*for*Water Research Snapshot

TO: *for*Water Members

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SUBJECT: **Advancing on the promises of techno-ecological nature-based solutions: A framework for green technology in water supply & treatment**

Research Summary

Water managers are increasingly asked to integrate "green" approaches or nature-based solutions (NBS) into water supply and treatment practices because they are widely believed to offer environmentally conscientious, energy-efficient, and economically viable solutions. For example, NBS for climate change mitigation include forest management-based source water protection strategies. Despite the widespread use of the term "green", however, there is no consistently applied definition for "green technology".

This research developed a framework to differentiate technology "greenness" by examining key attributes:

1. natural resource-basis (i.e., quantity and type of resources being used to implement technology)
2. energy consumption (i.e., energy the selected technology uses)
3. waste production (i.e., waste created by using the selected technology)
4. footprint (i.e., amount of land used by the technology)

The key to using the framework effectively is to acknowledge that the attributes are closely linked and must be considered relative to the environment in which they are applied and the other technologies to which they are being compared. The use of the framework can facilitate decision-making that addresses diverse stakeholder priorities—including the influence of sociocultural factors (e.g., cultural uses of water, cultural links to land) on green technology preferences of individuals, groups, or communities.

Framework example: A remote community

A remote community may be challenged by site accessibility and unreliable supply chains, unreliable power supplies, and institutional memory and staff retention. The community may, therefore, value technologies that are natural resource-based and reduce energy consumption and waste production, as compared to those that reduce physical footprint. Natural resource-based technologies tend to be passive and therefore typically have lower energy demands and lower operational capacities. These technologies would also address site accessibility challenges as fewer components and chemicals would need to be sourced externally for operation, maintenance, and repairs, thereby reducing transportation costs. Footprint may not be prioritized, as the small population and remote location imply lower water demand and more available space, respectively.

This example demonstrates how examining the key attributes simultaneously, within the specific context of the environment that it will be implemented, allows decision-makers to analyze the short- and long-term impacts of selecting green technologies for water treatment processes.

Key Messages

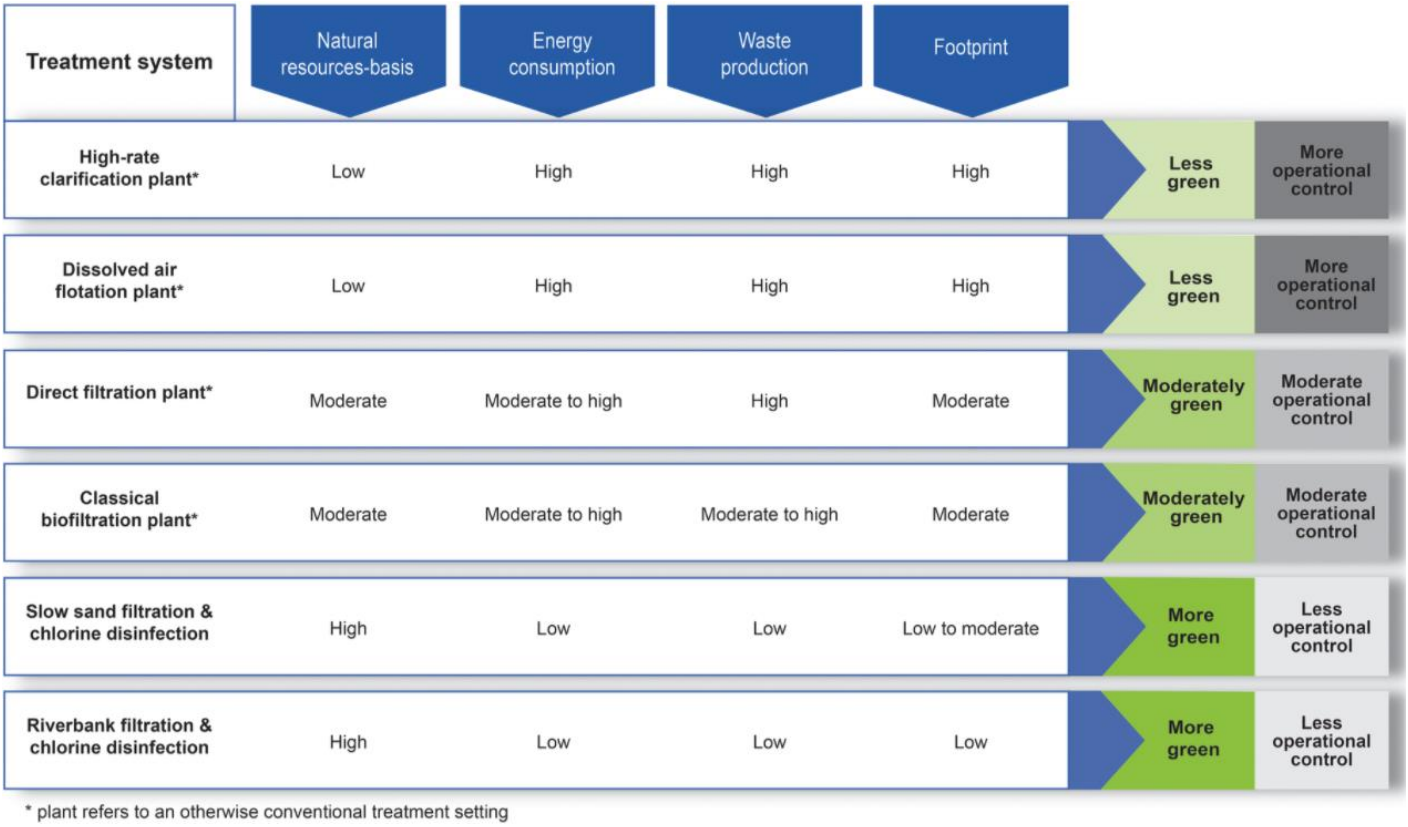
- Green technology falls on a spectrum, where technologies exclusively reliant on natural processes are not fit-for-purpose for the provision of safe drinking water, and some range of built technology is required.
- The four main attributes of green technology are: natural resource-basis, energy consumption, waste production, and footprint.
- Operational control is often reduced as technology "greenness" increases.
- Biofiltration is an underutilized, green drinking water treatment technology because it has not yet experienced as much uptake as conventional treatment technologies in some regions due to misplaced concerns regarding the health risk attributable to microbially mediated treatment, difficulties in operation, and unlikely regulatory approvals.

Figure 1

*Technologies are assumed to be fit-for-purpose. Whether or not technologies are green is not absolute; they are more or less green relative to one another.

Framework for the evaluation of green attributes of water supply, treatment, and distribution technologies. (Photo credits bottom row from left to right: Humboldt Bay Municipal Water District; Reprinted from Nalwanga et al. (2014), with permission from Elsevier; Mount Carmel Ltd; DVGW, Water Technology Center, Karlsruhe).

Figure 2



General greenness assessment of common drinking water treatment typologies.

Reference

Emma A.J. Blackburn, Monica B. Emelko, Sarah Dickson-Anderson, Micheal Stone, 2021. Advancing on the promises of techno-ecological nature-based solutions: A framework for green technology in water supply and treatment. *Blue-Green Systems*, 3(1): 81–94. doi: https://doi.org/10.2166/bgs.2021.008

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