Ecological key factors

An introduction

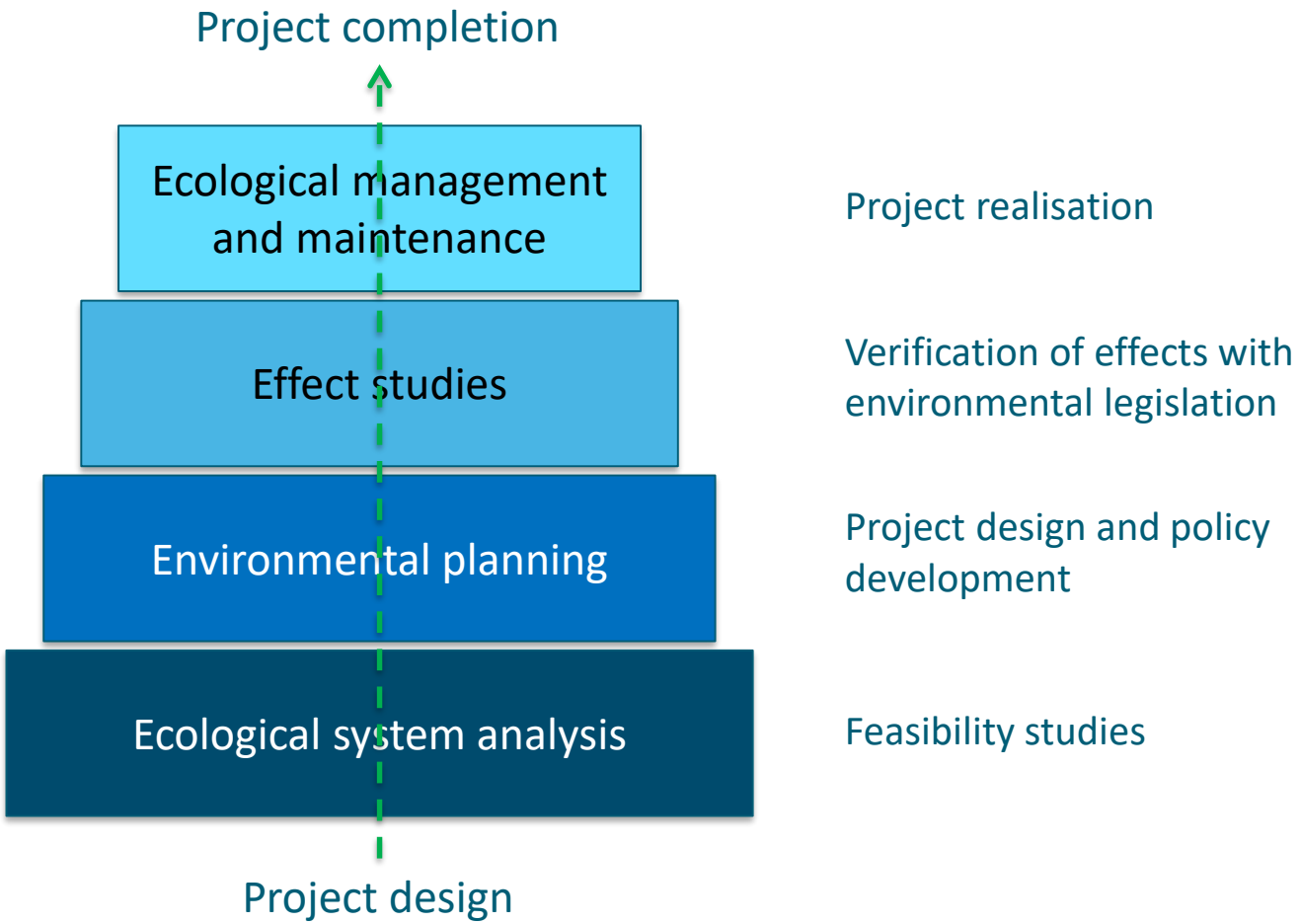
Marloes van der Kamp & Guus Kruitwagen

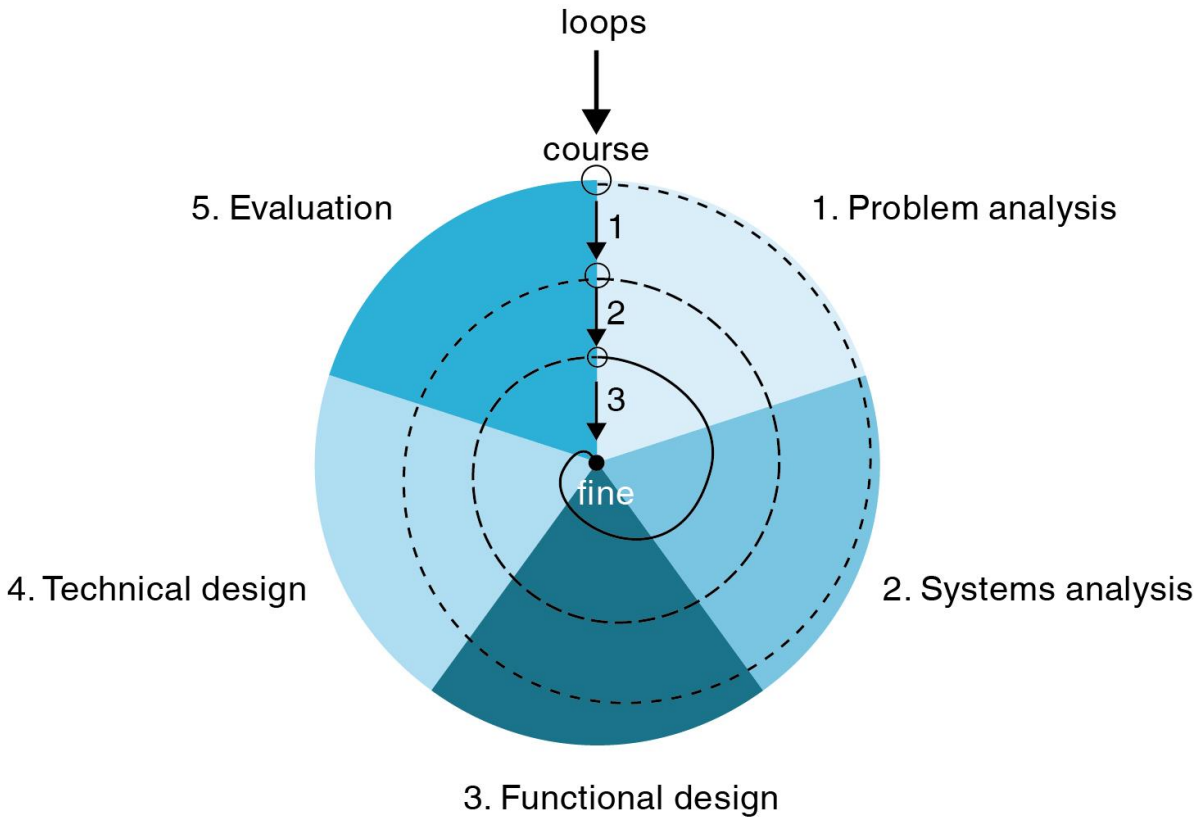
Marloes van der Kamp

- Aquatic ecologist, system analysis group Witteveen+Bos
- Graduate Wageningen university
- Waterboards

- Ambition in work:
  - Increase sustainability of water management in NL and abroad

- Ambition for today:
  - First insight in the ecological key factors


Project completion
Ecological management and maintenance
Effect studies
Environmental planning
Ecological system analysis
Project design
Project realisation
Verification of effects with environmental legislation
Project design and policy development
Feasibility studies


loops
course
5. Evaluation
1. Problem analysis
1
2
3
fine
4. Technical design
2. Systems analysis
3. Functional design

Witteveen + Bos

Focus

- What all of us have in common:
  - Our focus is on understanding of ecological functioning
  - No focus on individual species
  - We think in terms of processes and factors

- For example:
  - How can we create conditions to encourage a specific type of nature?
  - How will a project influence the characteristics of an area?
  - Which factors have caused water quality problems?

...and who are you?

System analysis

What is it and how does it help you?

Why use system analysis?

- Challenge for water managers all over the world:
  - Maintain and restore good water quality
  - Selection of the most effective water quality measures

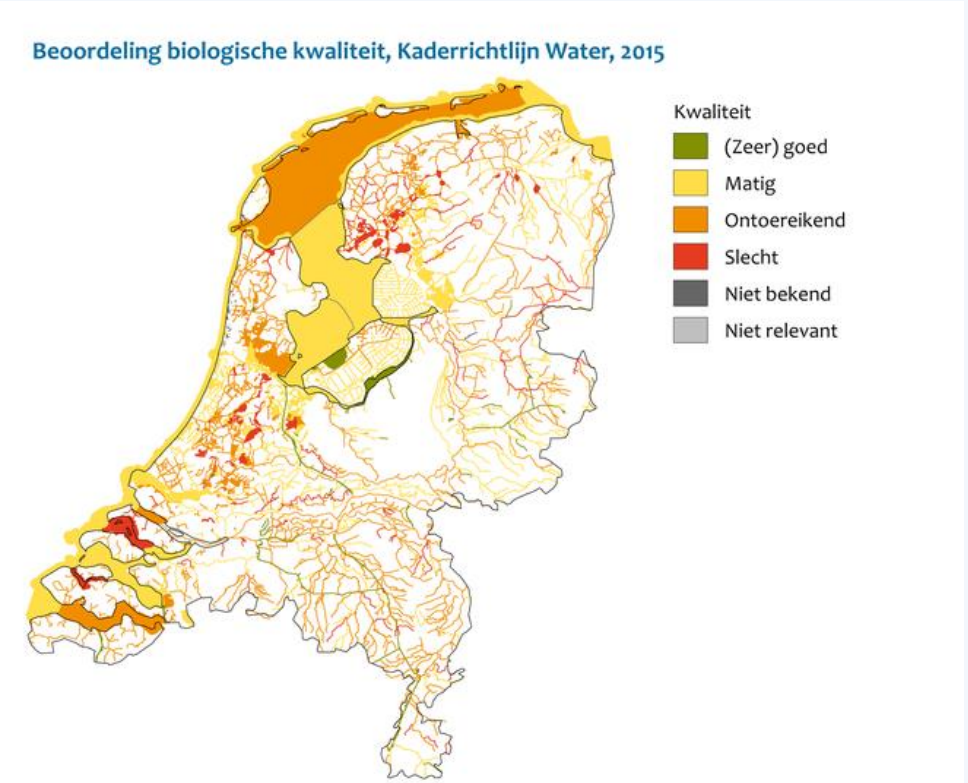
- Much trial and error in application of measures
- Goal : Less spending, more effect

Water framework directive

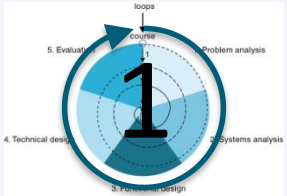
- Targets defined
- Water quality assessment
- Comparison to targets

- Aim:

realistic goals and effective measures

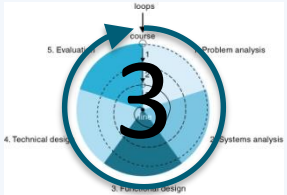


System analysis in loops



- Identification of key issues and processes
- Do we do the right thing?

