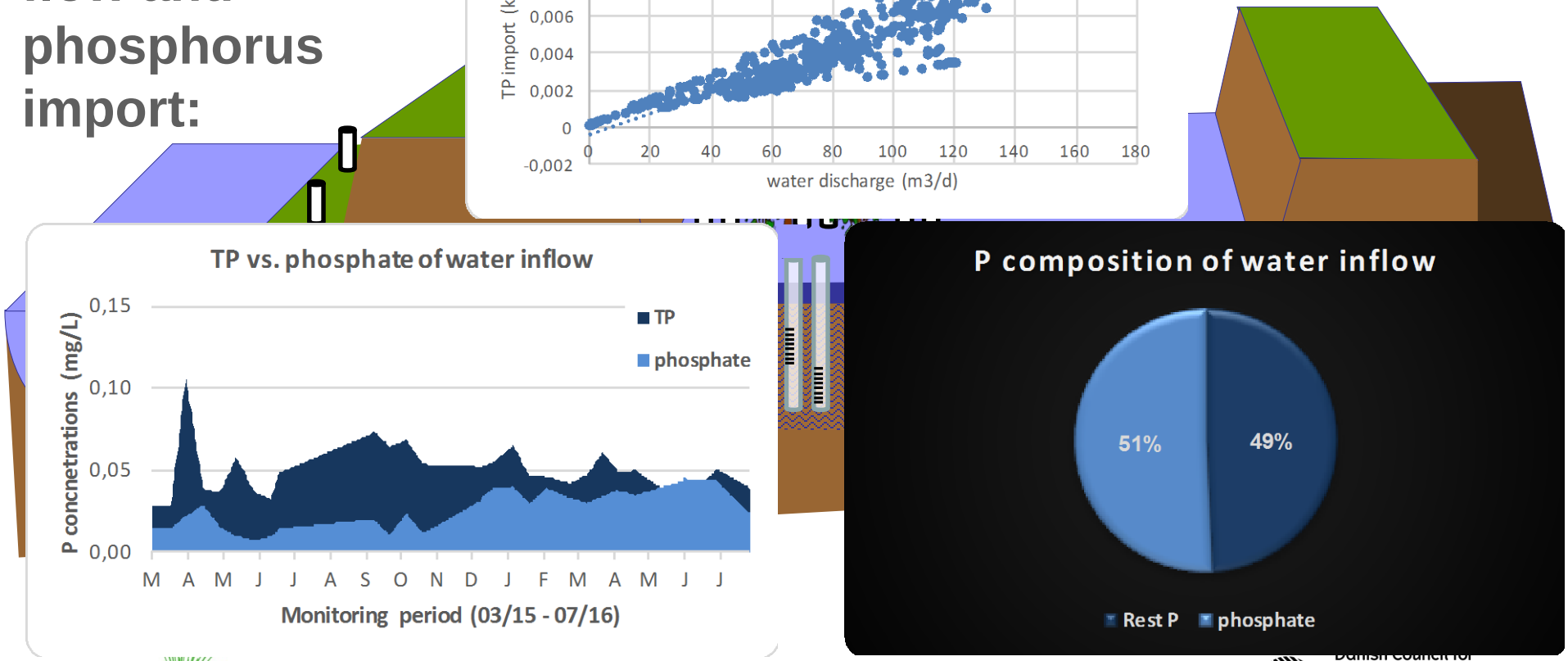
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

Strategic Research

BUFFERtech

Results,

about the water flow and phosphorus import:



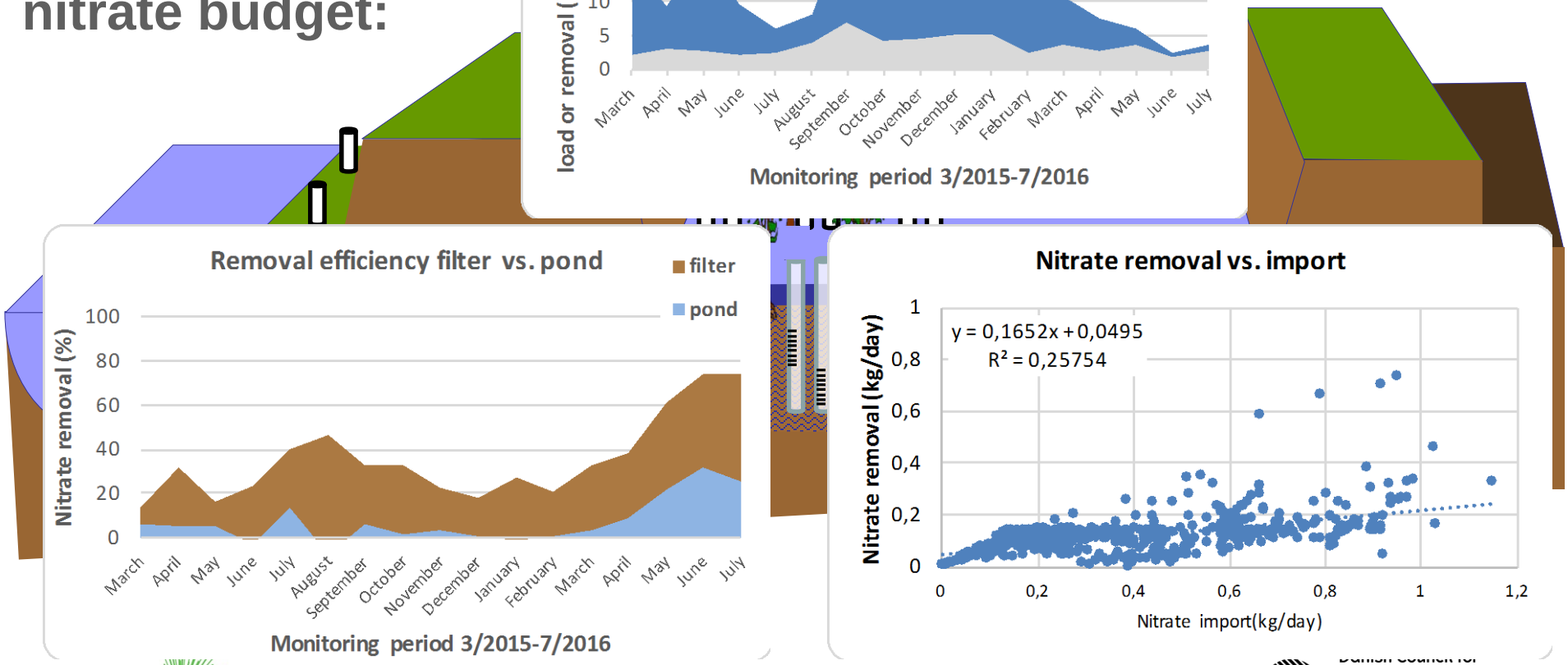
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

Danish Council for Strategic Research

BUFFERtech

Results,

about the nitrate budget:



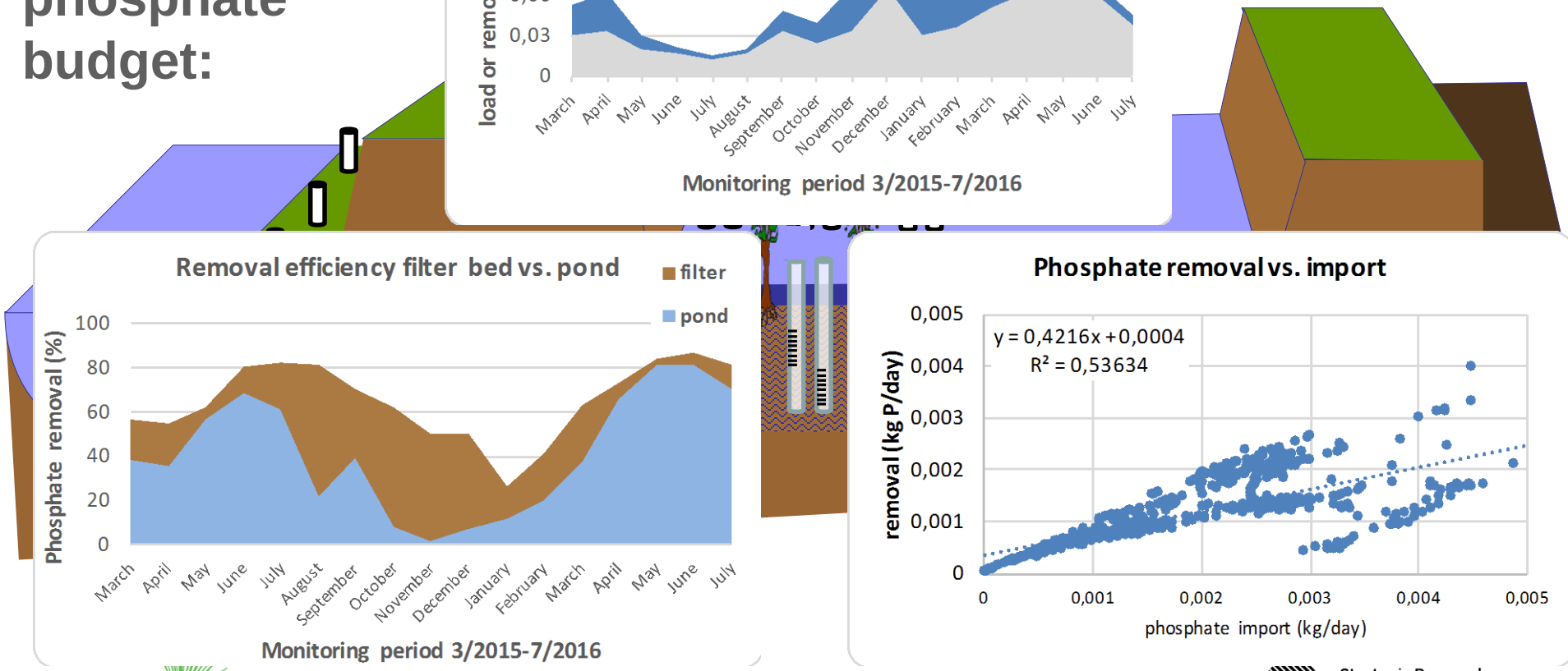
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

