

Managing public health risk from microbial contamination of drinking water

The problem:

Managing public health risk from pathogen discharges to land near drinking water wells

Human activity near drinking water wells, is a source of pathogens that pose a significant risk to human health. Despite monitoring at regular intervals for various water quality indicators, waterborne outbreaks are regularly reported worldwide.

Key features include:

- Provides a preliminary screening of activities near drinking water wells without the need for significant investment in complex modelling
- Designed to be accessible for non-modellers, regional & district council staff, consultants etc.
- Provides visualisation of uncertainty to assist in understanding trade-offs in risk with different separation distances and land use activities
- Can evaluate multiple contaminant sources simultaneously

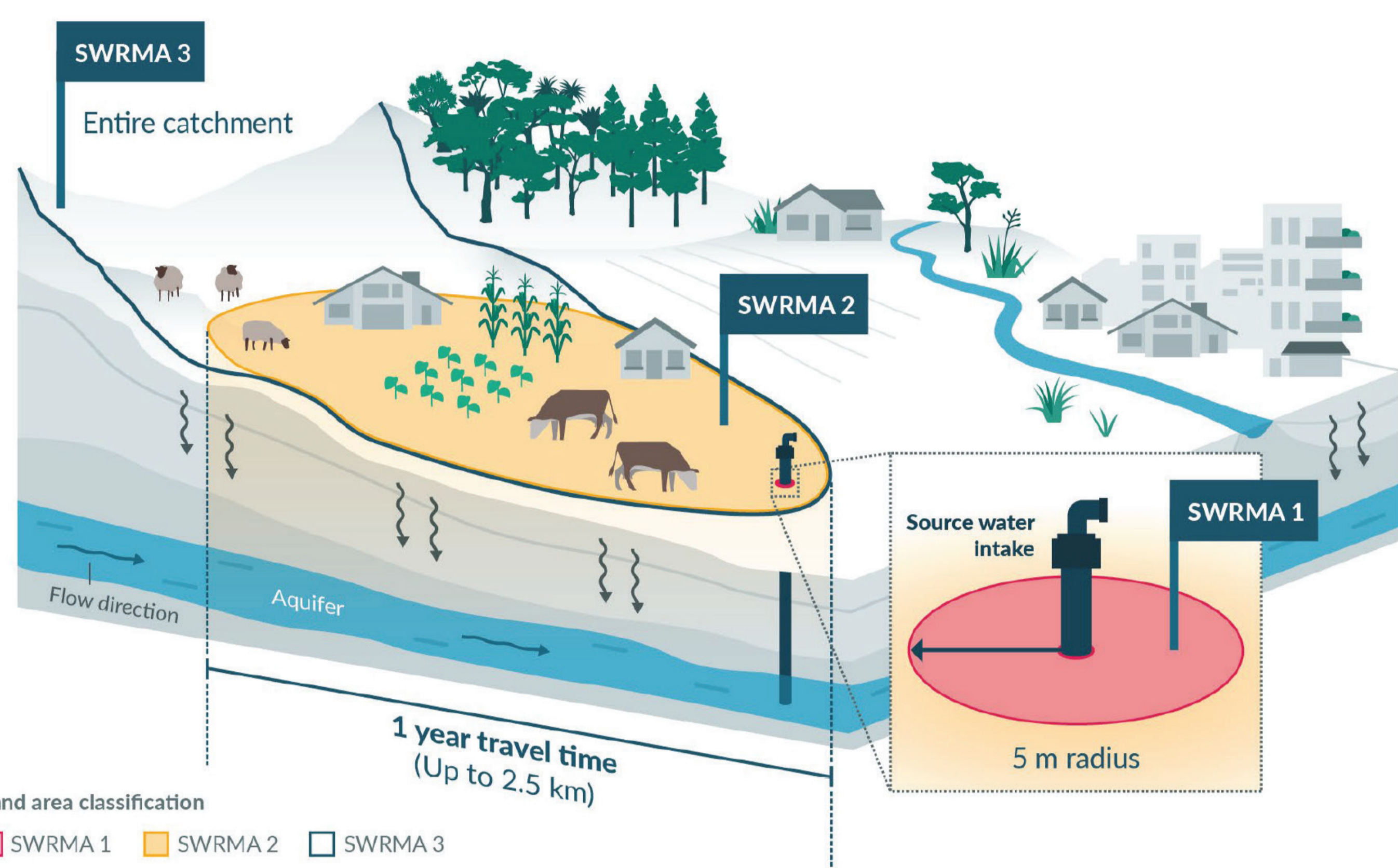


Figure 1: Overview of source water risk management areas (SWRMAs) for groundwater in New Zealand (Ministry for the Environment (2023). Delineating source water risk management areas)

The solution: Microbial Risk Assessment (MRA) Tool

Groundwater modellers, hydrologists and microbiologists at PHF Science and GNS, along with Environment Canterbury (ECan), developed the Microbial Risk Assessment (MRA) tool to provide a more objective and transparent basis for consent decision-making on land use applications. This risk assessment tool involves modelling potential microbial contamination of groundwater supplies from various land use activities, incorporating uncertainty at each step.

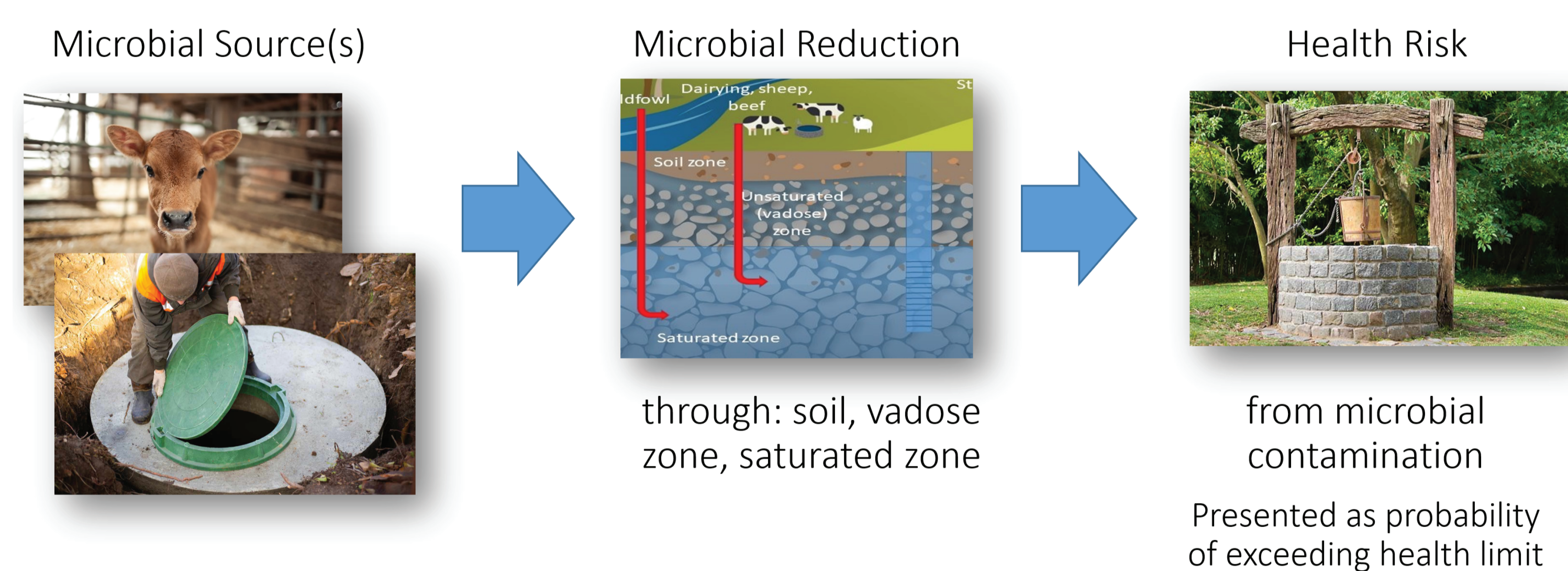


Figure 2: Modelling approach used for the MRA tool, where the final output is a health risk from microbial contamination

The MRA tool considers:

- **Land uses:** On-site wastewater management systems (OWMS), dairy farming, sheep & beef farming, wildfowl, stormwater systems, and animal effluent/manure application
- **Microbes:** Norovirus, *Campylobacter*, *E. coli*
- **Supply size:** Domestic, small community, and large community supply wells
- **Climate:** Four climate scenarios representative of Aotearoa New Zealand
- **Hydrogeology:** Various soil and groundwater system types such as alluvial gravel, sand, clay, etc.

The MRA tool is available online as an interactive web application at <https://mra-tool-nz.streamlit.app/>. The tool benefits both land users and regional councils by providing greater guidance and certainty to stakeholders, reducing variation in assessment quality, assisting in consent processing, and avoiding duplication of effort in developing methods by individual councils.



Microbial Risk Assessment Tool

Select microbes:

Norovirus x E. coli x Campylobacter x

Export to PDF

Show figures on the web page

Use interactive figures (slower, may cause issues for multiple-source scenarios)

Select figures for viewing and/or exporting to PDF:

Initial concentrations x Log reduction components x

Log reduction for each source x Concentration at the well from each source x

Total concentration at the well x

Compare each source with the maximum acceptable concentration

Figure 3: MRA tool web interface, available online to the public at <https://mra-tool-nz.streamlit.app/>

Example case study: multiple on-site wastewater management systems (OWMS)

- Estimated median concentration of *E. coli* at the drinking well from multiple OWMS contaminant sources: 0.08 per L (below NZ Ministry of Health drinking water standard of <1 per 100 ml)
- Probability of exceeding the *E. coli* drinking water standard at the well: 8%

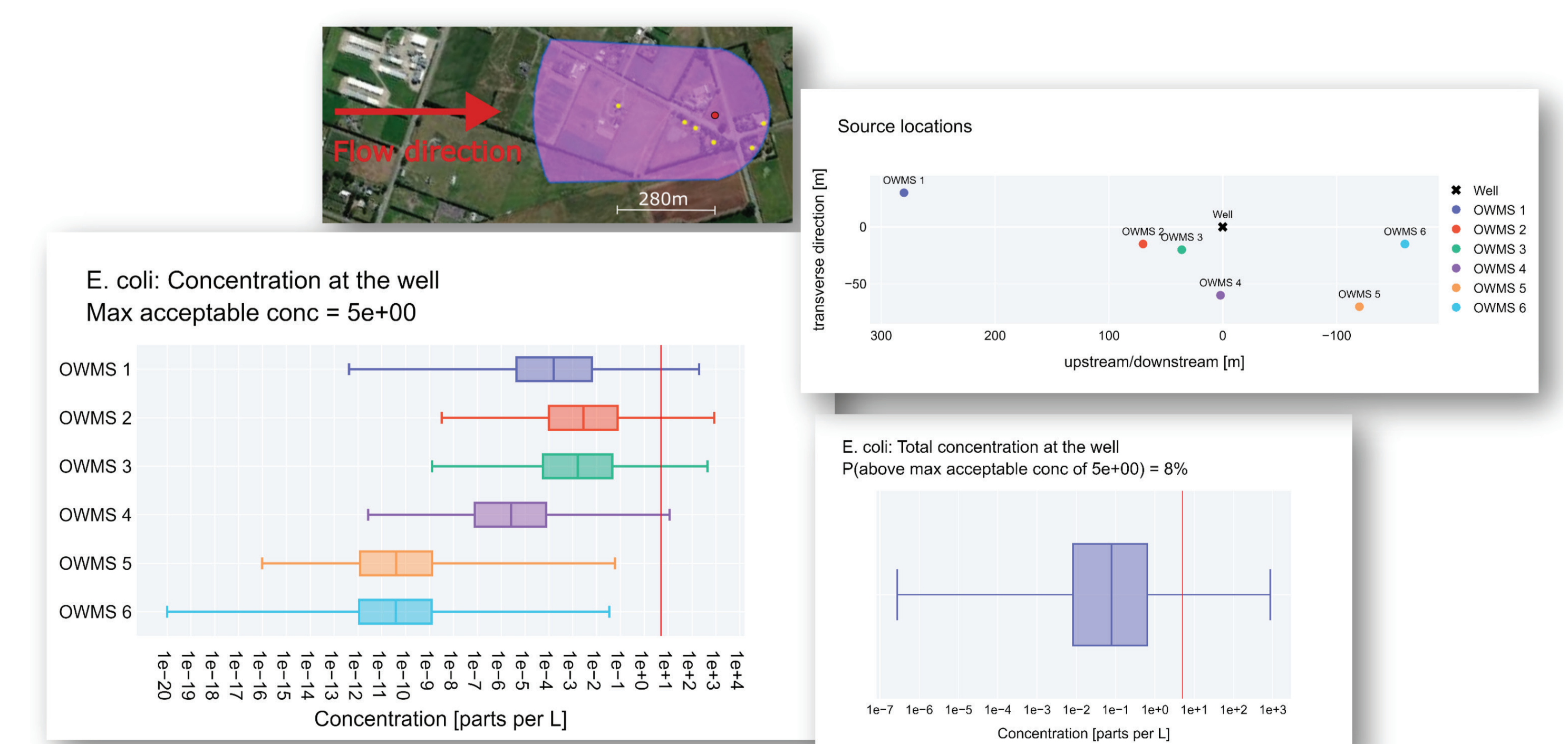


Figure 4: Estimated *E. coli* concentrations from multiple OWMS within a source water risk management area (SWRMA)