- Design of applicable measures
- Verification whether desired effect will be achieved



- Fine tuning

System analysis

- ...is NOT a product
- It's a way of thinking

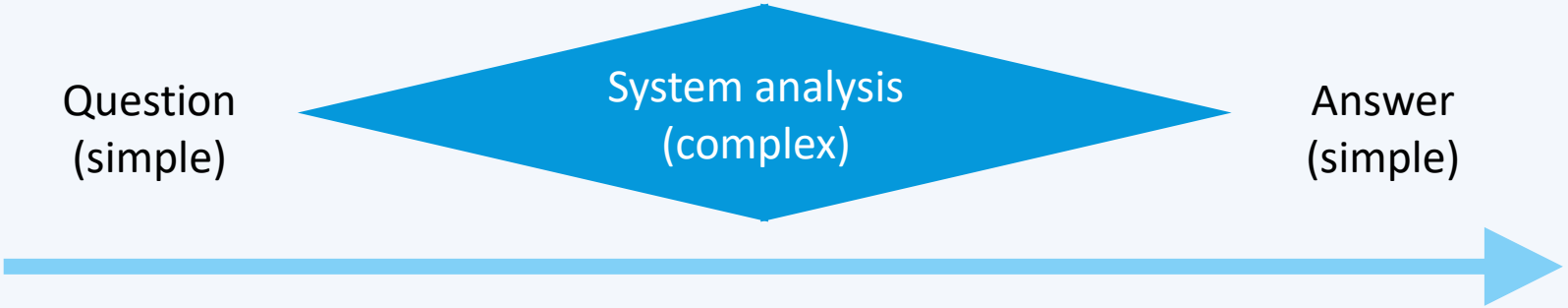
System analysis approach

- How to perform a system analysis?
  - Question as central element
  - System analysis should provide you the answers
  - The correct answer is obtained by creating understanding of the water system

- Do we understand the system sufficiently?

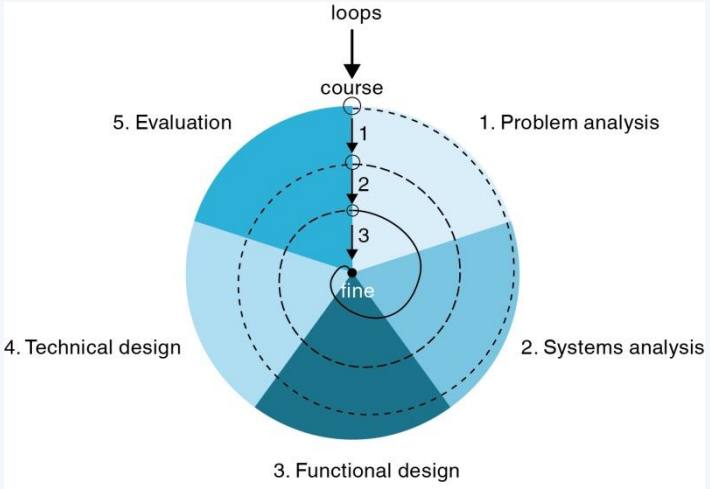
- Not production of reality
- We learn from differences between models and observations

System analysis approach

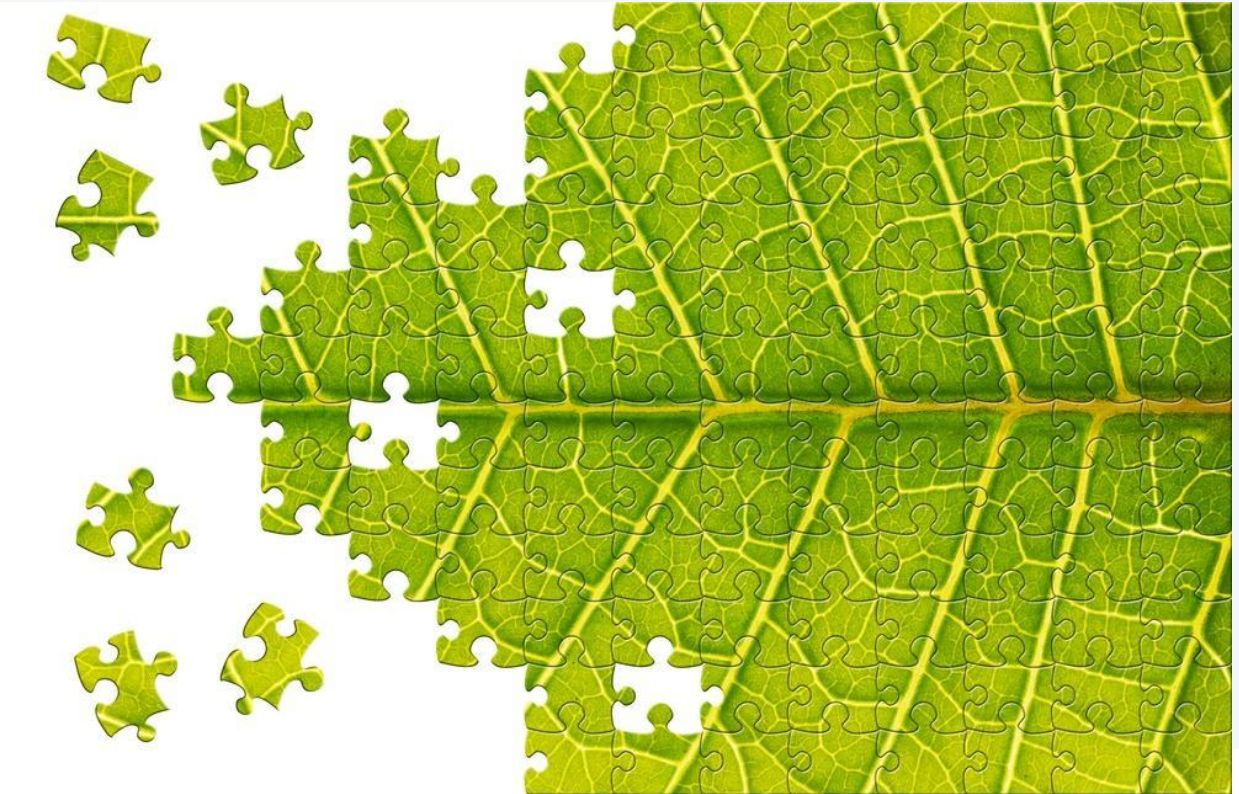


System analysis approach

- Approach differs by question
  - Add as much detail as required to answer your questions
  - …but not too much
- Proceed with caution, don’t get lost in details



One goal, two approaches

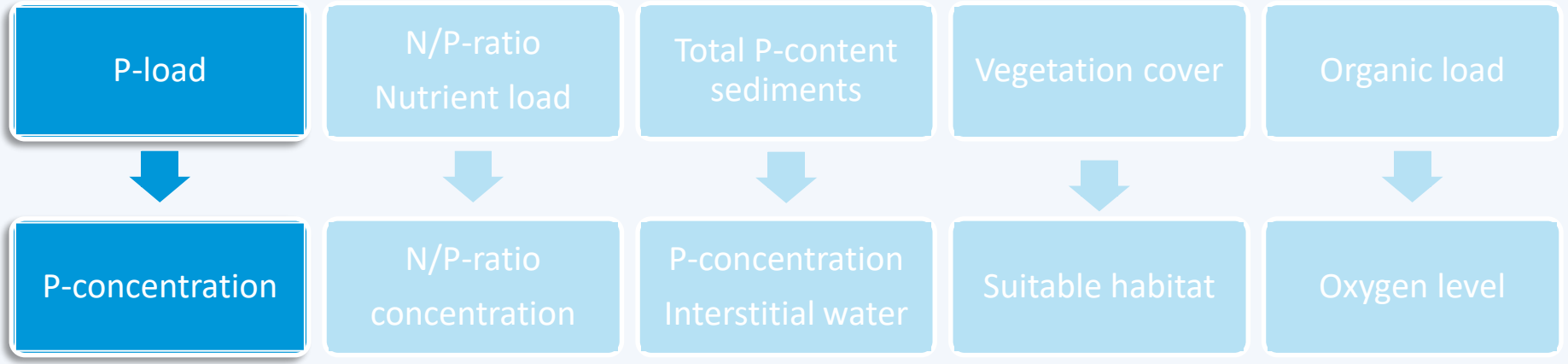


Current condition versus precondition

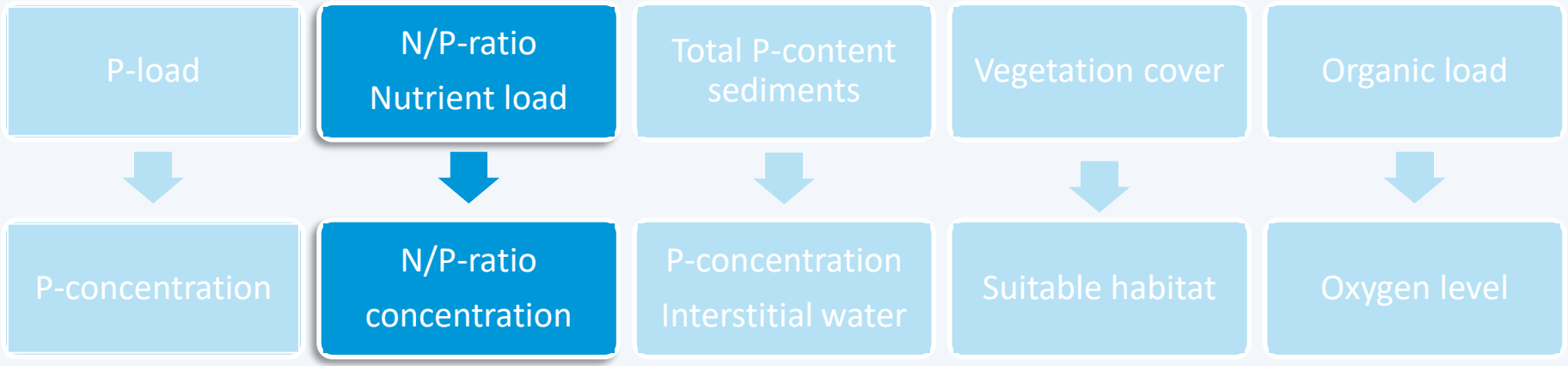
- Current condition
  - What can we see / measure?

- Precondition
  - Which factors have led to this situation?

Current condition versus precondition



Current condition versus precondition



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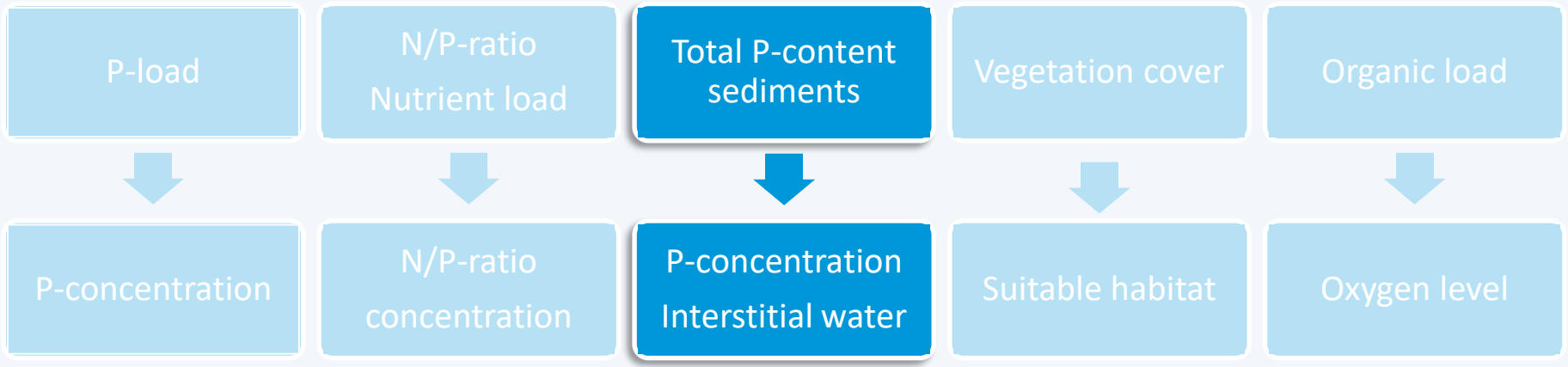

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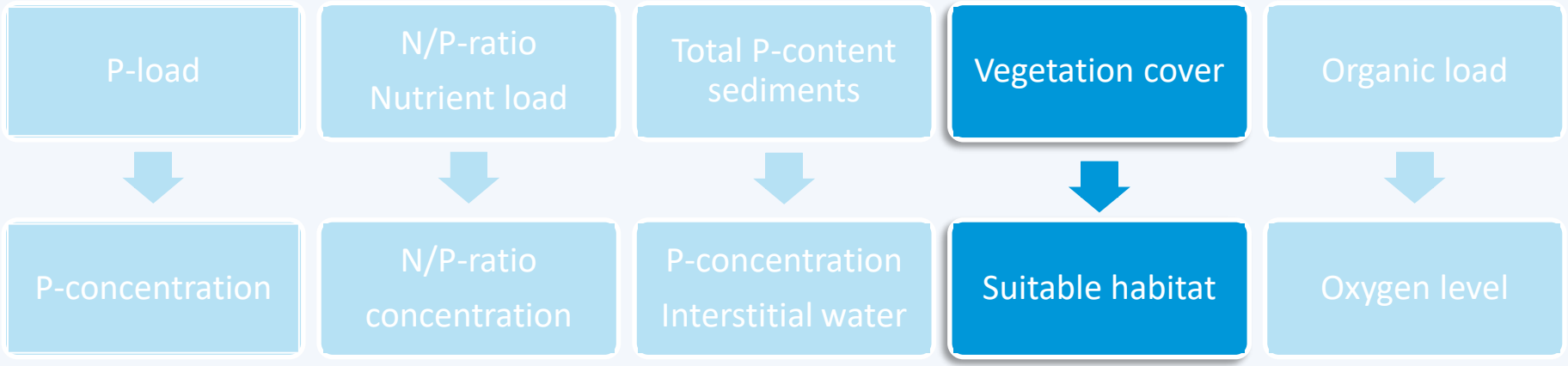
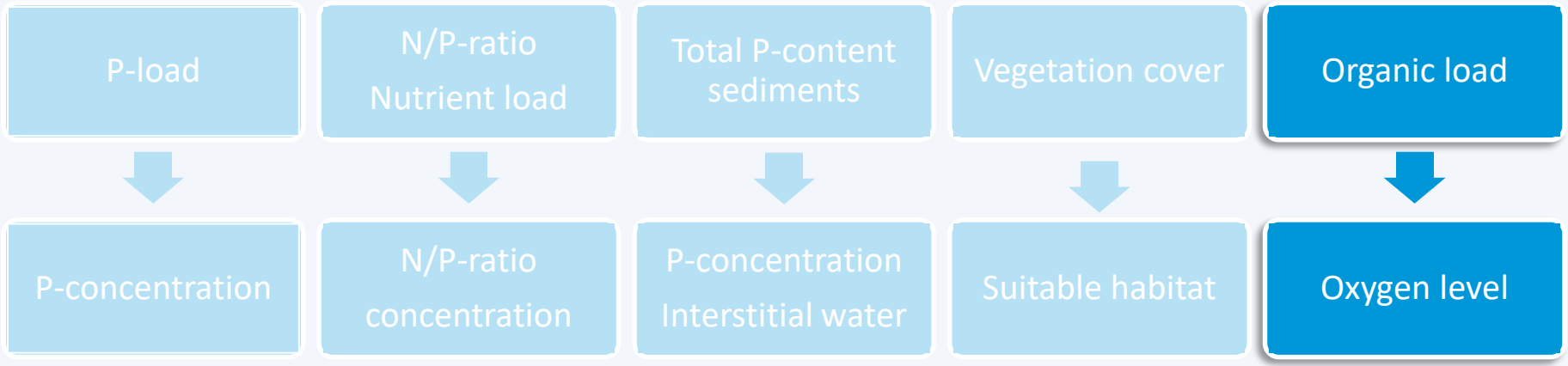
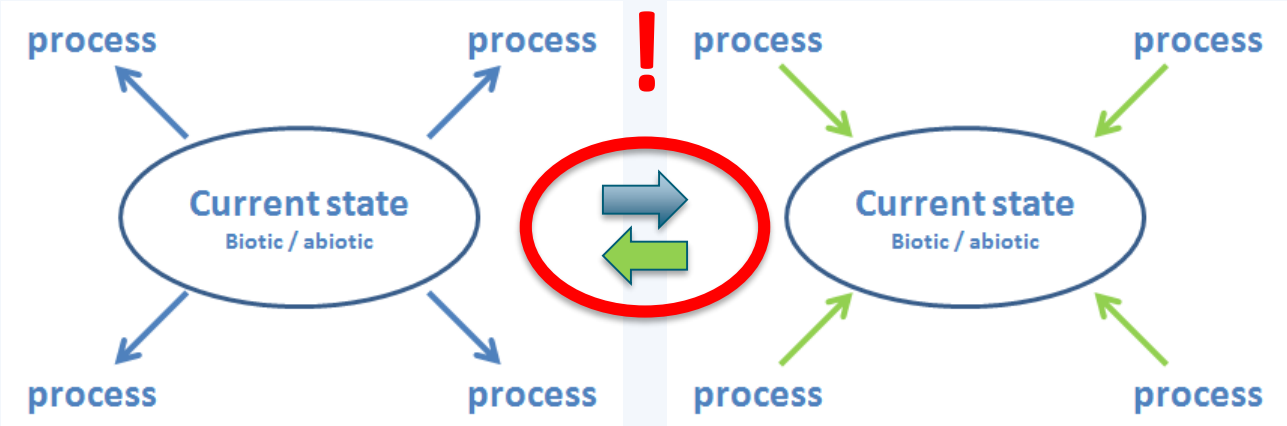


Current condition versus precondition

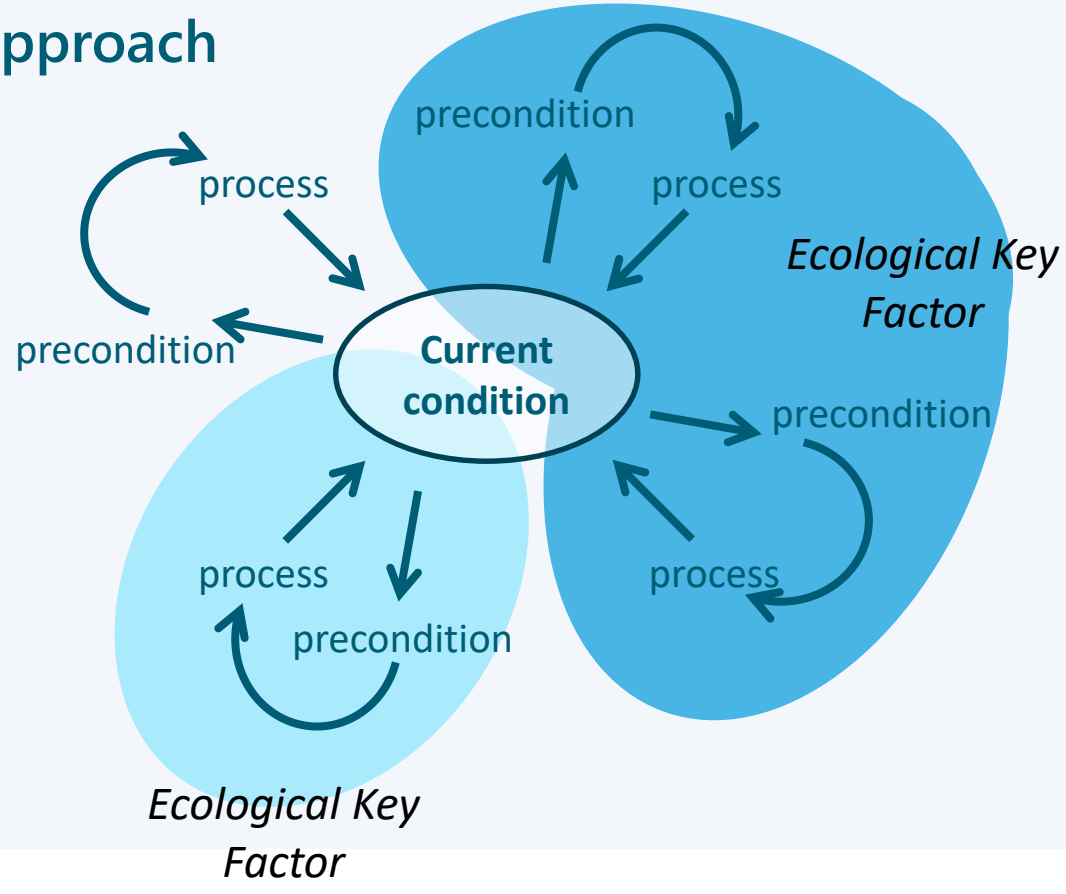


System analysis approach

1. Current and historical condition — *What tells the state about defining processes?*
2. Model predictions of current state — *What can we expect based on the defining processes?*
3. Confrontation / dialogue



System analysis approach



Ecological Key Factors

- Describe the conditions that have to be met to enable good water quality
- Confrontation current state and processes
- EKFs describe the complex of current state, processes, and interactions

Ecological Key Factors

- Hierarchy
- Traffic light concept: only proceed when preceeding EKFs are ‘green’
- Tool for identification of the most effective measures

Ecological Key Factors

- Conceptual framework to structure assessments
- Meant as guidance, not obligatory
- Continuing development

Ecological Key Factors for stagnant water & floating water

Ecological Key Factors

Productivity of the water | *Light climate* | *Productivity of the sediments* | *Habitat suitability* | *Connectivity*

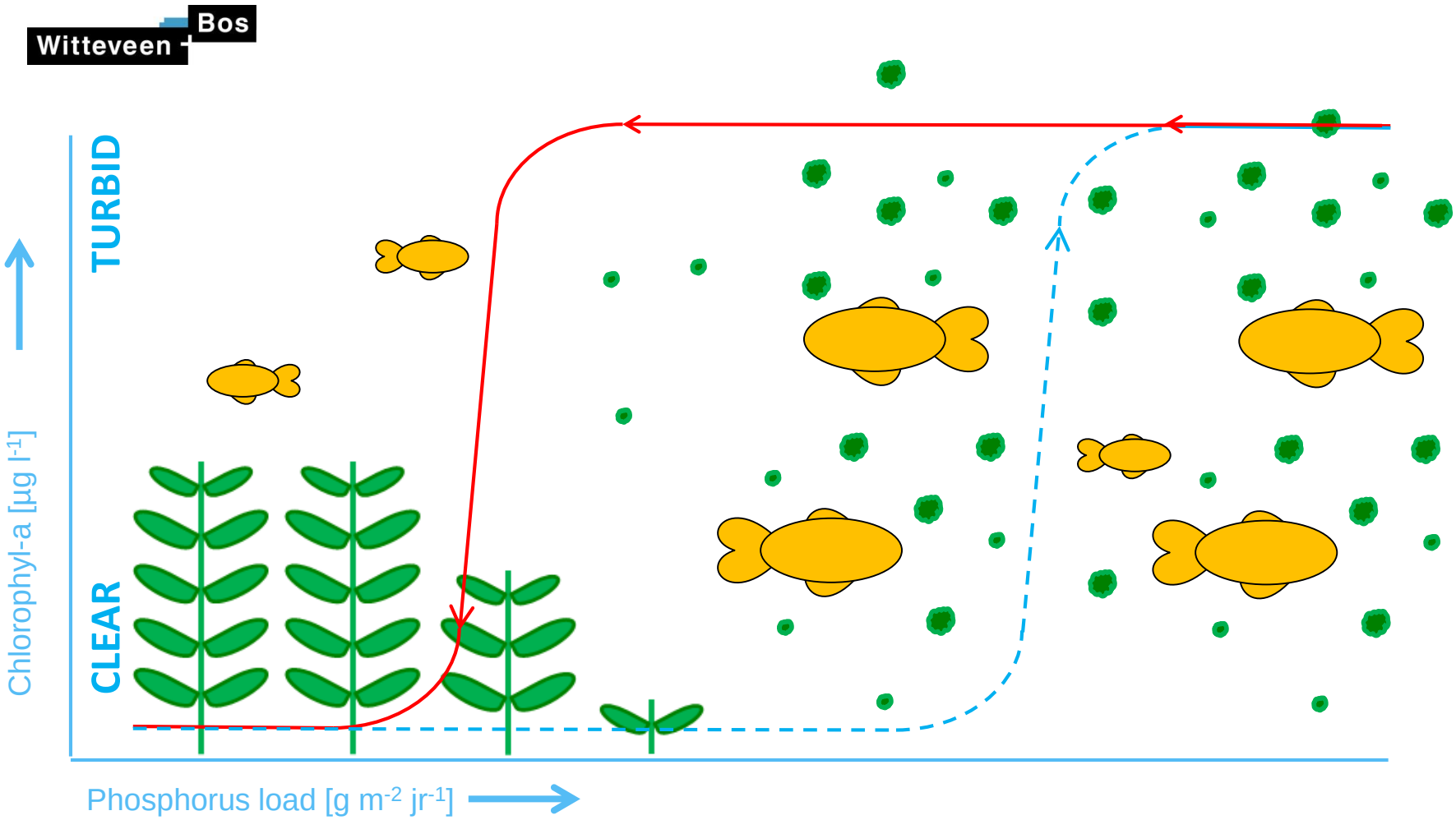
Removal | *Organic loading* | *Toxicity* | *Experience*

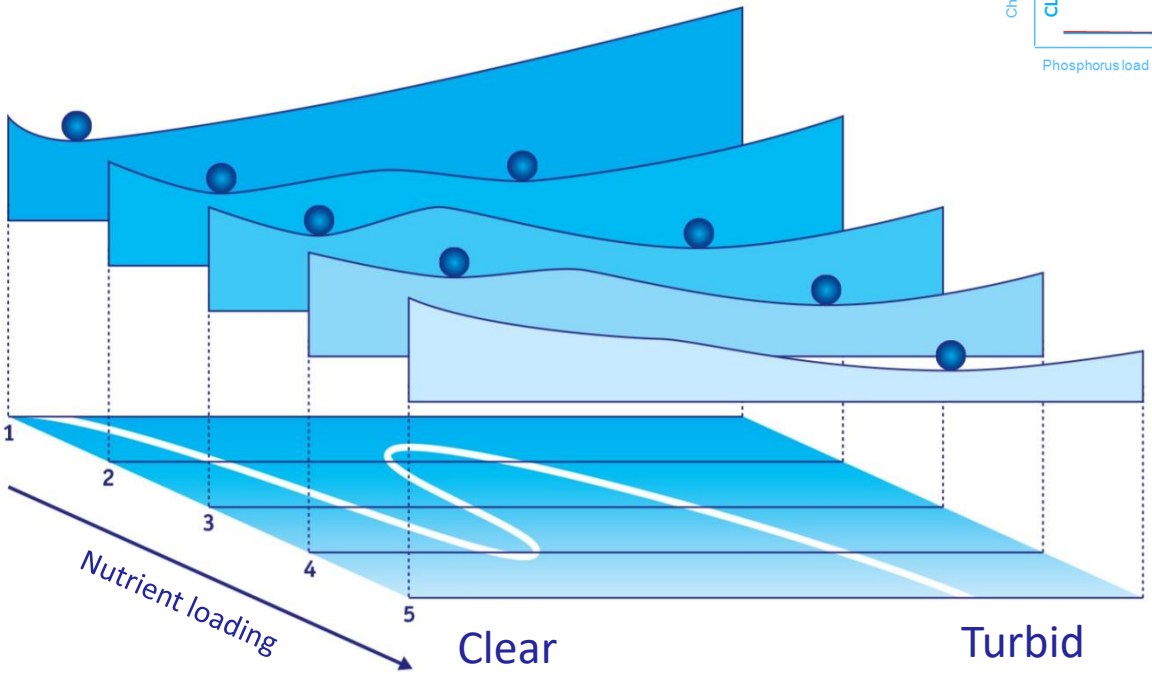
EKF1: Productivity of the water

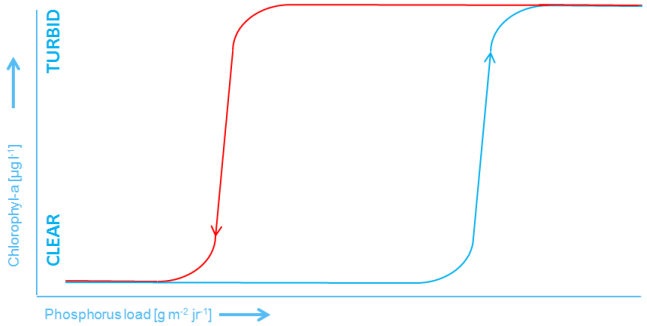
- Central question:
  - Does the nutrient level support the development of submerged aquatic vegetation?

- Precondition:
  - Nutrient loading < Critical nutrient load

EKF1: Productivity of the water


Witteveen + Bos
TURBID
CLEAR
Chlorophyl-a [µg l-1]
Phosphorus load [g m-2 jr-1]


1
2
3
4
5
Nutrient loading
Clear
Turbid


TURBID
CLEAR
Chlorophyl-a [µg l-1]
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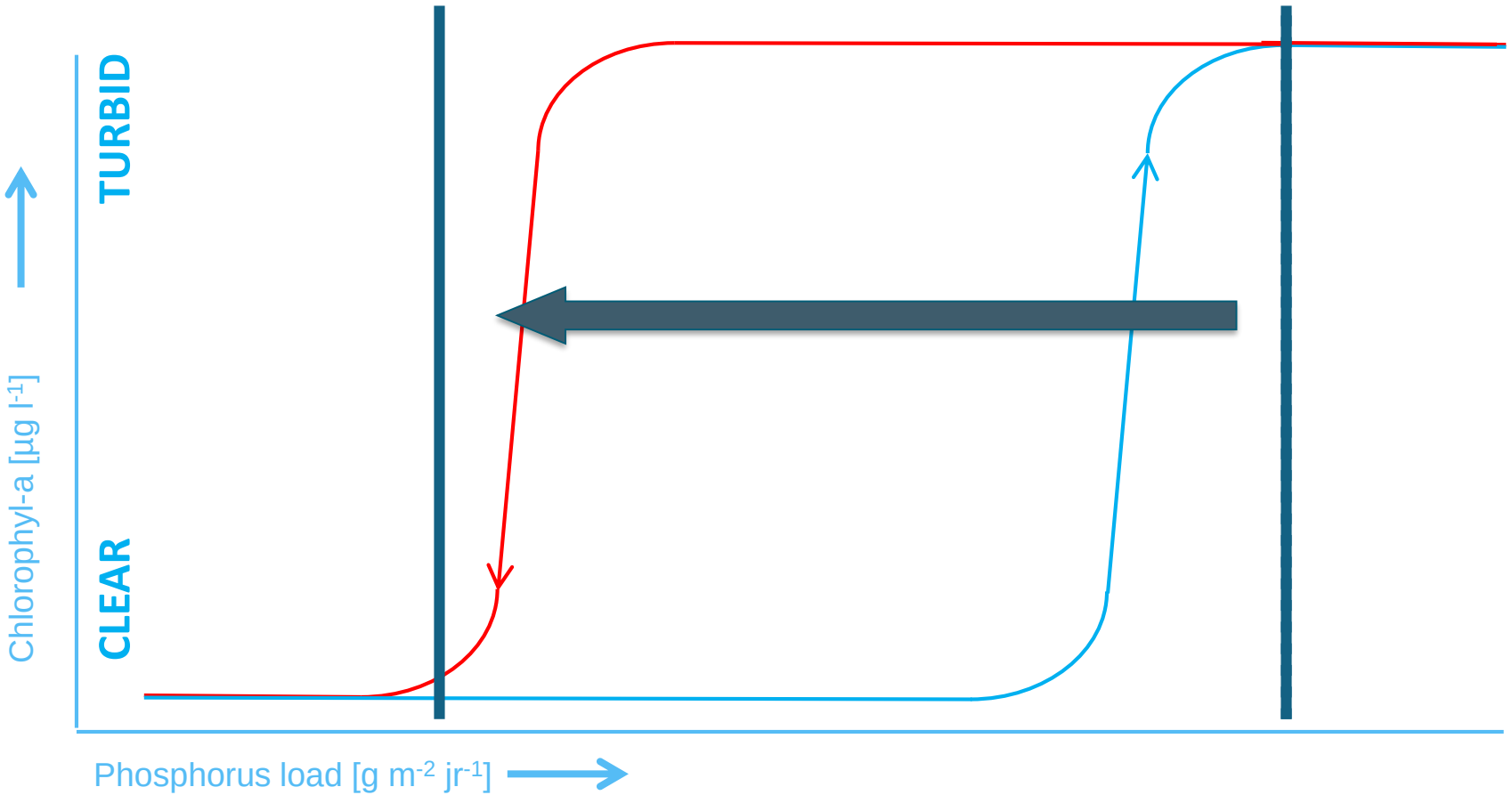
Witteveen + Bos

Type I: Source measure



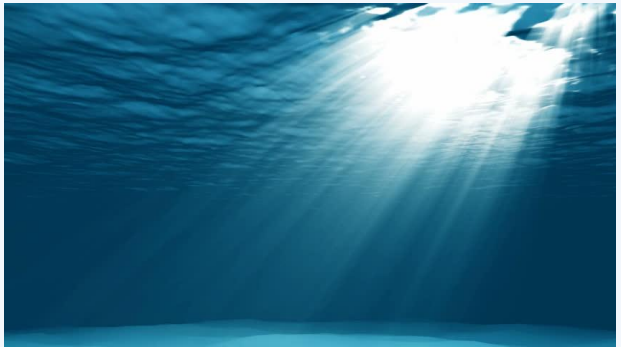
Common used tools

- Water- nutriënt balances
- Ecological model PCLake

EKF2: Light climate

- Central question:
  - Does sufficient light reach the sediments to enable germination of seeds?

- Precondition:
  - Amount of light reaching the sediments exceeds the minimum amount of light required for germination of seeds



EKF2: Light climate

Tools

- General rule
  - Transparancy / waterdepth < 0.6
- Attenuation models

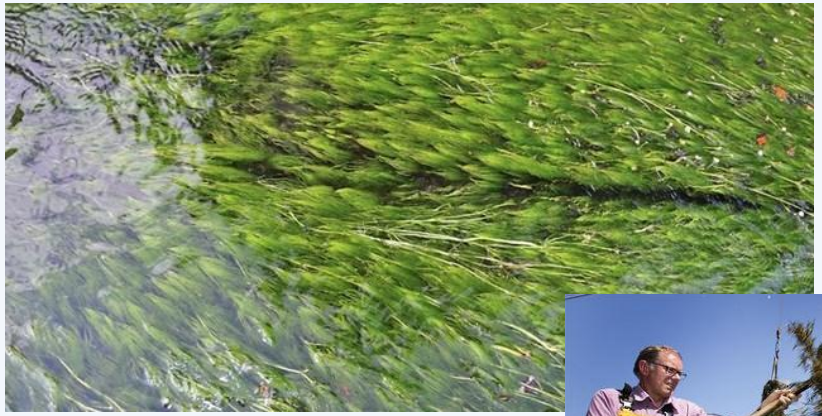
EKF3: Sediment productivity

- Central question:
  - Does the nutrient availability in the sediments enable development of a species rich submerged vegetation?

- Precondition:
  - Nutrient availability < critical nutrient load

EKF3: Sediment productivity

EKF3: Sediment productivity

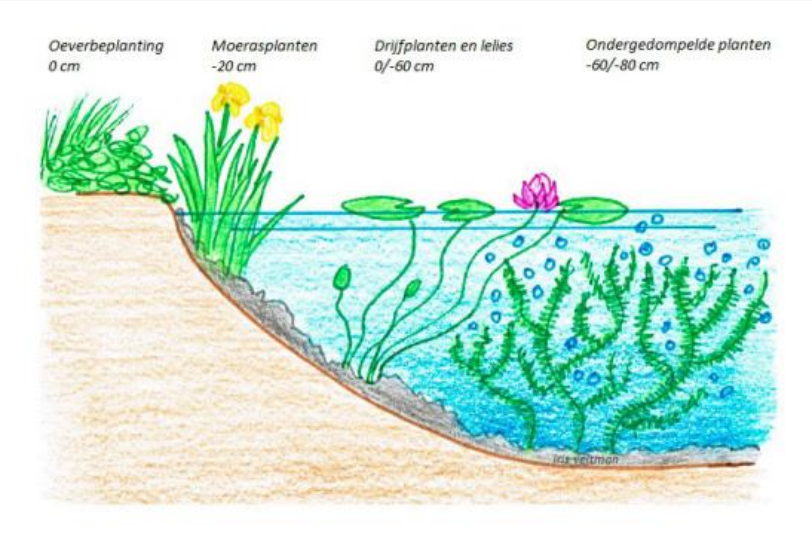


EKF4: Habitat suitability

- Central question:
  - Is habitat availability limiting for the presence and/or abundance of those species that are associated with a good water quality?

- Precondition:
  - Habitat availability > habitat requirement

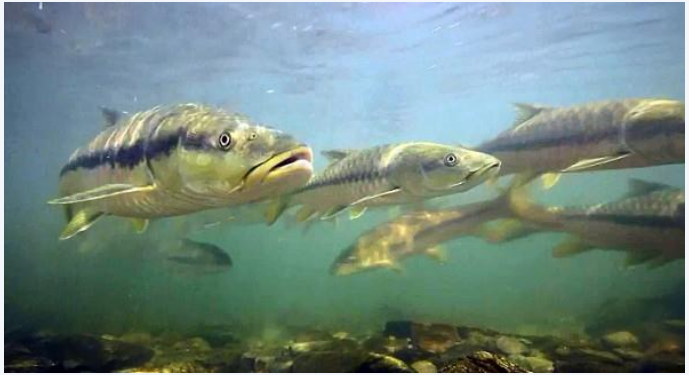
EKF4: Habitat suitability



EKF5: Dispersal

- Central question:
  - Are there any barriers that limit the dispersal of species that are associated with a good water quality?

- Precondition:
  - The water system is reachable for all species



EKF5: Dispersal

EKF6: Removal

- Central question:
  - Is the presence and/or abundance of species limited by disturbance or removal?

- Precondition:
  - Removal/disturbance < carrying capacity

EKF6: Removal

EKF7: Organic loading

- Central question:
  - Does organic loading result in limitations for presence and/or abundance of species?

- Precondition:
  - Oxygen requirement < (minimum) Oxygen availability

EKF7: Organic loading

EKF8: Toxicity

- Central question:
  - Is the presence and abundance of species limited by the presence of toxic substances?

- Precondition:
  - Concentrations of toxins < Carrying capacity of desired species

EKF8: Toxicity

(E)KF9: Context

- Central question:
  - Which ecological condition is desirable from the viewpoint of the socioeconomic functions of the water system?

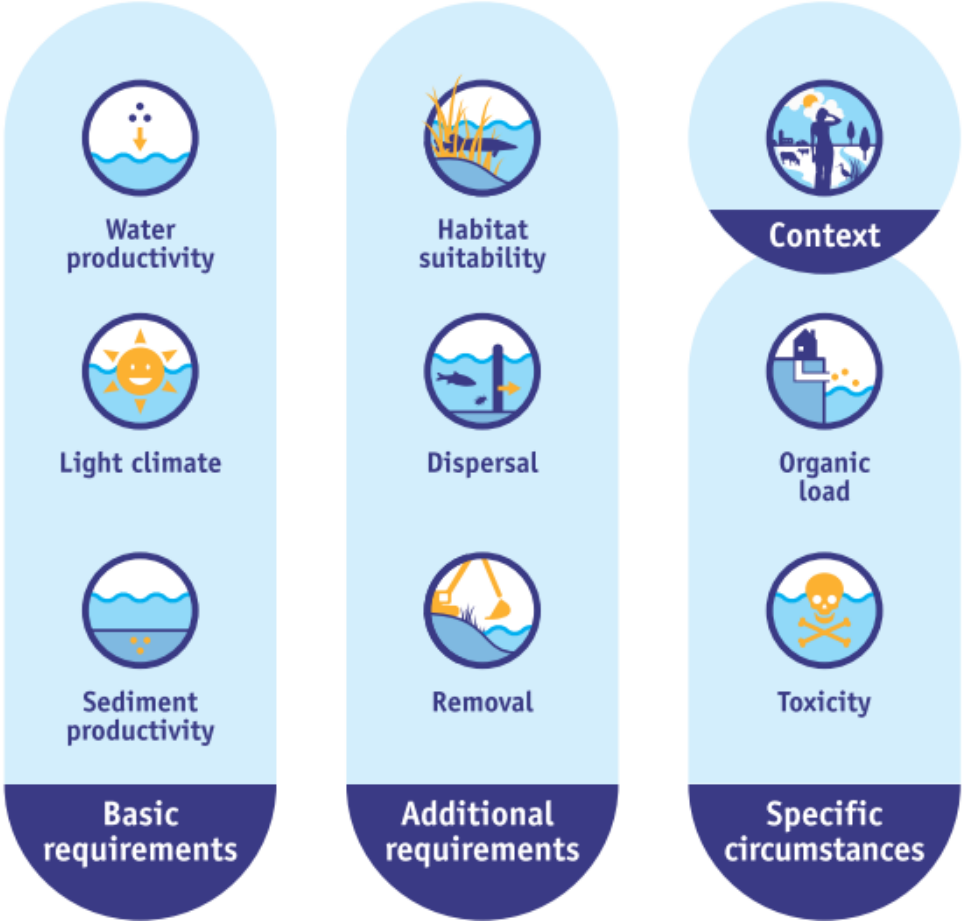
- Precondition:
  - Ecology is compatible with socioeconomic functions

EKF9: Context

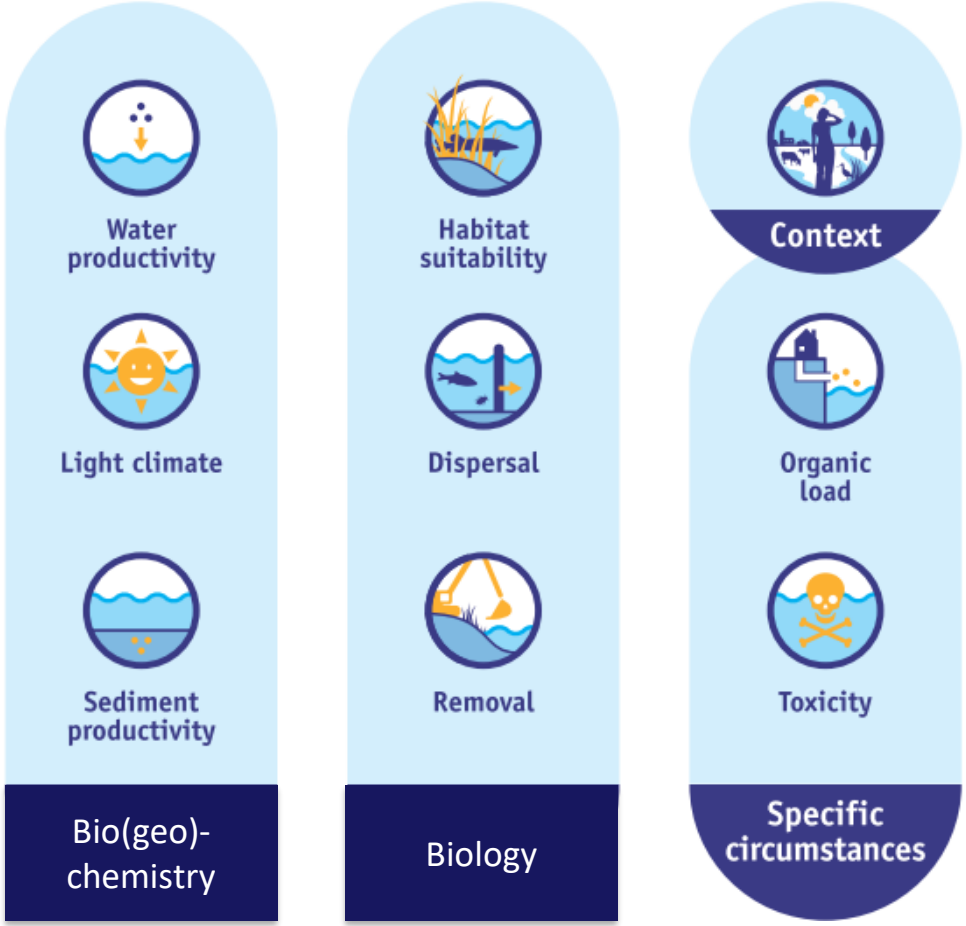





Ecological Key Factors



Ecological Key Factors



Sum-up

The methodology of the Ecological Key Factors can be used:

1. to structure a system analysis;
2. as a means to combine and integrate available information;
3. for identification of (cost-) effective water quality measures;
4. for identification of feasible water quality targets within the existing socio-economic context;
5. as a communication tool.

Ecological Key Factors

- EKFs were developed in NL as tool for WFD
- What's their applicability outside NL and EU?

Questions?

Game

Changi Reservoir

- High ambitions for recreation and residential areas
- Suffering from severe algal blooms

- Budget of SGD 10,000,000 for water quality measures

Changi Reservoir

- Measures and effect…

Case studies

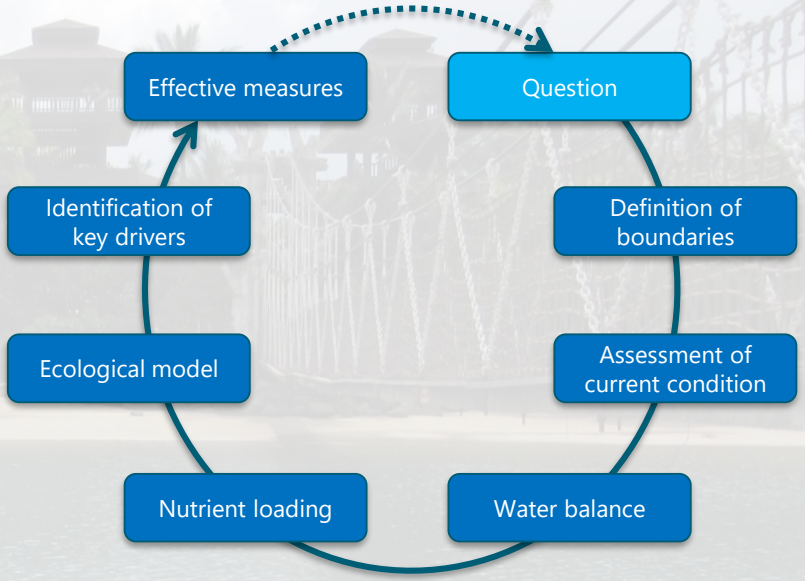
Illustration of use of EKFs and PCLake

Palawan Beach, Sentosa

Palawan Beach, Sentosa

Definition of research question

- Occasional water quality problems
- Adverse effect on tourist enjoyment
- Effective water quality measures?

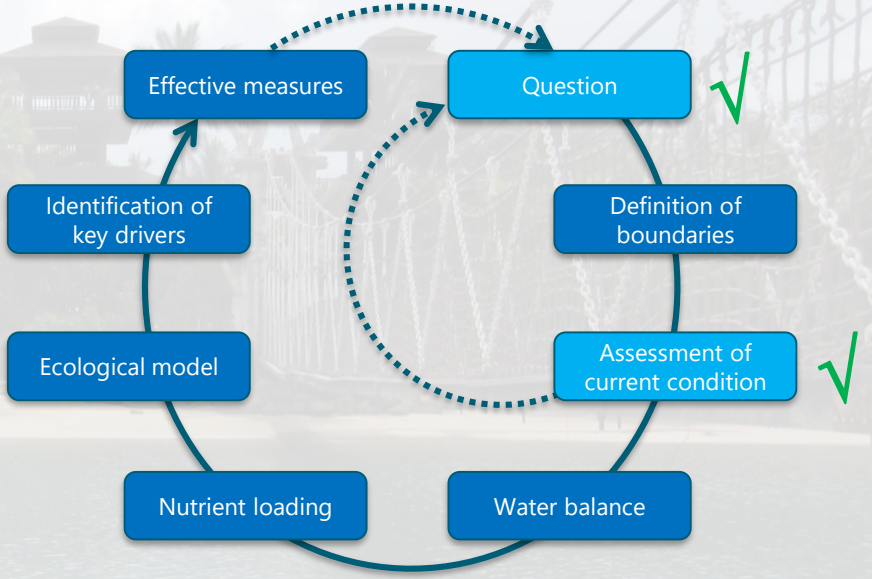


Palawan Beach, Sentosa

Understanding of current condition

- Inventory of day to day management
- Field monitoring of water quality
- Marine biodiversity survey

Palawan Beach, Sentosa



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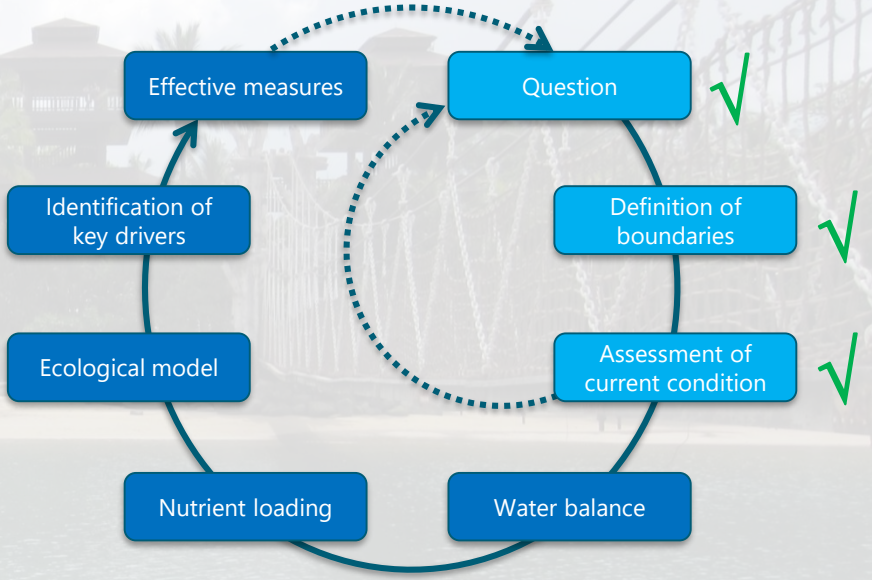
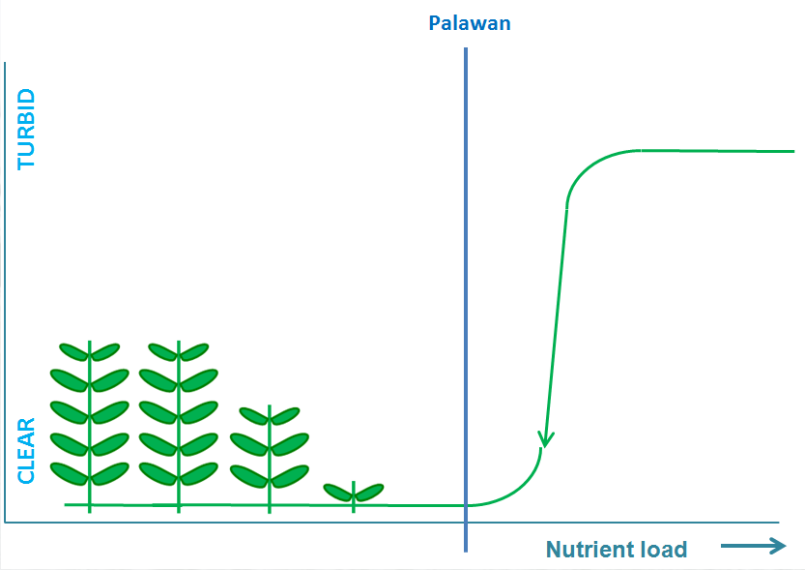
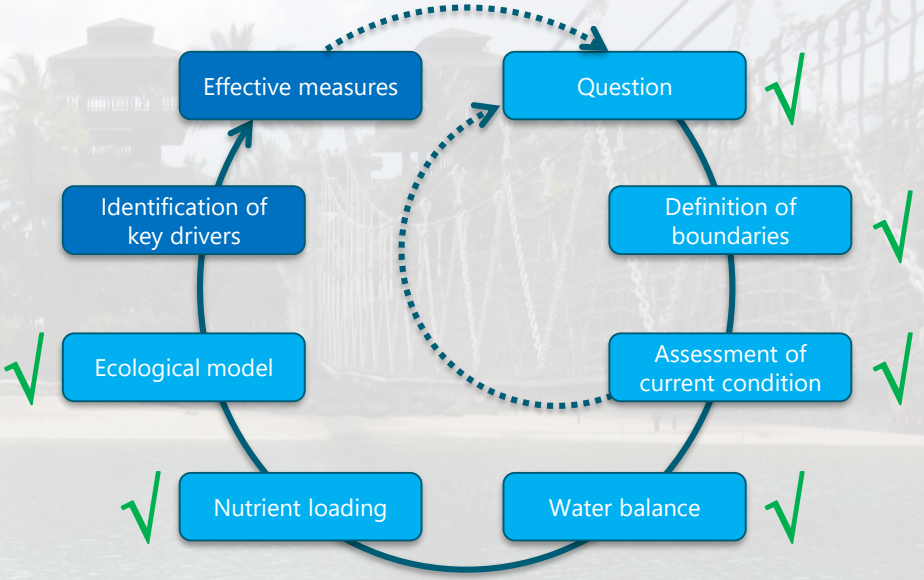


Palawan Beach, Sentosa





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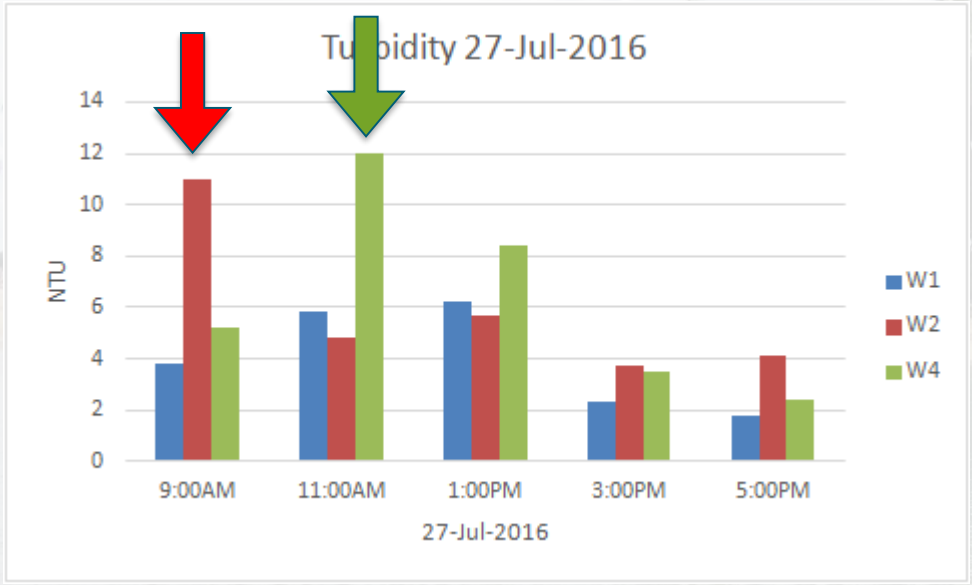
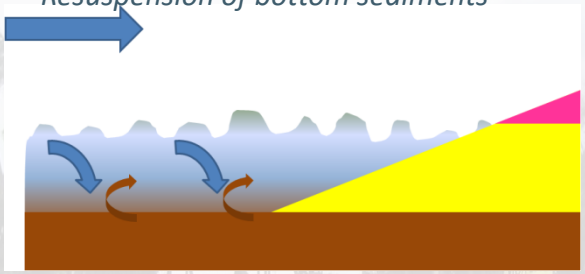
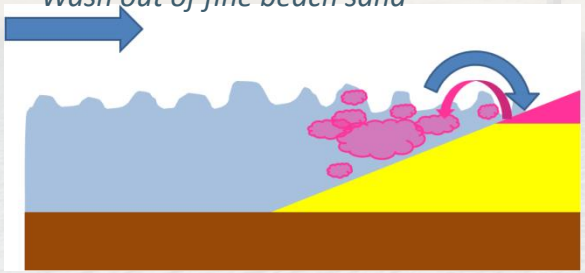


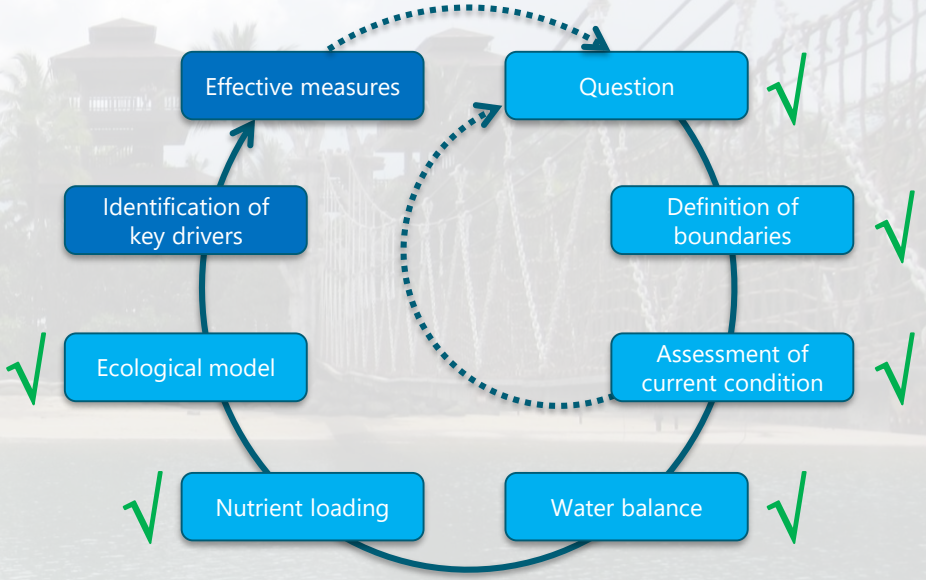
Palawan Beach, Sentosa

Resuspension of bottom sediments

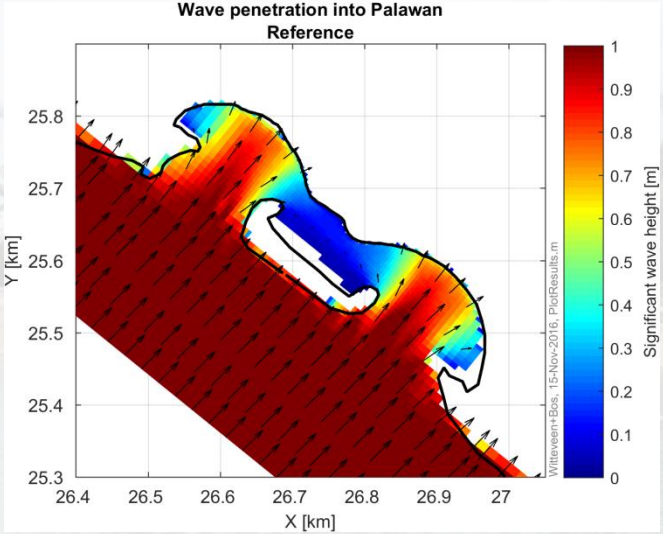


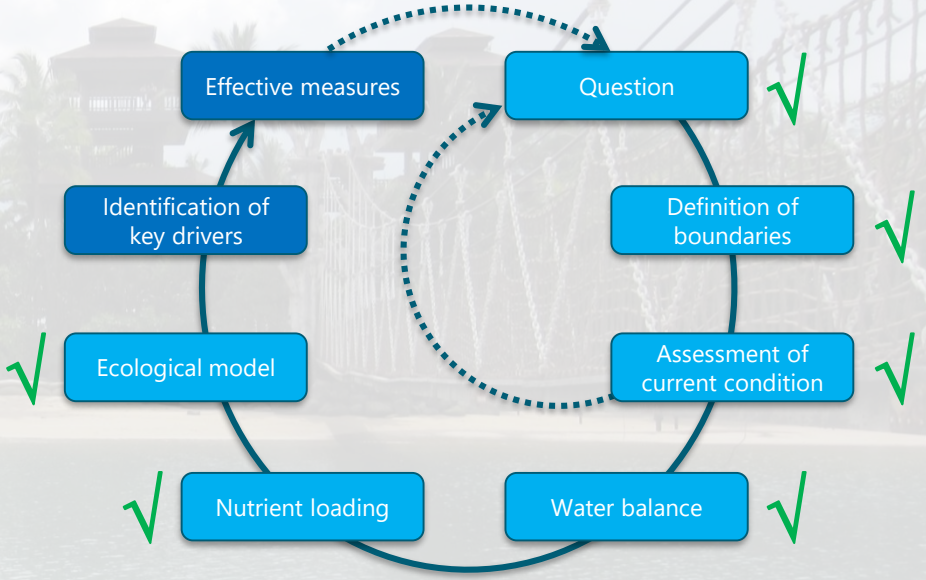
Wash out of fine beach sand





Palawan Beach, Sentosa





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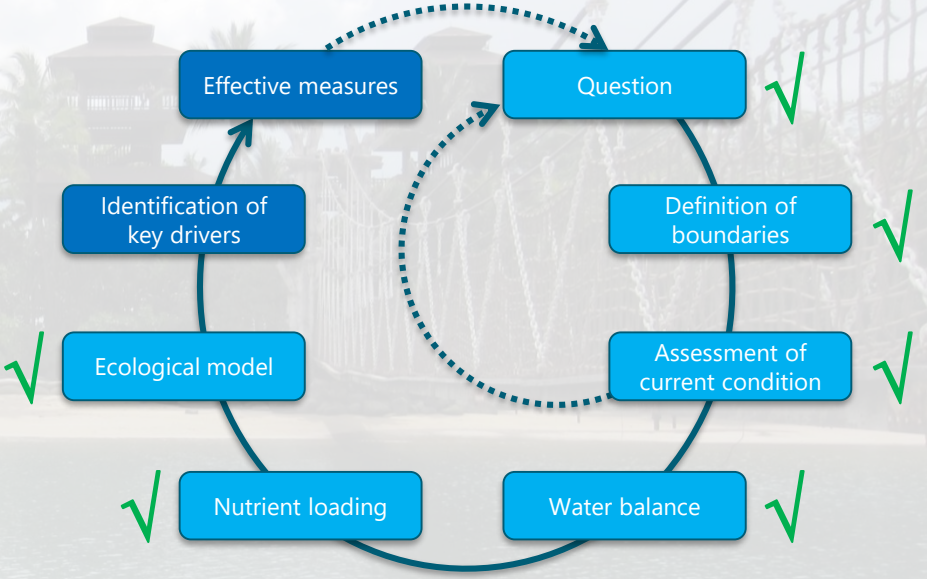

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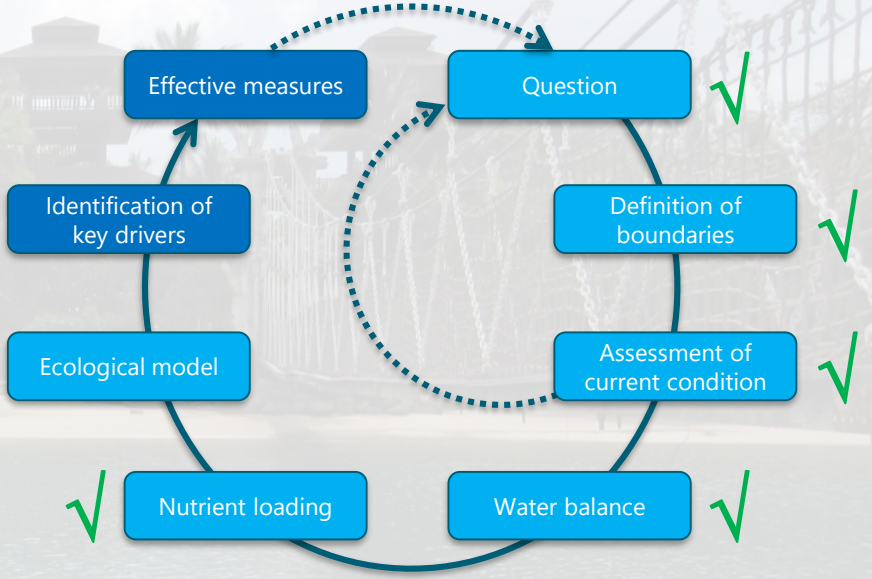

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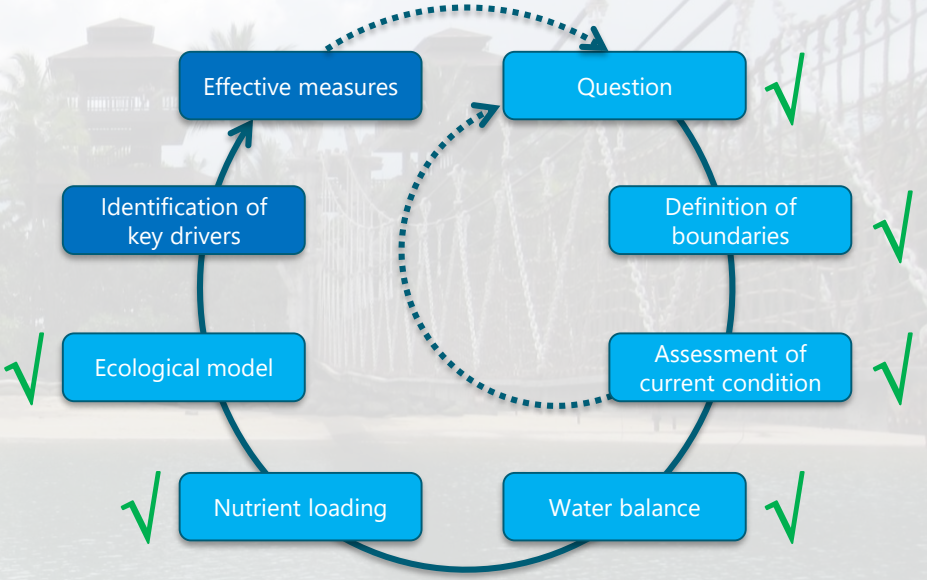

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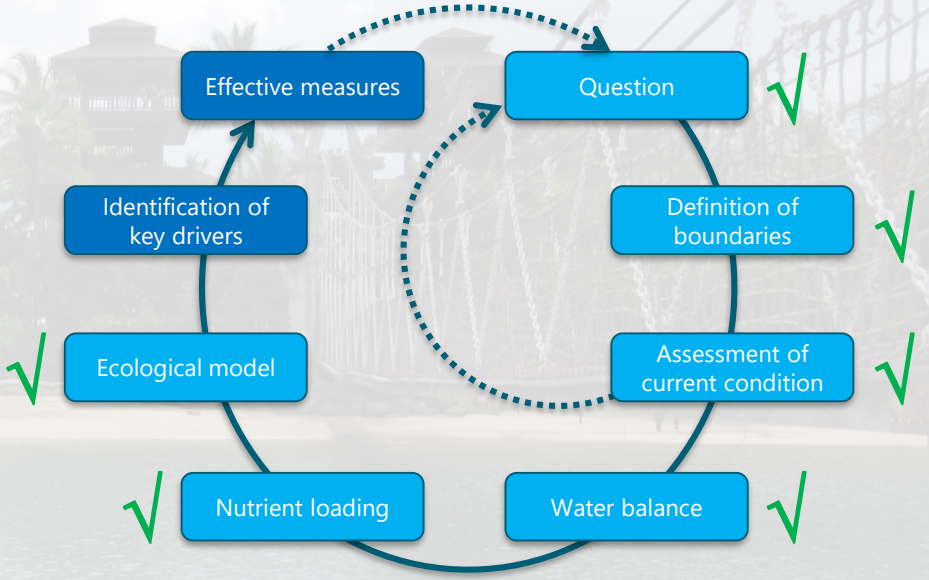
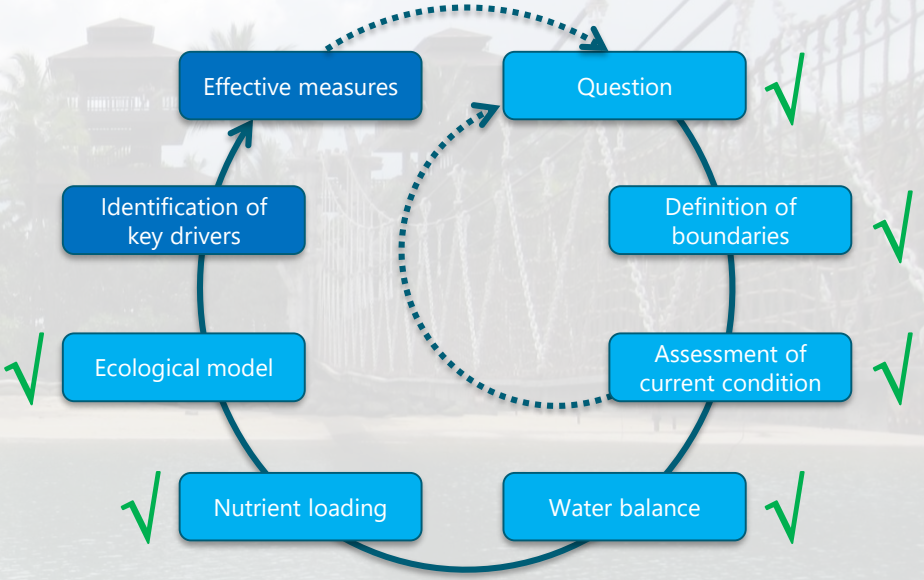


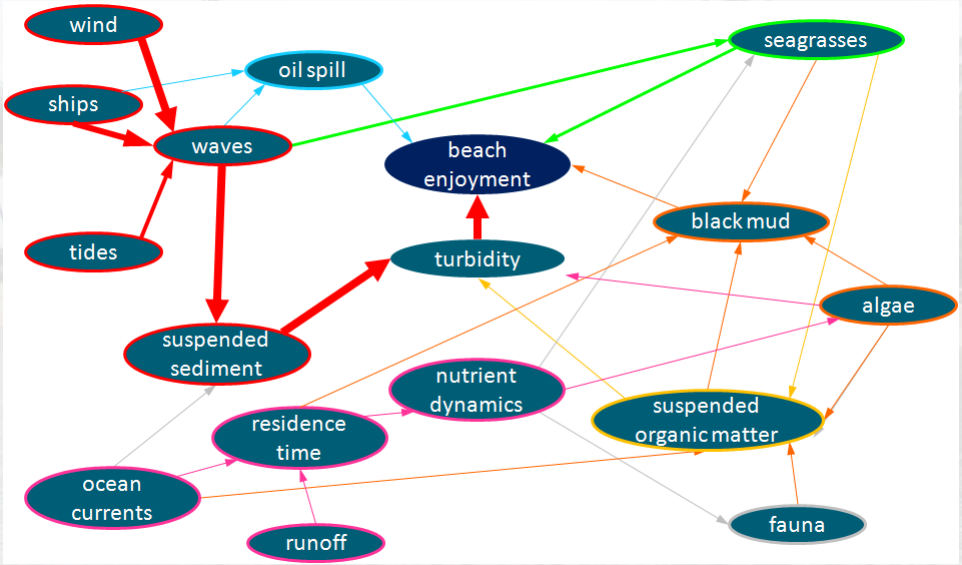
Palawan Beach, Sentosa

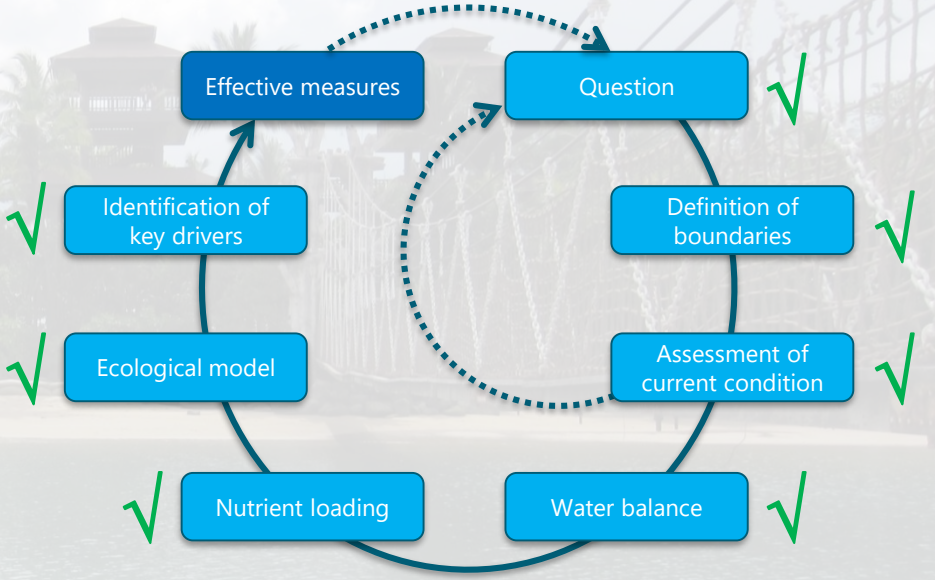
Experience of visitors

- Turbid murky waters
- Beaching of sea weed
- Beaching of oil spills
- Unattractive species



