

# KWVB

**Interreg**  
Baltic Sea Region



Co-funded by  
the European Union

 SUSTAINABLE WATERS  
**WaterMan**

## WaterMan – 1<sup>st</sup> method & tool workshop

Water reuse with focus on risk & life  
cycle assessment


12.06.2023

# QMRA & QCRA tools at KWB

# KWB QMRA tool: QMRA.org

- **Who:** KWB developed the tool
- **What:** Probabilistic risk assessment tool developed in the EU project [DEMOWARE](#) (in which Water Reuse Europe was created) & refined in [AquaNES](#)
- Based on log removal values (LRV) published by the World Health Organization
- Has built in treatments, exposures, and pathogens (reference pathogens)
  - + User can additionally define exposures, pathogen removal, treatment
  - + Reference pathogens: rotavirus, *Cryptosporidium*, *Campylobacter*
  - + User can compare multiple assessments / treatment trains
  - + Results are downloadable as a .csv or .jpeg
  - Cannot add any new source water types
- **Where/When:** Applied at beginning and during monitoring phases of water reuse projects
- **Why:** For quantitative risk assessment
- **How:** By following the steps on the next slides

# QMRA tool: Risk assessments



zhiteneva ▾

New Risk Assessment

Compare Assessment

Risk Assessments

My Treatments

My Exposure scenarios

### Risk assessments of Zhiteneva

- **Waterman 2**

Alternative train for WaterMan site study visit in June 2023

✎ ✕ 📄
- **Waterman 1**

For WaterMan site visit June 2023

✎ ✕ 📄

DSGVO  
<https://qmra.org>

Kompetenzzentrum Wasser Berlin

# QMRA tool

## Source

Choose what type of water quality your assessment will begin with → only 1 possible

Source

sewage, treated

Municipal sewage that has received secondary, so including activated sludge

- surface water, general
- surface water, contaminated
- surface water, protected
- rainwater, rooftop harvesting
- rainwater, stormwater harvesting
- groundwater
- sewage, raw

Please select your source water

## Treatments

Choose which types of treatments should be evaluated → many possible

Treatment

- Conventional clarification
- Dissolved air flotation
- High-rate clarification
- Lime softening
- Granular high-rate filtration
- Precoat filtration
- Slow sand filtration
- Bank filtration
- Roughing filters
- Storage reservoirs
- Chlorination, wastewater
- Chlorine dioxide
- Ozonation, drinking water
- UV disinfection 20 mJ/cm<sup>2</sup>, drinking
- Primary treatment

- Secondary treatment
- Dual media filtration
- Membrane filtration
- Chlorination, drinking water
- Reverse osmosis
- Ozonation, wastewater
- Wetlands, surface flow
- Wetlands, subsurface flow
- UV disinfection, wastewater
- Microfiltration
- Ultrafiltration
- Nanofiltration
- UV disinfection 40 mJ/cm<sup>2</sup>, drinking
- WaterMan 3

Please select your treatment configuration

## Exposure

Choose what type of exposure your assessment will evaluate → only 1 possible

Exposure


- irrigation, unrestricted
- domestic use, car washing
- irrigation, restricted
- domestic use, toilet flushing
- drinking water

Assumption for ingestion of drinking water  
Events per year [N]: **365**  
Volume per exposure event [L]: **1.000000**

- irrigation, public
- irrigation, garden
- domestic use, washing machine

Please define your exposure scenario

# QMRA tool: Treatments




[Risk Assessments](#)

**My Treatments**

[My Exposure scenarios](#)

[Create new treatment](#)

### Treatments of Zhiteneva

 **Waterman 3** ✕  
Test example for WaterMan  
[Edit virus removal](#) [Edit bacteria removal](#) [Edit protozoa removal](#)

### Create Log-Removal for Viruses

Please add minimum and maximum treatment performance for viruses

Min\*

Max\*

Reference\*

[Submit](#)

### Create Log-Removal for Bacteria

Please add minimum and maximum treatment performance for bacteria

Min\*

Max\*

Reference\*

[Submit](#)

### Create Log-Removal for Protozoa

Please add minimum and maximum treatment performance for protozoa


Min\*

Max\*

Reference\*

[Submit](#)

# QMRA tool: Exposure scenarios



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Risk Assessments

My Treatments

My Exposure scenarios

### Create new exposure scenario

Please add a name, a brief description, the number of exposure events per year and the volume per event

Name\*

The name of the exposure scenario should be unique

Description\*

Please enter a short description of the exposure scenario

Events per year\*

Please enter the number of expected exposure events per year

Volume per event\*

Please enter the volume per exposure event in liters (e.g. 50 mL = 0.050)

Reference\*

Submit

[https://qmra.org/edit\\_scenario](https://qmra.org/edit_scenario)

# QMRA tool: Exposure scenarios



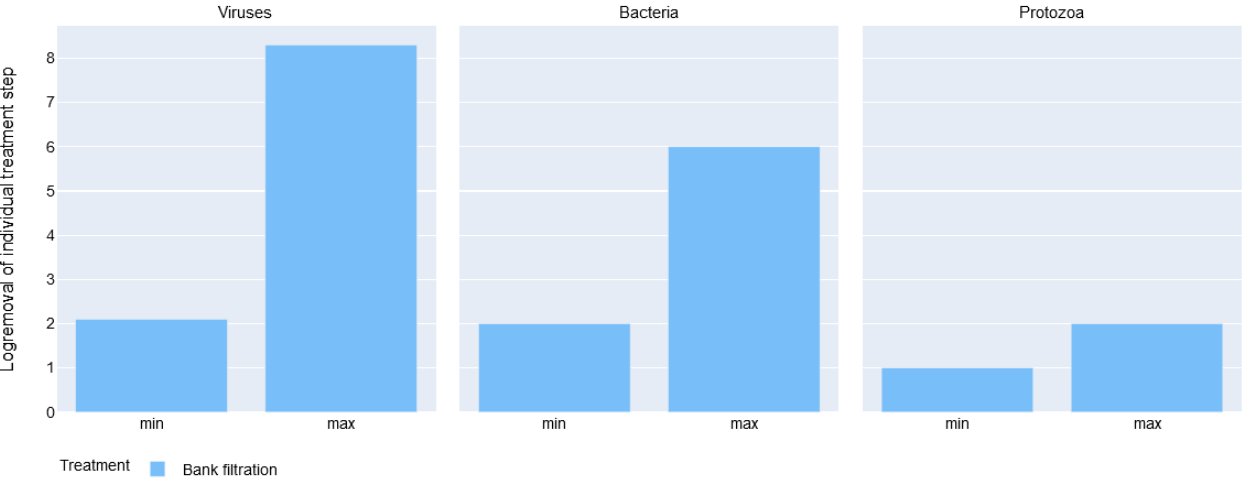
Risk Assessments

My Treatments

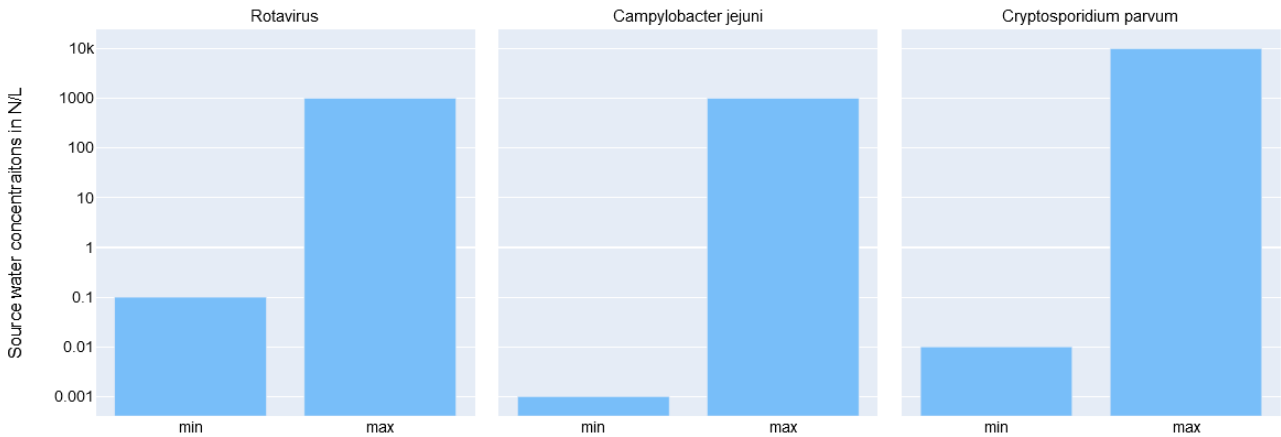
My Exposure scenarios

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Treatment performance of selected treatments



