Preface

We are pleased to invite you to participate in the internal consultation of the initial methods for freshwater science-based targets. These methods, focusing on freshwater quality and quantity, will be part of the first release of science-based targets for nature in early 2023.

The purpose of this 4-week internal consultation is to solicit feedback from technical experts and corporate practitioners on the scientific rigor and robustness, as well as usability of the initial freshwater methods. The review is open to the SBTN partner community, Corporate Engagement Program members, and a small set of select external experts. We expect the primary audience of this document to have the technical knowledge necessary to review the content. This content is in draft form and will become available for public consultation in August 2022 with a corporate-friendly version released publicly in early 2023.

We are requesting that you provide feedback on key consultation questions by June 3, 2021. Note that partners and corporates will receive separate feedback forms. If you cannot find the applicable feedback form, partners can email info@sciencebasedtargetsnetwork.org and Corporate Engagement Program members can email corporate-engagement@sciencebasedtargetsnetwork.org. Please ensure that you have filled out the applicable form before submitting.

Thank you in advance for your feedback; we look forward to your contributions.

DISCLAIMERS FOR REVIEWERS

Please keep the following disclaimers in mind as you review this content.

1. This consultation is open to the SBTN partner community, Corporate Engagement Program members, and a small set of select external experts. This content is in confidential draft form and is not for public circulation.
2. The content covered in this consultation will only become available for public consultation in August 2022. Companies are not expected to be able to start setting targets using the method in this document until early 2023. SBTN will not recognize claims, public statements, or any targets coming from the use of these methods before public approval.
3. The scope of this content is restricted to Step 3 ("Measure Baseline, Set Target, and Disclose") of the five-step SBTN Framework. Guidance related to Step 4 ("Act") and Step 5 ("Track") is expected in 2023.
4. SBTN recognizes that this content is currently written in highly technical language; we expect the primary audience of this document to have the technical knowledge necessary to engage with this content. A corporate-friendly version of this content will be released publicly in January 2023.
5. This content covers the following areas:
    a. Water quantity for surface water flows and groundwater levels (only if local model/thresholds exist)
    b. Water quality for nutrient pollution of nitrogen and phosphorus
    c. Upstream and direct operations scope
6. This content does not cover the following areas, all of which will be included in future versions of the method:
    a. Water quantity for groundwater levels with a global model
    b. Water quality for toxic chemical and other water quality parameters
    c. Downstream scope
    d. Freshwater biodiversity and direct conversion of freshwater ecosystems
    e. Consideration of how future climate change will impact water availability and quality
7. SBTN recognizes that biodiversity has not yet been explicitly addressed in these Step 3 methods, but it is expected to be incorporated in future versions. Currently, biodiversity is indirectly accounted for in the methodology when defining the desired state of nature for freshwater systems in terms of water quality and water availability. Additionally, companies implementing these Step 3 methods should have also already used SBTN's Step 1 and Step 2 methods which will direct companies to focus on the parts of their value chain and sites within this which matter most for biodiversity[1].

[1] Referring to biodiversity broadly (not specifically freshwater biodiversity). The indicators used in Steps 1 and 2 are currently only able to sufficiently capture terrestrial biodiversity.

Freshwater Science-Based Targets:
Step 3 Methodology

Internal review draft for
SBTN members and
Technical and Practitioner Advisory Groups

May 4, 2022

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Glossary

(Adapted and expanded upon from SBTN, 2020)

Allocation: Assignment of a given company's 'fair share' of effort towards issue/impact mitigation.[2]

AR^{3}T: SBTN's Action Framework, named AR^{3}T because it covers actions to avoid future impacts, reduce current impacts, regenerate and restore ecosystems, and transform the systems in which companies are embedded.

Authorized basin agency: National, regional, state or local government agency that has the authority to make decisions on the allocation of water resources, including regulating pollutant loads. Examples include basin management authorities, water resource management agencies, and catchment councils.

Baseline: Value of impacts (on nature) or state (of nature) against which an actor's targets are assessed, in a particular previous year or years.