Danish Council for Strategic Research

BUFFERtech

Results,

about the phosphate budget:

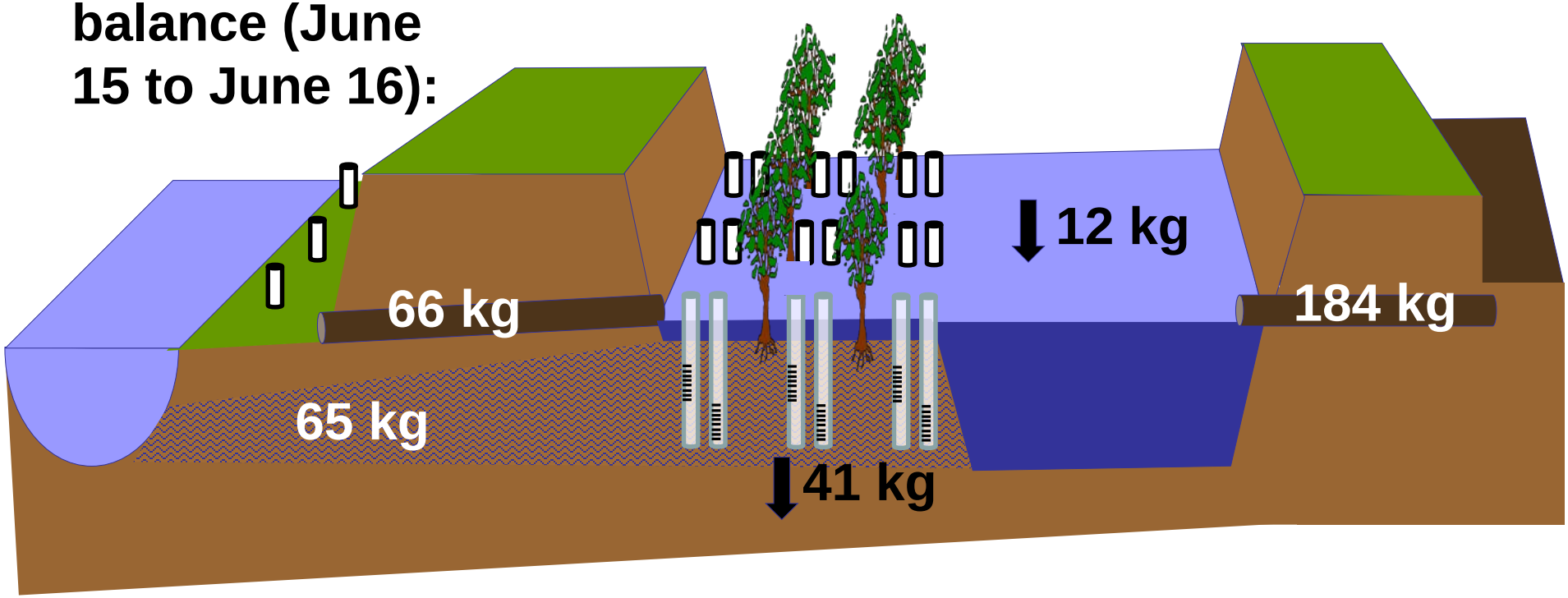


InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

Strategic Research

To sum up,

the annual TN balance (June 15 to June 16):