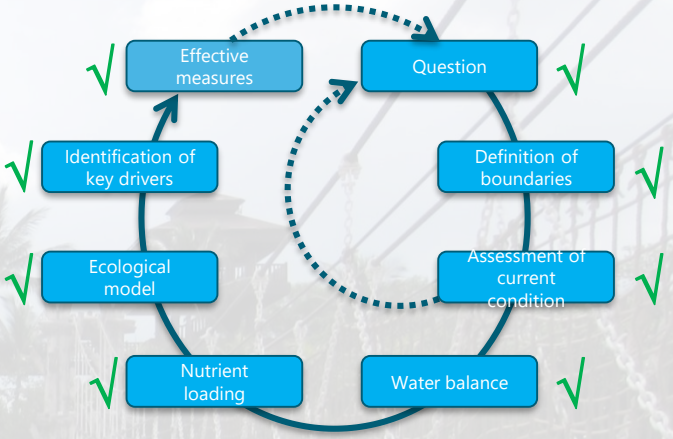
Palawan Beach, Sentosa





Palawan Beach, Sentosa

- Measures should primarily improve light climate
- Measures should focus on key driving processes:
  - wave attack
  - sediment resuspension
- Beware, measures aimed at EKF2 could adversely affect EKF1



Productivity of the water

Light climate

Productivity of the sediments

Habitat suitability

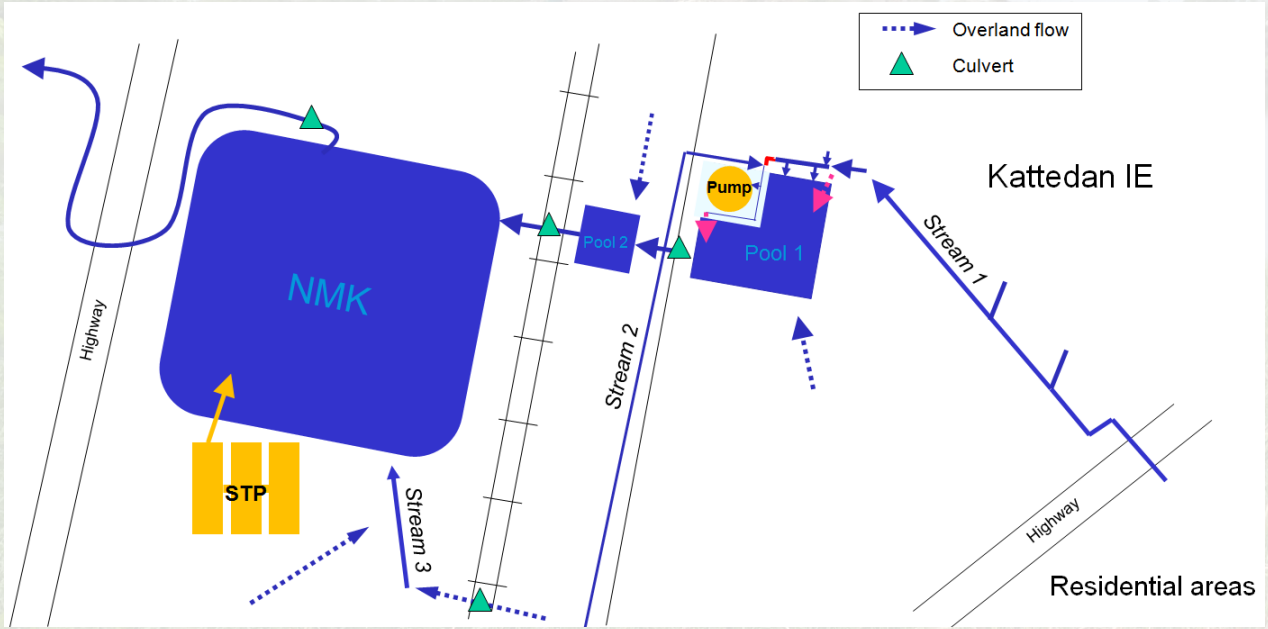
Connectivity

Disturbance

Experience


Lake Noor Mohammed Kunta, Hyderabad, India

Lake Noor Mohammed Kunta, Hyderabad



Lake Noor Mohammed Kunta, Hyderabad

Lake Noor Mohammed Kunta, Hyderabad

Context

- Lake water used for irrigation
- Bad water quality due to insufficient WTP capacity
- Upgrade of WTP needed in combination with measures in the lake

Research question

- What is required from WTP upgrade to get good water quality?

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Approach

- Hydrological schematisation
- Assessment of dynamics in hydrology and nutrient loading
- Assessment of carrying capacity in time with PCLake

Goal

- Assess effect of proposed WTP upgrade
- Derive maximum allowable nutrient discharge to the lake

Water flow to Lake NMK

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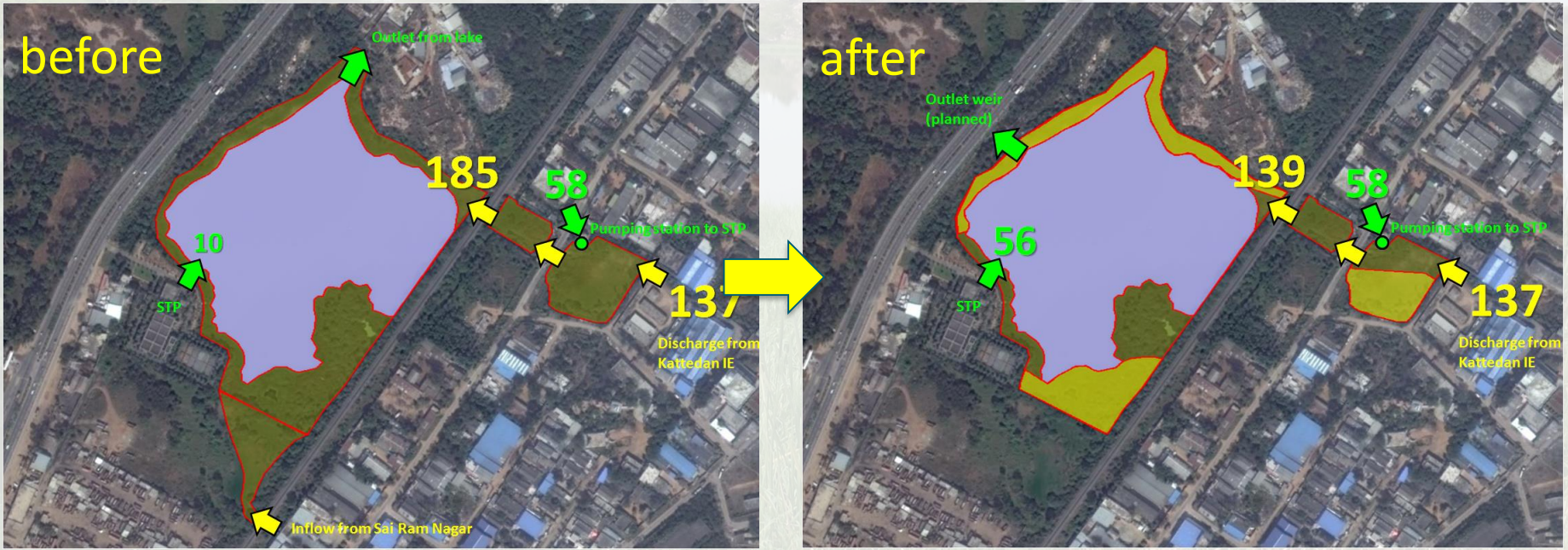
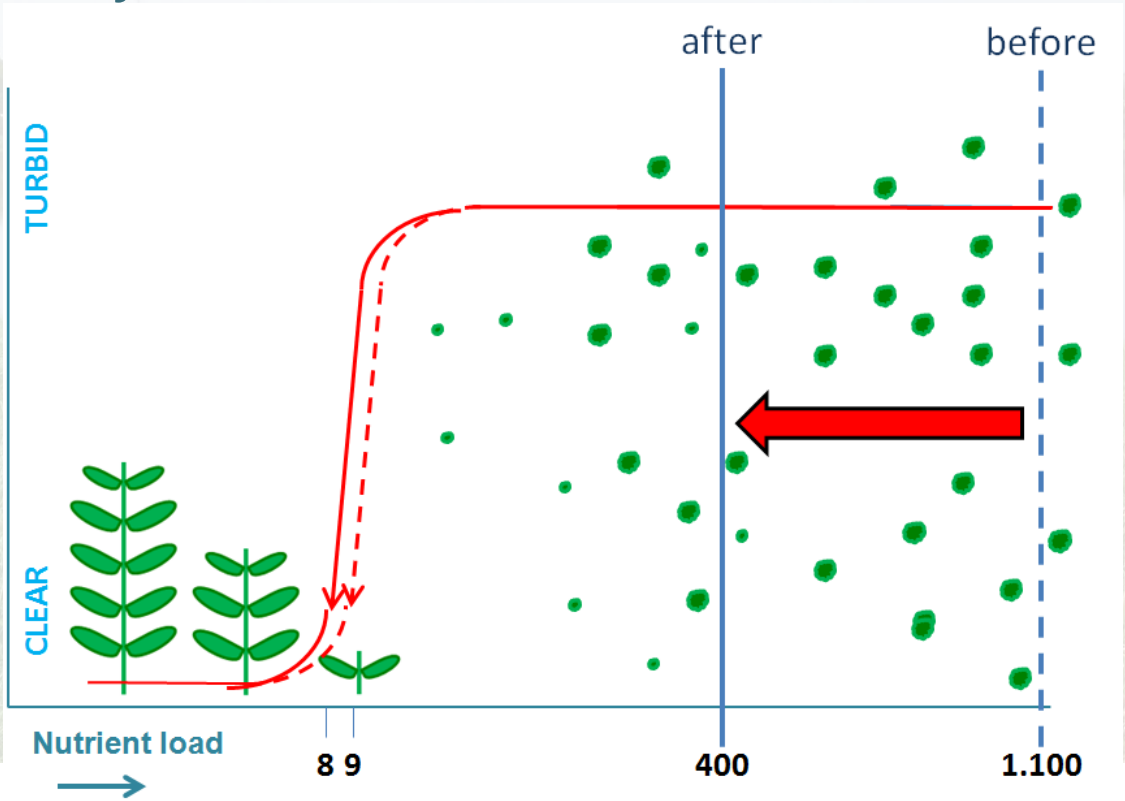


Carrying capacity of Lake NMK



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Result

- Ecological standard for WTP effluent

Conclusions

- Planned measure give big reduction in nutrient load
- But, further measures needed to ensure good water quality...


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