Basin: The area of land that provides all surface runoff and subsurface waters to a given waterbody. Also referred to as watershed or catchment.

Blue water availability: Natural run-off (through groundwater and rivers) minus environmental flow requirements. Blue water availability typically varies within the year and from year to year.

Blue water footprint: Volume of surface and groundwater consumed as a result of the production of a good or service.

Catchment: The area of land that provides all surface runoff and subsurface waters to a given waterbody. Also referred to as watershed or basin.

Concentration: The amount of a substance in a given volume of water, specified in units of mass per volume (e.g., mg phosphorus/liter).

Consumption: The net use of water, i.e., volume of water withdrawn minus volume of water discharged/returned.

Cumulative impacts: Impacts that result from incremental changes caused by other actions along with the entity of interest.

Dependencies: Aspects of nature's contributions to people that a person or organization relies on to function, including water flow and quality regulation; regulation of hazards like fires and floods; pollination; carbon sequestration.

Direct operations: All activities and sites (e.g., buildings, farms, mines, retail stores) over which the enterprise has operational or financial control. This includes majority owned subsidiaries.

Drivers: The values and behaviors of individuals, organizations and society as a whole, underpinning production and consumption patterns (e.g., fast fashion and food waste), population growth, trade relationships (e.g., outsourcing environmentally harmful production processes), technological innovations

[2] The use of this term in this guide is not to be confused with the use of "allocation" related to water rights.

(e.g., the rise of e-commerce) and systems of governance/social institutions (like those that govern access to and ownership over natural resources). "Drivers" feed into "pressures", which then fuel the degradation and loss of nature.

Desired state of nature: A state of nature consistent with the safe operating space defined by Planetary Boundaries, either for direct indicators (species, ecosystems, and nature's contributions to people) or surrogates representing these indicators.

Downstream: All activities that are linked to the sale of products and services produced by the company setting targets. This includes the use and re-use of the product and its end of life to include recovery, recycling and final disposal.

E-flows (environmental flows): Environmental flows describe the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being (Arthington et al, 2018).

Effluent: The outflow of water from a structure such as a wastewater treatment plant, sewer pipe, or industrial outfall.

Impacts: Can be positive or negative contributions of a company or other actor toward the state of nature, including pollution of air, water, soil; fragmentation or disruption of ecosystems and habitats for non-human species; alteration of ecosystem processes.

Indicator: A specific metric by which a threshold or target is measured. Example: Red List Index (SDG Target 15.5; Aichi Target 12).

Key local stakeholders: Groups directly affected by target setting with specialized knowledge and insights relevant to the basin or hydrological science**.**

Load: The rate at which a pollutant such as nutrients is delivered to a receiving water, specified in units of mass per time (e.g., kg phosphorus/day).

Measurement: The process of collecting data for baseline setting, monitoring, and reporting.

Monitoring: Tracking progress towards targets.

Nature: All non-human living entities and their interaction with other living or non-living physical entities and processes.

Nature loss: The loss and/or decline of the state of nature, as defined above.

Nonpoint source: Sources of pollution that are delivered to the receiving water in a diffuse manner, i.e. not through a confined channel or discharge pipe.

Planetary boundary: The framework, following (Steffen et al. 2015), that defines a "safe operating space" for humanity, based on nine key natural processes that regulate the stability and resilience of the Earth system as a whole. The assumption underlying this concept is that remaining within these boundaries can help humanity to avoid unacceptable global environmental change.

Point source: Any single identifiable source of pollution from which pollutants are discharged, such as a confined channel or discharge pipe.

Prescriptive approach: An approach that must fully adhere to all aspects of the specified method.

Pressures: Stresses that human activities place on nature. Following IPBES, five key pressures contribute most to the loss of nature globally: Land and sea use change; direct exploitation of organisms; climate change; pollution; and invasion of alien species. While we generally follow IPBES definitions for these categories, we take a slightly broader conceptualization of 'direct exploitation' to include both biotic and abiotic resources, such as water use--we thus use the term "Resource exploitation".

Primary data: Data collected specifically for the assessment being undertaken. Generally primary data will be collected from site-level measurement on a specific issue area through the use of direct measurement (e.g., volume of fresh water used for irrigation each month).

Reporting: Preparing of a formal written document typically connected to desired objectives, outcomes or outputs, such as those connected to targets and goals.

Restore: Initiate or accelerate the recovery of an ecosystem with respect to its health, integrity and sustainability with a focus on permanent changes in state (adapted from Society of Ecological Restoration)

Science-based targets (SBTs): Measurable, actionable and time-bound objectives, based on the best available science, that allow actors to align with Earth's limits and societal sustainability goals.

Secondary data: Data that were originally collected and published for another purpose or a different assessment, e.g., derived from modeled or proxy-level data.

Site(s): Operational locations within a company's value chain/spheres of control and influence (including direct operations). Sites can include operations from any phase of a product's life cycle, from extractive operations (e.g., mines), material processing (e.g. mills), production facilities (e.g. factories), logistics facilities (e.g. warehouses), wholesale and retail (e.g. stores), and recycling/end of life (e.g. material recovery).

Site-level targets, value chain-level targets, corporate-level targets: Different commonly defined boundaries for SBTs, representing different types of sites within or beyond a value chain. Site-level targets occur at a specific site. Value chain-level targets occur throughout the company's entire value chain. Corporate-level targets can be a mix of site-level, value chain-level, or other levels (e.g., systems- and/or scape-level); this depends on the specific methodology/issue area.

Spatial domain: The specific land area (i.e. basin) being covered by the target, which includes all company activities occurring in the basin. In the case of this method, the spatial domain is the basin.

State of Nature: The quality of the environment in relation to the functions that it fulfills. For SBTs, 'state of nature' typically refers to three key categories: species (abundance and extinction risk), ecosystems (extent, integrity, and connectivity), and nature's contributions to people.

Target: In global (e.g., UN) sustainability framings, a more specific quantitative objective, usually nested under a goal, with defined measurement and an associated indicator.

Target boundary: The corporate scope of the target, specific to each issue area. The target boundary may be defined in terms of the value chain aspect covered, as well as the specific locations, products, brands, etc. that will be in focus in a given time period.

Threshold: Level of an environmental indicator representing attainment of the desired state of nature.

Upstream: All activities associated with suppliers, e.g., production or cultivation, sourcing of commodities of goods, as well as transportation of commodities to manufacturing facilities.

Validation: An independent process involving expert review to ensure the target meets required criteria and methods of science-based targets.

Verification: Assessment and validation of compliance, performance, and/or actions relative to a stated commitment, standard, or target. With respect to SBTs, an independent third-party confirmation of either or both: a) baseline values of a target indicator (e.g., a company's water or GHG inventory) and b) progress made toward achieving the target.

Water challenge: Water-related issues including physical water scarcity, insufficient water quality, and/or regulatory restrictions on water use**.**

Water use: A general term that can represent either gross or net consumption (i.e., water withdrawn minus volume of water discharged/returned).

Watershed: The area of land that provides all surface runoff and subsurface waters to a given waterbody. Also referred to as basin or catchment.

Important Guidance about this Version of the Science-Based Targets for Nature: Freshwater Step 3 Methodology

The present document includes the first version of methods to set Science-Based Targets for Nature: Freshwater, henceforth referred to as the "freshwater science-based targets (SBT) methods, version 2023". They are being shared now for internal review by SBTN members and the Technical and Practitioner Advisory Groups of the Freshwater Hub. They will then be updated for public consultation in August 2022. Once these methods are finalized and approved by SBTN for public use, companies will be able to use these methods to set freshwater SBTs as part of the first release of science-based targets for nature in early 2023. SBTN will not recognize claims, public statements, or any targets coming from the use of these methods before public approval.

These methods were developed by the SBTN Freshwater Hub: WWF (co-lead), CDP (co-lead), The Nature Conservancy, the Pacific Institute and the World Resources Institute. LimnoTech, Earth Genome, Future H2O and Quantis provided writing, review and technical support. Several companies were also involved in piloting the methods and providing feedback on early versions. The supporting products, including a corporate manual (link to be provided when available), will enable and support companies in implementing the target-setting method contained here. The corporate manual will indicate the period in which the method will be valid for use by companies. SBTN will deliver updated versions of methods and supporting products over the coming years as part of a continued development roadmap (to be included when methods are released for public consultation).

These methods are the very first released by the SBTN and are not expected to be usable by all companies for managing all freshwater-related impacts. This version of freshwater SBT methods (version 2023) focuses on the following pressures on nature, and in particular, on:

- Water quantity: Withdrawals of freshwater from surface water bodies and groundwater
- Water quality: Loading of nitrogen and phosphorus (N and P) to surface water bodies

Specifically, the scope of what is included or not in this version of the methods (for freshwater SBTs, version 2023) is outlined as follows:

Included in version 2023	**Not included in version 2023 (i.e., to be included in subsequent version)**
Water Quantity: ⇛ Surface water flows ⇛ Groundwater levels (only if local model/thresholds exist)	Water Quantity: ⇛ Groundwater levels (global model)
Water Quality: ⇛ Nutrient pollution (N, P)	Water Quality: ⇛Toxic chemicals and other water quality parameters
Scope: ⇛ Upstream ⇛ Direct operations	Scope: ⇛ Downstream
	Freshwater biodiversity and direct conversion of freshwater ecosystems
	Consideration of forward-looking scenarios, including how future climate change will impact water availability and quality

These methods are likely to be best suited to companies that know the geographical location of their operations (direct operations and upstream value chain activities), so that pressures on water quantity and water quality can be located to specific water basins. Future iterations on these methods will expand the set of issues and impacts that can be addressed.

Finally, the scope of the methods presented here is restricted to Step 3 of the five-step SBTN Framework ("Measure Baseline, Set Target, and Disclose"), as introduced in the SBTN Initial Guidance for Business. Companies using the water methods are expected to have completed Steps 1 ("Assess") and 2 ("Interpret & Prioritize") of the SBT-setting process (Note: separate guidance for these steps is currently under review; links will be provided here in the final document). Guidance related to Step 4 ("Act") and Step 5 ("Track") is expected in 2023. Until this time, companies should not use these draft methods to set freshwater SBTs. This documentation is for technical review purposes only. Specific corporate guidance will be developed for companies based on this technical documentation.

● Step 3: Measure, Set and Disclose Targets

1. Introduction

The third step of the freshwater SBTs process uses data from the sites and issues as identified and prioritized in Steps 1 and 2 to set targets aligned with Earth's limits and societal goals. This document provides a methodology for setting those targets. This introduction defines the scope of application for freshwater SBTs, describes the general approach for setting freshwater SBTs, outlines the specific steps that must be taken, and describes a tiered approach towards selecting the degree of rigor to be applied in defining the target. Detailed descriptions of the process for water quantity and water quality are then provided in Chapters 2 and 3, respectively.

1.1 Scope of Application

This method applies to all companies that have activities either in their direct operations or upstream supply chain that were prioritized for either water use or water quality in Steps 1 and 2. When Steps 1 and 2 are updated to include downstream activities, the water methods will be updated to include methods for downstream activities as well. Water quality targets for this initial version are restricted solely to nutrients. Future iterations of the water methods are anticipated to include other aspects of water quality.

1. 1.2 Approach for Setting Freshwater SBTs

The approach for setting SBTs for nature is largely based upon the concept that various stresses that human activities place on nature (called "pressures") affect the resulting state of nature, as shown in the left half of Figure 1. For example, the pressure of water pollution can impair the state of nature corresponding to aquatic ecosystems. The right half of Figure 1 illustrates the role of targets which are designed to define the maximum level of pressure that could be applied while maintaining a desired state of nature (i.e., consistent with Earth's limits). Using pollution as an example, the target would define the maximum allowable load of contaminants a company could discharge while maintaining healthy ecosystems within a given basin.

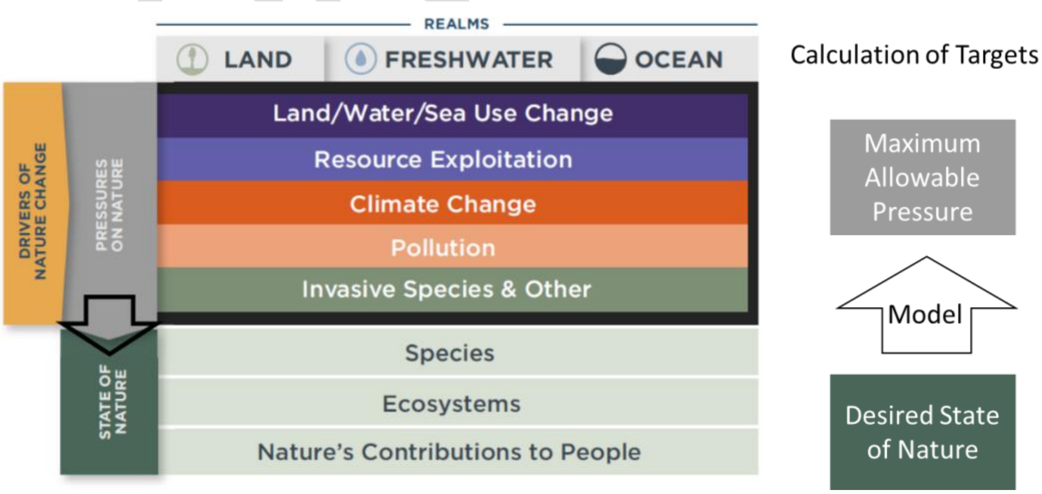

Figure 1. Relationship among Pressures on Nature, State of Nature, and Targets (adapted from SBTN, 2020)

Defining targets for pressures based upon the desired state of nature requires three components:

1. Specific indicators to represent the pressure(s) and state of nature: For example, the rate at which the nutrient phosphorus is loaded to a water body (mass per time, such as kg P/year) is an indicator of pressure. The nutrient concentration in the water body itself (mass per volume, such as mg P/l) is an indicator of the state of nature.
2. Quantitative value(s) representing the desired state of nature for each indicator: Continuing the example, this corresponds to the maximum phosphorus concentration determined to result in a healthy aquatic ecosystem (e.g., 0.046 mg P/l).
3. A method to relate the desired state of nature to the level of pressure: Completing the example, this would consist of an analytical tool (such as a water quality model) capable of answering the question "What is the maximum phosphorus load that will result in attainment of a phosphorus concentration of 0.046 mg P/l?"

Figure 1 contains broad categories of pressures on nature (e.g., Resource Exploitation) and state of nature (e.g., Species). For purposes of this initial freshwater SBTs methodology[3], we are focusing on the pressure categories of resource exploitation (represented by water withdrawal[4]) and pollution (represented by nutrient load). These are selected because: 1) they are the pressures most relevant to the impacts that most corporations pose to freshwater, and 2) methods are currently available to define quantitative target levels for these pressures that can be linked to a healthy state of nature. The indicator for the desired state of nature with respect to resource exploitation is water quantity, defined as a sufficient volume of water to support ecosystem integrity and human needs. The indicator for the desired state of nature with respect to pollution represents sufficient water quality to support ecosystem integrity and provide safe waters for human uses (e.g., fishable, swimmable, drinkable) (Figure 2). These indicators are aligned with those specified in the United Nations' Sustainable Development Goals and CEO Water Mandate's Setting Site Water Targets Informed By Catchment Context: A Guide For Companies.

[3] SBTs for nature will eventually address pressures affecting other relevant water-related states of nature and other components of water quality. UN Global Compact CEO Water Mandate et al., (2019) provides guidance on addressing a broader range of impacts than discussed here.

[4] Defined here as gross withdrawal, either directly from groundwater or surface water, or indirectly via a third-party water supplier.

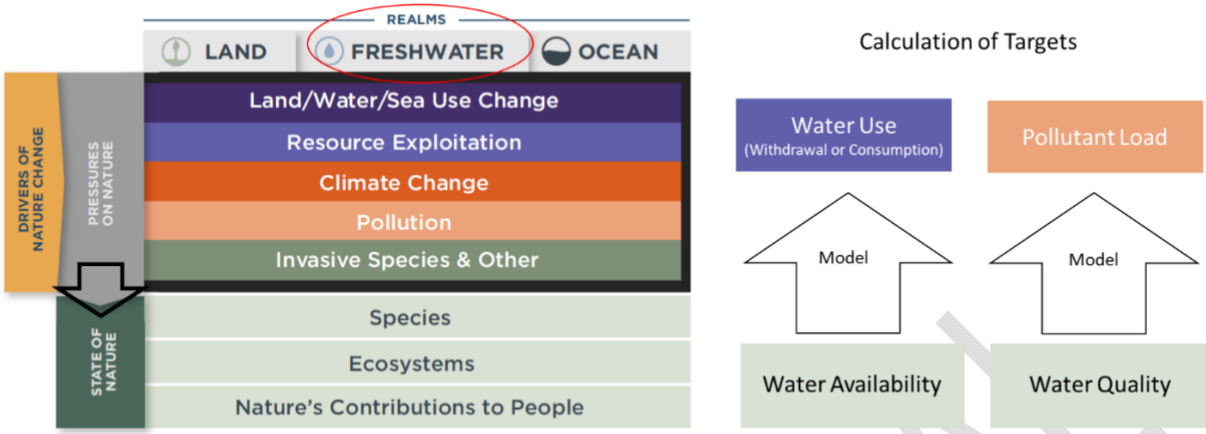

Figure 2. Freshwater SBTs Focus for Defining Targets for Pressures based upon Desired State of Nature (adapted from SBTN, 2020)

1.2.1 Specific Steps for Setting Freshwater SBTs

Step 3 target setting for water consists of four components as shown in Figure 3, which follow from Steps 1 and 2. In the first part of Step 3, the company specifies the spatial domain (i.e., basin) for which the targets will apply. In the second part of Step 3, the company, the company aggregates the total pressures from all its activities across the specified basin for the specified time period and records the baseline value. These data will, in most cases, be available from process undertaken in Step 2. The company calculates the maximum allowable level of pressure in the third part of Step 3 by applying a tool that defines the maximum level of pressure from all actors in the basin that won't compromise the desired state of nature The final part of Step 3 consists of setting targets, where the company defines a target level for their pressures consistent with the extent to which their pressures must be reduced in order to meet their fair share of the maximum allowable level. Determination of "fair share" requires a decision regarding how the maximum basin-wide level of pressure is allocated between other users of water in the basin.

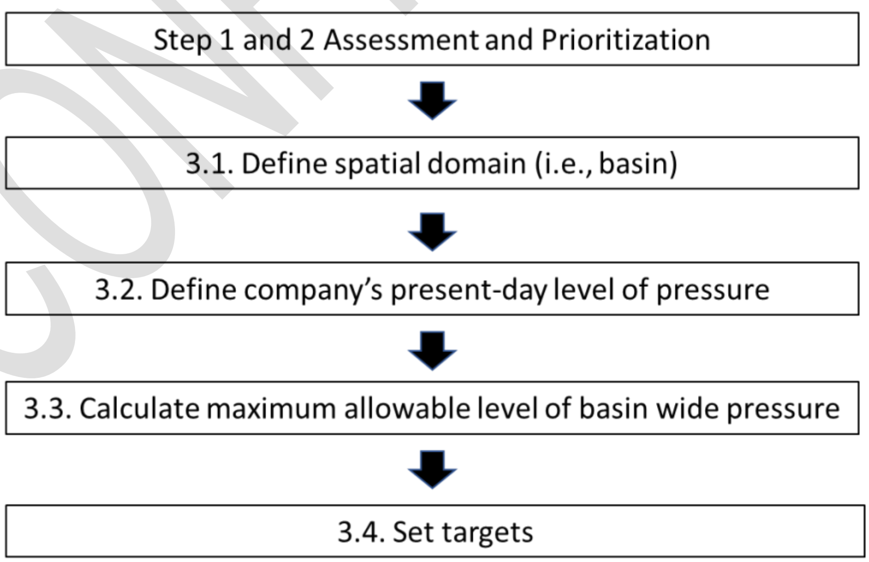

Figure 3. Component Steps for Setting Freshwater SBTs

The details of each step will depend upon the degree of rigor chosen for the target-setting process, as well as whether targets are being set for water quality or water quantity. Section 1.2.2 describes a tiered approach to addressing degree of rigor that is applicable for both quantity and quality. Sections 2 and 3 provide details of the target-setting approach for water quantity and quality, respectively.

1.2.2 Tiered Approach to Setting Freshwater SBTs

Unlike science-based targets for climate designed to protect against Global Climate Change, two aspects of defining targets to protect water (i.e., selecting a quantitative value representing the desired state of nature and defining the relationship between pressures and the desired state of nature) depend greatly on site-specific conditions. For example, the environmental flow requirements representing the desired state of nature in a lowland river will be different from the flow requirements for a headwater stream. Similarly, the relationship between water withdrawal and attainment of the desired environmental flows also varies greatly depending upon local context.

The level of resources (i.e., data, time, effort) required to accurately define scientifically rigorous site-specific water targets can be challenging and time-consuming, depending on the science and data availability, and may be impractical to implement immediately on a widespread basis. Setting targets in the near term requires simpler approaches based on best available global datasets and thresholds. For that reason, freshwater SBTs can be developed following a tiered approach as described below:

- Tier 1: Targets are based on catchment-specific hydrologic and/or water quality models, paired with locally based thresholds, all of which are recognized by the local basin management authority.
- Tier 2: Targets are based upon global models paired with thresholds that are either globally defined or also based upon results of global models.

Figure 4 shows a decision tree guiding selection of a Tier 1 vs. Tier 2 approach to be applied for each basin that was previously selected as a priority under Step 2. Companies are required to follow this decision tree to determine whether to use a Tier 1 or Tier 2 approach. The process begins with stakeholder engagement, discussed below in Section 2.1. The first decision in Figure 4 corresponds to whether locally accepted environmental thresholds[5] (i.e., environmental flow requirements or water quality targets) and a method for relating pressures to those thresholds (e.g., a model) have already been developed for the basin of interest. If so, companies must use the results of that model along with the local thresholds to directly develop Tier 1 targets[6]. The second decision in Figure 4 corresponds to whether models and thresholds are being developed for the basin of interest. This decision is relevant because the SBTN is considering developing local thresholds and models for a subset of basins worldwide where there is a high level of corporate engagement to support development of Freshwater SBTs. If models and thresholds are being developed, companies have the option of using these tools when they become available to set targets using Tier 1 approaches or to proceed directly in setting targets using Tier 2 approaches. If models or thresholds do not exist (and are not being developed by SBTN), companies must follow a Tier 2 approach. Companies taking a Tier 2 approach can

[5] Companies must provide documentation that existing thresholds were selected to be protective of nature (not just human requirements)

[6] Section 2.3.5 provides validation criteria for demonstrating that an adequate search was made for the presence of Tier 1 models and thresholds.

refine their targets in future years with additional stakeholder engagement and application of local models and thresholds, where available.