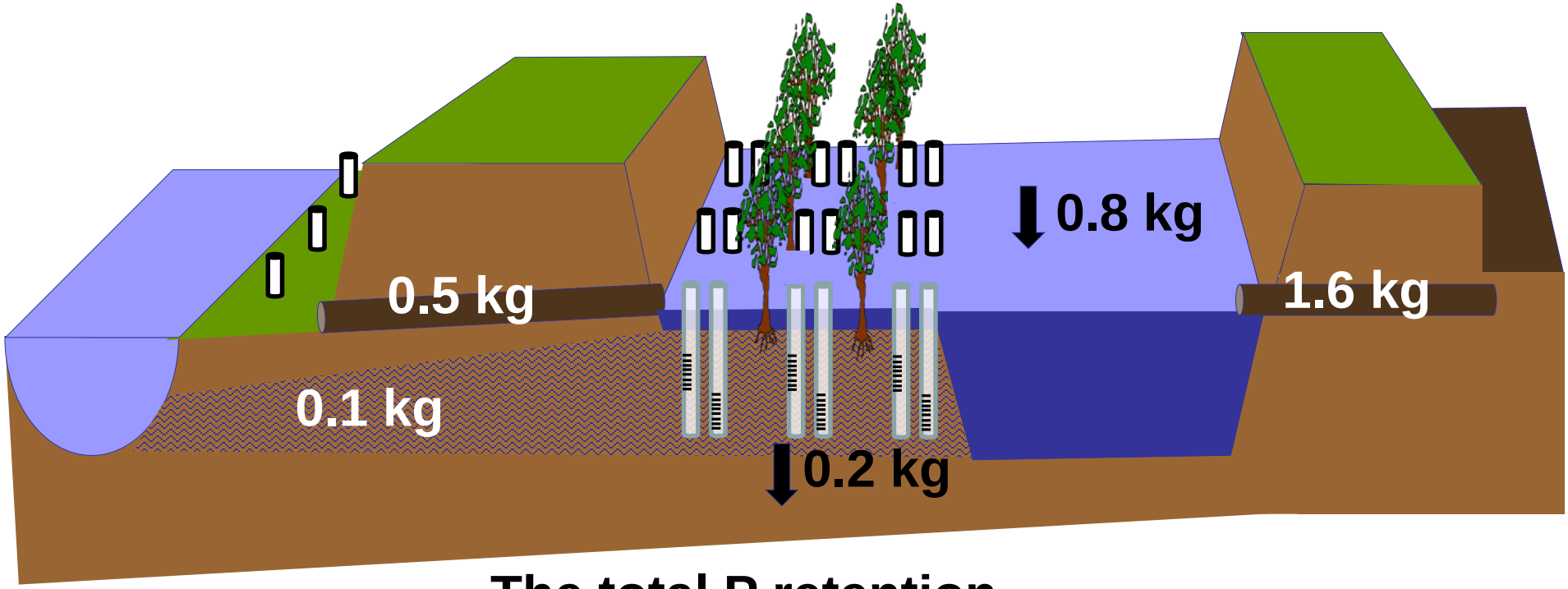


The total N retention per ha and year: 2400 kg!

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech



The total P retention per ha and year: 32 kg!