Inflow concentrations of reference pathogens



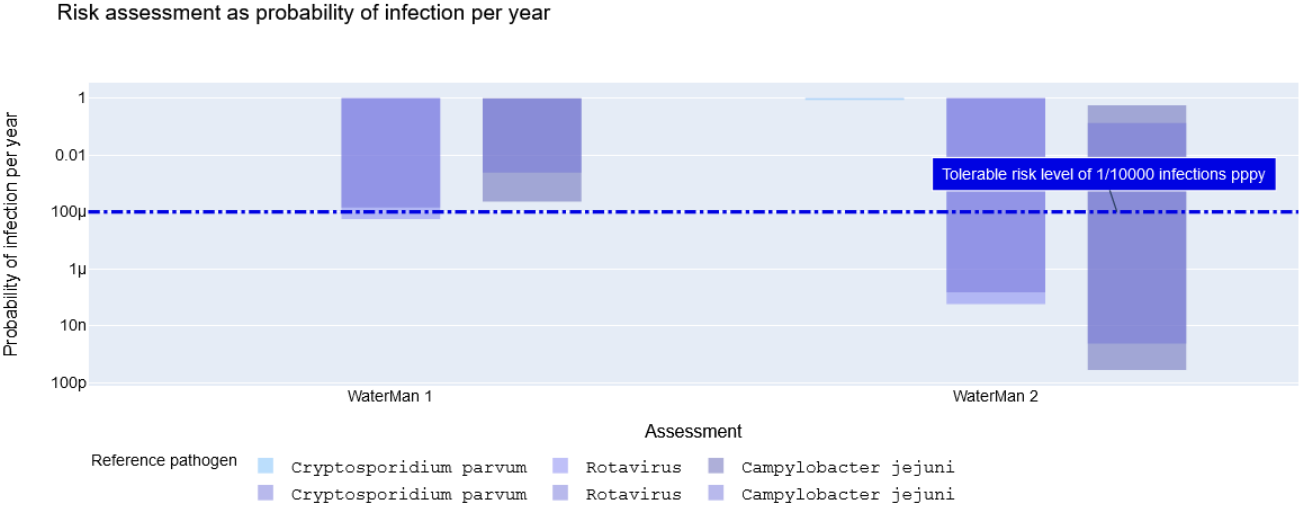


# QMRA tool: Comparing assessments



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- Risk Assessments
- My Treatments
- My Exposure scenarios



For each pathogen, the outer boundaries of each barplot refer to the range between the maximum of the maximum LRV scenario and the minimum of the minimum risk scenario (maximal range). The inner range refers to the range between the mean of the maximum and the mean of the minimum risk scenario (difference in means). The mean of the distribution is often considered as the preferred point estimator, for deciding whether health targets are achieved.

- 1) Sewage (treated)
- 2) Bank filtration
- 3) Drinking water

VS

- 1) Sewage (treated)
- 2) Bank filtration
- 3) Ozonation (drinking water)
- 4) Drinking water

# KWB LRV tool

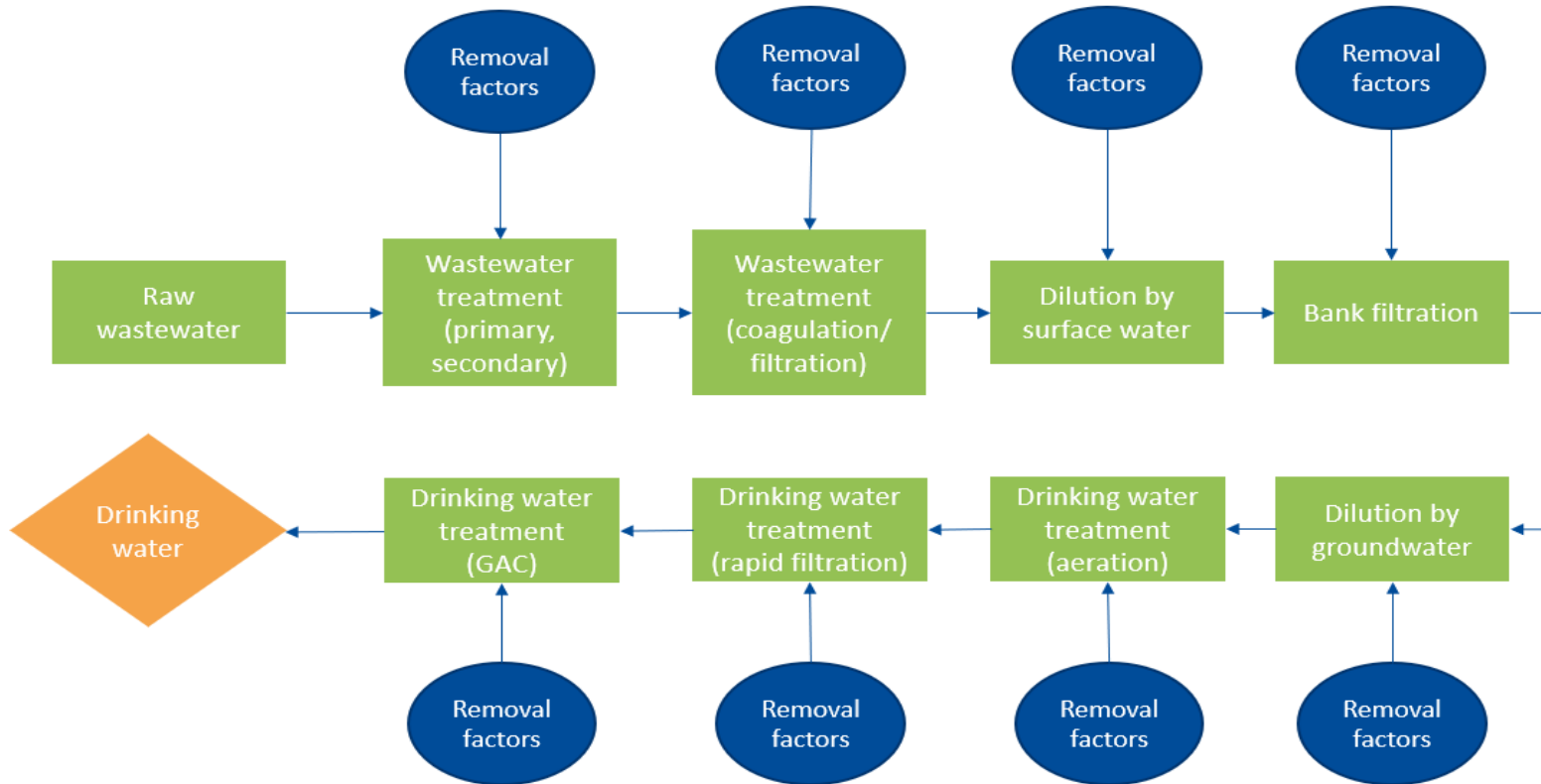
- Another microbial removal assessment tool developed by KWB
- Focus is on microbial log removal values (LRVs) for Class A agricultural irrigation
- Simplified tool where user can upload influent and effluent pathogen concentrations → tool will show the likelihood of reaching the LRVs using the best available statistical method
- Not yet available → projected for 2024/2025

# QCRA tool



- Currently being developed within the EU Green Deal project [PROMISCES](#)
- Will be an open source application ready for download by mid 2025
  - Target group: water researchers/engineers (with programming knowledge)
- Tool for performing a probabilistic quantitative risk-based human health exposure assessment for PFAS and other industrial chemicals which are persistent, mobile, and potentially toxic
  - Could be extended to other chemicals based on the user's interest and availability of concentrations/information in treatments
- Exposure routes included (which are relevant for WaterMan):
  - Municipal wastewater reuse via agricultural irrigation
  - Semi-closed drinking water cycle

# QCRA tool



- The goal of the risk-based HHEA is:
  - to estimate the most probable compound concentration along the exposure route? **No**

$$\text{Risk} = \text{Likelihood} \times \text{Impact}$$

- to describe final risk **Yes**



# KWVB

## THANK YOU

Contact: Pia Schumann, Elisa Rose  
[pia.schumann@kompetenz-wasser.de](mailto:pia.schumann@kompetenz-wasser.de)  
[elisa.rose@kompetenz-wasser.de](mailto:elisa.rose@kompetenz-wasser.de)



@Kompetenzzentrum Wasser Berlin



@kompetenzwasser



[www.kompetenz-wasser.de](http://www.kompetenz-wasser.de)