# Is there a role for Effect-Based Methods (EBM) in a Water Safety Plan (WSP) context?

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This GWRC project "Effect Based Monitoring in Water Safety Planning" is a collaboration between GWRC, KWR, Veolia, Suez, UFZ and Griffith University. The project addresses the implementation of *in vitro* bioassays for monitoring of micropollutants in water and wastewater treatment installations at a global scale, profiling experiences and case-studies from Europe, Australia, North America and South-East Asia. Three other presentations summarise work from this project at this conference: Effect-based monitoring in global water safety planning (platform presentation), EBM perception and barriers to implementation (poster), and a literature review of global case studies (poster).

## Introduction

- Water Safety Plans (WSP) ensure safe drinking water by enabling assessment and control of risks associated with microbial, chemical, physical and radiological hazards.[1]
- Chemical hazards in drinking water include diverse and complex organic micropollutants, such as pesticides, pharmaceuticals and industrial chemicals, and targeted chemical analysis only detects a small portion of the total chemical burden.
- Effect-based monitoring (EBM) using *in vitro* bioassays and well plate-based *in vivo* assays can be used to more comprehensively assess the risk of chemical hazards in drinking water systems.
- EBM captures mixture effects of groups of chemicals with a specific toxic mode of action.
- EBM is proposed as a complementary tool to targeted chemical analysis to support risk analysis and risk management within the WSP framework (Fig 1).

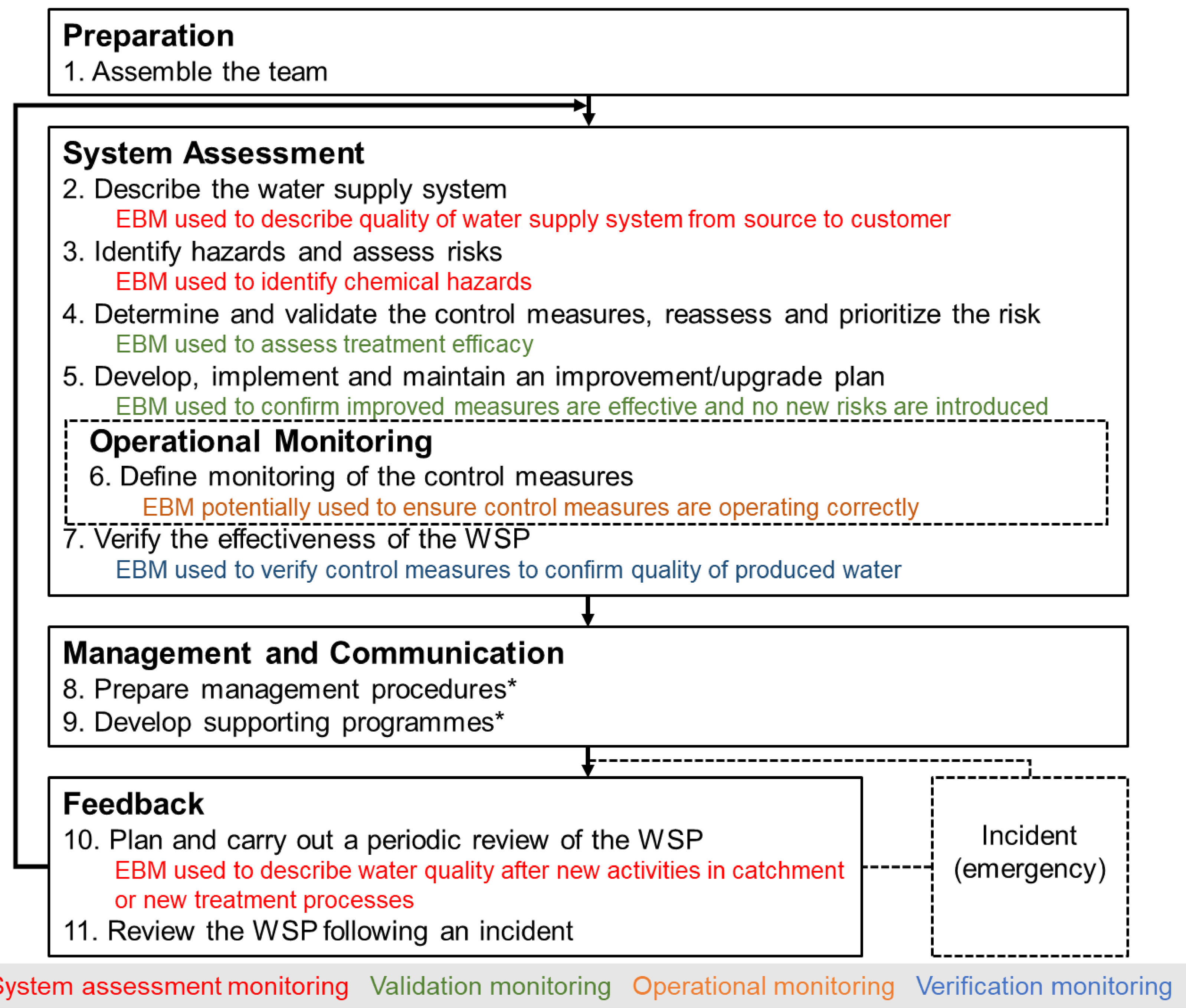


*Fig 1: The WSP framework[1], with examples of how EBM could be integrated (in coloured text)*

## What is required to support uptake of EBM into WSPs?

The availability of tools and resources was identified as a key factor enabling the uptake of WSPs[2] and this is also required for the implementation of EBM in WSPs. This includes:

- Standard operating procedures and analysis workflows.
- A practical and purposeful bioassay test battery.
- Guidance to operators and managers in how to deploy and interpret bioassay results.

## Monitoring within WSP

Within the WSP framework, EBM could benefit each of the four monitoring categories, namely system assessment, validation, operational and verification (Fig 2):

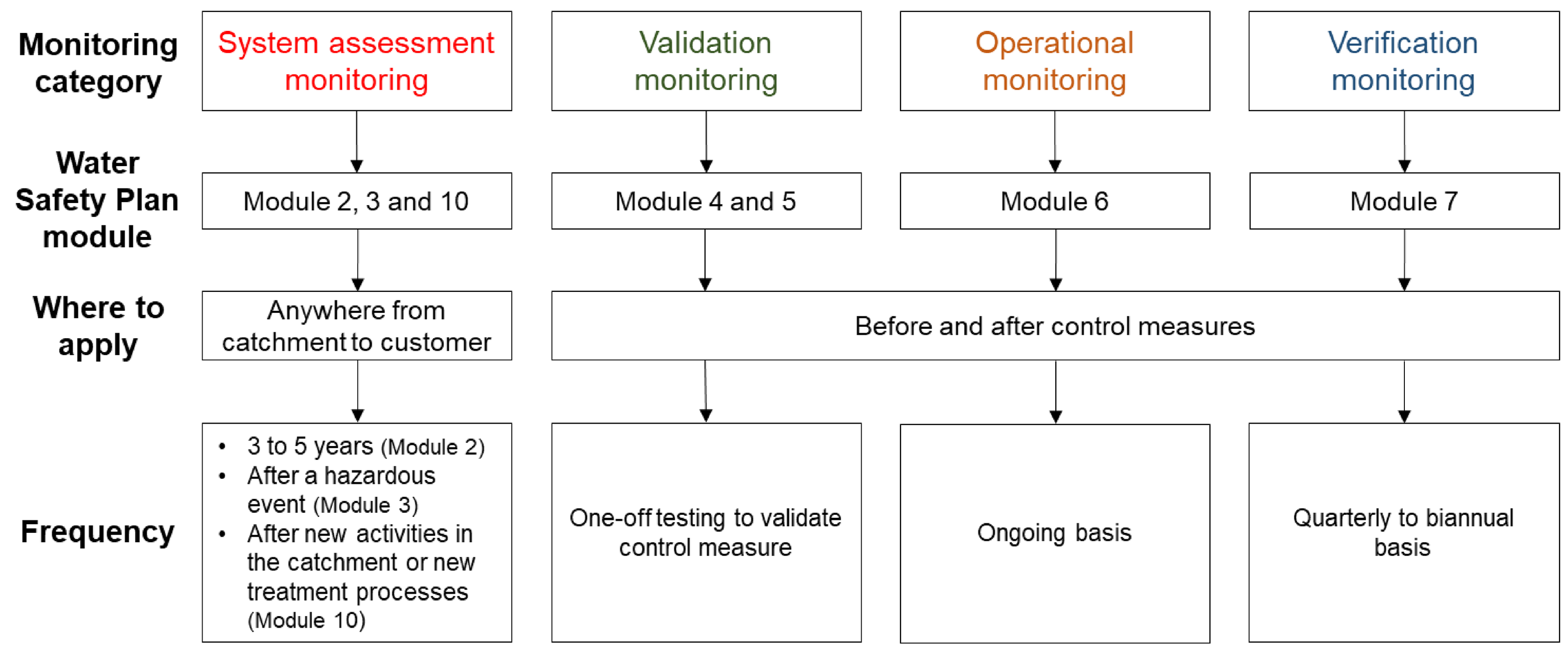


*Fig 2: Framework to demonstrate where and how frequently to apply EBM within the different WSP monitoring categories and modules.*

### System assessment monitoring

- Provides a baseline and ongoing background information to characterise water resources to understand their quality and help inform risk assessments and define treatment requirements.
- EBM can be applied to describe current quality of the water supply system from source to customer[3] (Module 2), identify chemical hazards[4] (Module 3) and characterise any resulting changes in water quality after new activities in a catchment[5] (Module 10).

### Validation monitoring

- Provides evidence on control measure effectiveness and includes research to understand and validate processes and identify critical control points.
- EBM can be used to assess and validate existing control measures to prove their ability to reduce or remove effects[6] (Module 4) or validate new control measures[7] (Module 5).

### Operational monitoring

- Detects potentially unsafe water and triggers a response to prevent any potentially unsafe water from reaching consumers.
- EBM has the potential to be applied to ensure preventive measures are operating correctly (Module 6), though the time taken to process and run samples in bioassays means that current EBM may be more suitable for operational monitoring of long-term developments of treatment and surveillance.

### Verification monitoring

- Used to verify routine operations to confirm that the system was producing good quality water.
- EBM can be used for verification monitoring of control measures and to confirm the quality of the treated water[8] (Module 7), with the observed effect in the product water compared to an established and validated effect-based trigger value (EBT).
- As a first application of EBM, treatment plant operators may decide to use EBM for verification monitoring of treated water.

## Conclusions

The ability of EBM to account for the effects of complex mixtures of chemicals in water and to detect a wide range of chemicals, even those present below conventional analytical detection limits, offers fundamental advantages for risk assessment and risk management in WSP frameworks.

EBM can be applied for system assessment, operational, verification and validation monitoring. Clear and science-based guidance documents, frameworks and standard operating procedures are required for both bioassay operators and the WSP team to support the uptake of EBM into WSPs.

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### References

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