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

BUFFERtech

IBZ's will also capture most of surface runoff from fields and the transported sediment, phosphorus and organic nitrogen – an example is from the IBZ test facility at Spjald, western Jutland

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

Fazit & Question

1. **IBZ are efficient wetlands to mitigate the nutrient pollution of streams throughout the year!**

2. **However, the highest efficiency is observed during summer, with highest seasonal impact for the pond!**

3. **What can we do to improve their efficiency and how they will perform over long-term?**

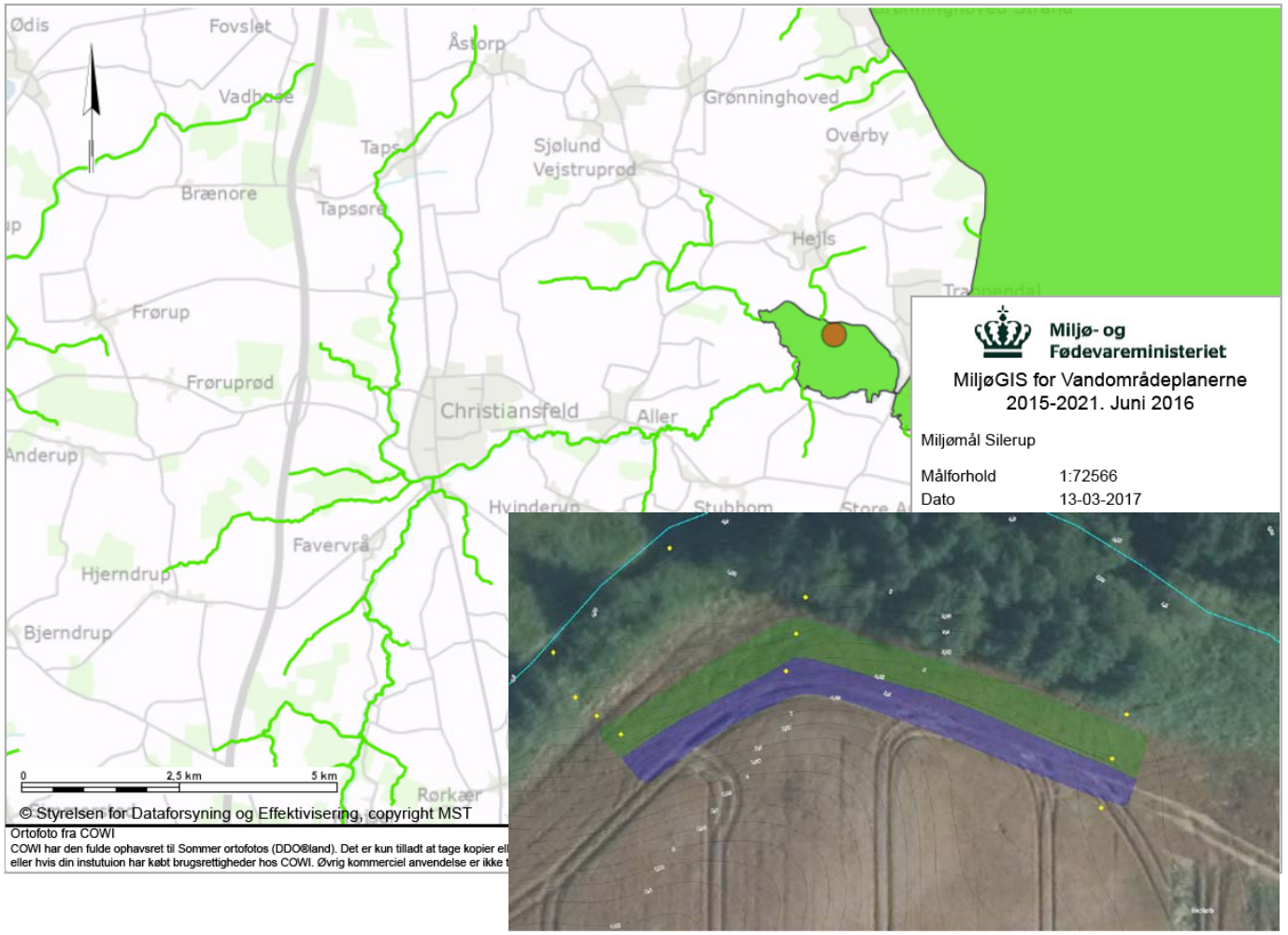
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK

The Danish Council for Strategic Research

Mange Tak!

Outlook

2 MILL. DKR FUNDING FOR ESTABLISHING TWO NEW FULL SCALE DEMONSTRATION IBZ'S DEZ 2016 LINKED TO THE INNOVATION FOUNDATION PROJECT 'BUFFERTECH'



The first IBZ will be established and instrumented in May 2017 at the Sillerup stream in Southern Jutland.

InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK