# POLICY BRIEFING NOTE 4

# Flipping Lakes: a board game to explain water management to stakeholders

BRIEF AUTHORS: Margaret Armstrong[1], Lisette de Senerpont Domis[1], Sven Teurlincx[1], Lilith Kramer[1,2,3], Malgorzata Golub[4], Eleanor Jennings[4]

1. Department of Aquatic Ecology, Netherlands Institute of Ecology (NIOO-KNAW), Wageningen, the Netherlands.
2. Aquatic Ecology and Water Quality Management Group, Wageningen University & Research, Wageningen, The Netherlands
3. Department of Freshwater Ecology and Water Quality, Deltares, Delft, The Netherlands
4. Centre for Freshwater and Environmental Studies, Dundalk Institute of Technology, Ireland.

## INTRODUCTION

**Using games to explain complex and discipline-specific concepts can offer a novel way to provide scientific knowledge to communities and other stakeholders. Flipping Lakes is a game-based approach for communicating and educating stakeholders about water quality management. In the game, the players take on the role of water managers and are tasked with preventing a lake from flipping from a clear to a turbid state. They play cards to implement management measures to keep the lake clean. The use of such games can lower communication barriers and increase understanding of difficult water quality concepts. Flipping Lakes is highly customisable, and therefore can be applied in a variety of settings. It provides a novel method to engage stakeholders and communities to address local and global water challenges.**

## BACKGROUND

- Water-quality management requires knowledge of many disciplines, including hydrology, ecology, governance, human behaviour and economy.

- This diverse information is often difficult to communicate to a wider stakeholder audience.

- Having a well-educated local community, however, allows for integration of their local knowledge into management actions and gives a better chance of success.

- Serious games, defined as "games that are used for purposes other than mere entertainment"[1], are now used in a wide range of scientific fields as a method for communicating complex concepts.

- This policy brief describes Flipping Lakes[2] a serious game that is intended to facilitate outreach and to educate on catchment-scale water-quality management to local communities and other stakeholders.

- The game was developed during the MANTEL MSCA* training programme.

## OVERVIEW OF THE FLIPPING LAKES GAME

Flipping Lakes[2] is a game about the management of nutrient enrichment of waters at the catchment-scale. The game takes place within a customisable fictitious catchment that is constructed as the players place cards on a table. The catchment has a focal lake. Nutrient pollution (i.e. excessive nutrient concentrations) is generated by 'catchment' cards and is transported from sources within the catchment towards the downstream lake. The players take on the role of water managers trying to protect the services provided by the lake (for example, drinking water use, recreation, biodiversity, tourism). At each turn, a player can carry out management actions aimed at either stopping the effects of the pollution (adaptation measures) or reducing pollution sources (mitigation measures). These actions have to be bought with "Aquabucks," which represent the allocation of public money for water management. A share of Aquabucks becomes available to the player at each turn.

A typical gameplay lasts for 15 rounds, each representing a year in the water system, with pollution being transported during each turn, and management actions implemented with the available Aquabucks. Failure to protect the lake can result in it flipping from a pristine (clear water) to a deteriorated (turbid water) state. This game targets a wide audience, including professionals, and is suitable for player of age 10+. It is designed to educate players on catchment management and to facilitate intersectoral discussions among water professionals and stakeholders.

## THE SCIENCE BEHIND THE GAME

Regime shifts are a core concept in lake science where lakes can go from a clear state, where they are dominated by larger plants, to a turbid state, where the lake water has high levels of small microalgae. These changes are often linked to high inputs of nutrients such as phosphorus and nitrogen to the lake which fuel the growth of the microalgae. The nutrients can also be stored in the lake sediment and leak out slowly over time, and so continue to fuel the growth of microalgae, even if no more nutrient is added.  Within the game, these concepts are reflected in two-sided lake cards, where one side represents a

clear state, when the lake serves as a nutrient sink, and the other side is a turbid state, when the lake acts as a nutrient source. The excess nutrients from the affected lake can also cascade downstream to other lakes. These spatial cascading effects are represented in Flipping Lakes through interactions among multiple lakes within the game catchment.

## HOW THE GAME IS PLAYED

The game is played for 15 rounds, each representing a lake year. There are three types of playing cards: lakes, pollution sources, and waterways (connection cards). The cards are first set up by the players as a 'catchment' on a table using a combination of cards. The configuration of the cards must always contain at least one focal lake, which is situated downstream, and an inflow point at the upstream end of the catchment. The catchment can be designed to suit the needs of the users, for example, they can replicate the local water system. As noted above, lake cards are two-sided, with one side representing a turbid state and the other a clear state (Figure 1). There are also catchment cards that represent agricultural areas, urban areas and sewage overflows that act as sources of pollution to the water system. These cards they add to the system.  In addition, there are 'event' cards which represent a set of societal events and natural events. An event card is revealed at the start of each turn and can influence the rules of the game for that "year". There are 'Business as usual' event cards where nothing changes, societal event cards ('Agricultural intensification', 'Feeding ducks', etc.) and natural event cards ('Heatwave', 'Extreme drought', 'Extreme rainfall').

The lake cards are dynamic over the gameplay as the lake may flip over into the alternate state depending on the amount of pollution pieces located on the card during a given turn. The number of pollution pieces that will lead to a flip are displayed on that card. Players can take direct action to alter the lake state by implementing various management measures on the card itself or elsewhere in the catchment of cards. They can also take direct action to alter the lake state by using various management measures. The main goal of the game is to keep the focal lake from flipping over into the card's turbid state.
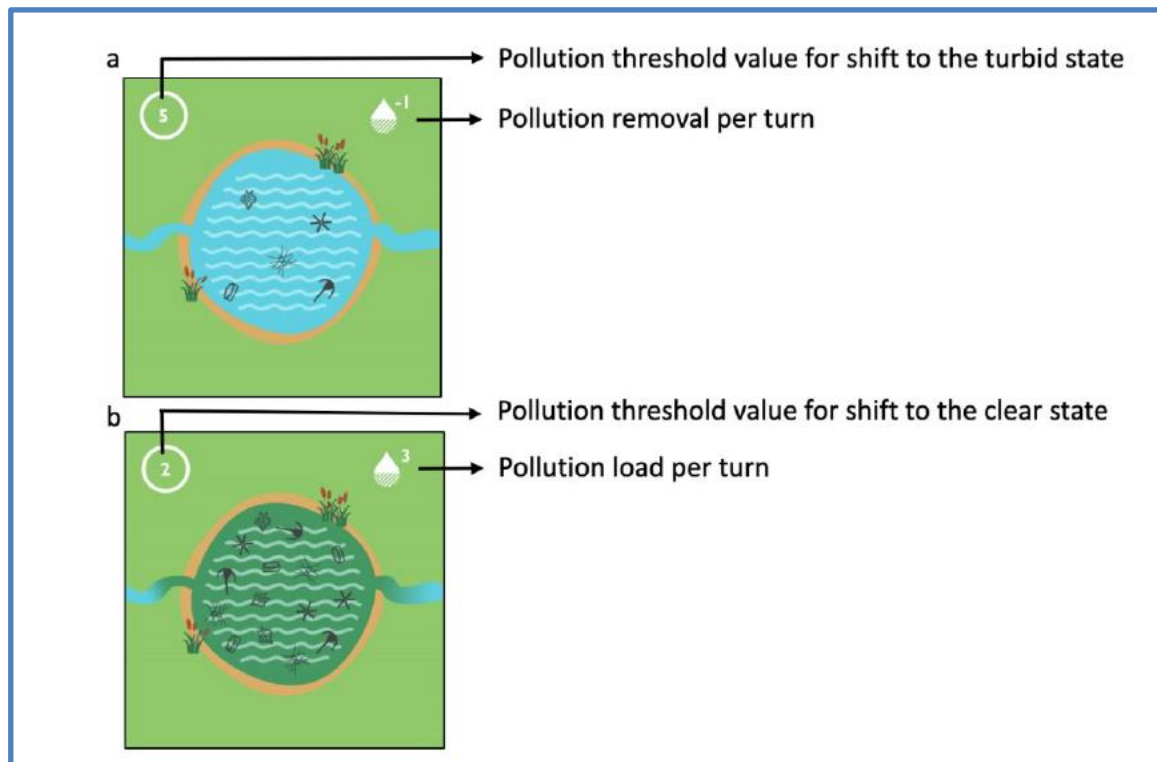
**Figure 1:** Example of lake catchment cards with the lake card's clear state (1a) including the pollution threshold value and pollution removal value and the lake card's turbid state (1b) including the pollution threshold value and pollution loading amount.

## AVAILABILITY

Flipping Lakes is an open communication tool under a Creative Commons license (CC-BY-NC342 SA). The game is available at www.nioo.knaw.nl/flippinglakes and www.nioo.knaw.nl/en/flippinglakes. Game instructions and all materials are provided on the website.

## ABOUT MANTEL

*MANTEL (Management of Climatic Extreme Events in Lakes & Reservoirs for the Protection of Ecosystem Services) was an EU funded Maire Skłodowska Curie Action (MSCA) European Joint Doctorate Innovative Training Network (2017-2021, Grant Agreement 722518) that focused on training a cohort of Early Stage Researchers to investigate the effects of the climate extremes on water quality, providing training in state-of-the art technology, data analysis and modelling, and linking to the water management sector.*

# REFERENCES AND ADDITIONAL READING

1. SUSI, T., M. JOHANNESSON, AND P. BACKLUND. 2007. SERIOUS GAMES – AN OVERVIEW 28. DOI:10.4324/9780203891650-40

2. ARMSTRONG, M., KRAMER, L., DE SENERPONT DOMIS, L.N., VAN WIJK, D., GSELL, A.S., MOOIJ, W.M. AND TEURLINCX, S. (2021) FLIPPING LAKES: EXPLAINING CONCEPTS OF CATCHMENT-SCALE WATER MANAGEMENT THROUGH A SERIOUS GAME. LIMNOLOGY AND OCEANOGRAPHY METHODS. HTTPS://DOI.ORG/10.1002/LOM3.10436

# CONTACT DETAILS AND GAME LINK

For information Flipping Lakes game: Dr Sven Teurlincx

s.teurlincx@nioo.knaw.nl


Flipping Lakes website: https://nioo.knaw.nl/flippinglakes


Policy brief and MANTEL coordinator: Prof. Eleanor Jennings

eleanor.jennings@dkit.ie


MANTEL website: https://www.mantel-itn.org