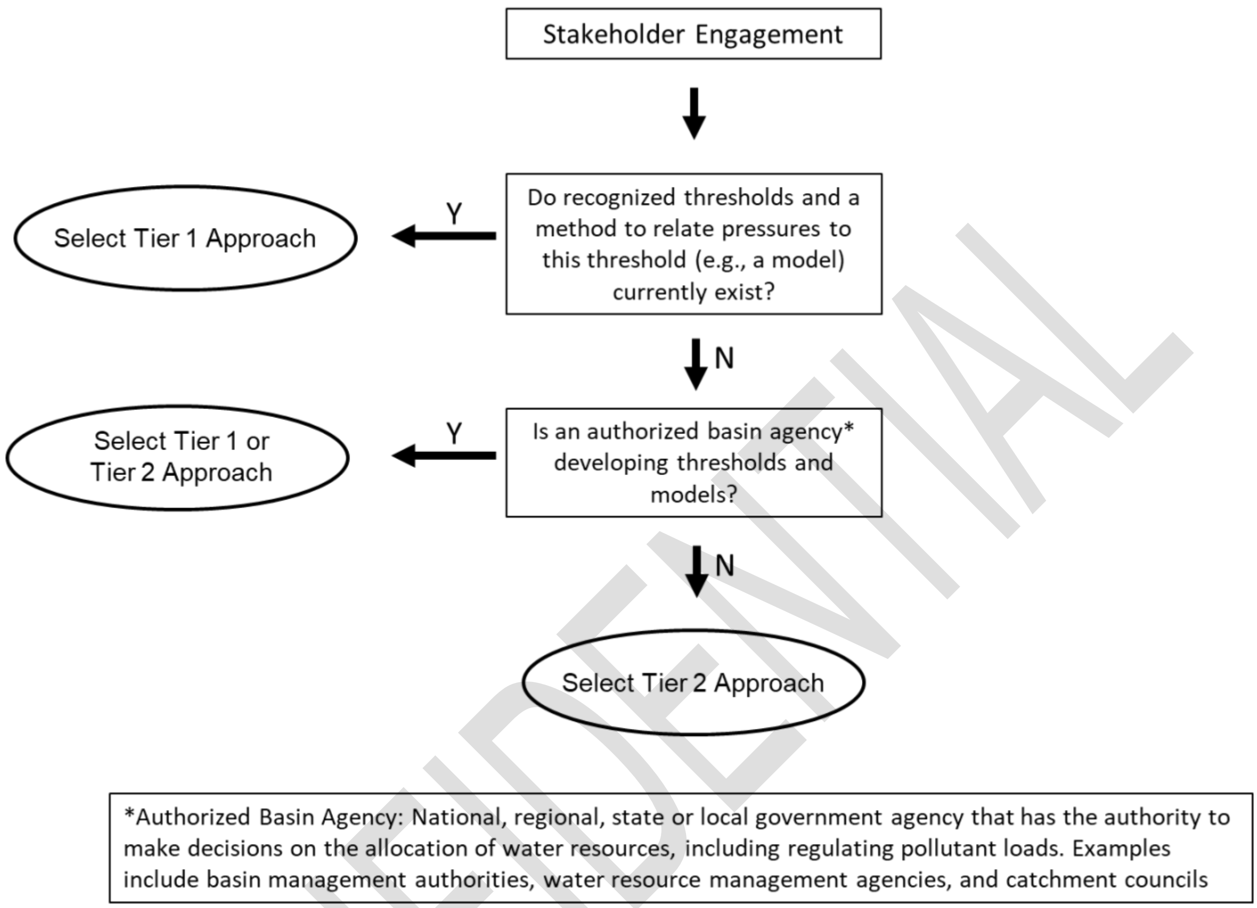

Figure 4. Flow Chart Illustrating Tiered Approach Decision Process.

2. Setting Site-Specific Freshwater SBTs for Quantity

This section describes the process for setting site-specific freshwater SBTs for Quantity and is divided into broad sections corresponding to Tier 1 and Tier 2 approaches. The section begins with requirements for stakeholder engagement. This is followed by the requirements for each tier for the target-setting steps of:

1) Define the spatial domain
2) Define present day/baseline level of company's pressures
3) Calculate maximum allowable level of basin wide pressures, and
4) Set targets.

The description of the stepwise process for each tier ends with a description of the relevant validation criteria. For this version of the method, targets are focused on surface waters, with some direction given on consideration of groundwater. Future versions of the method are expected to provide more detailed consideration of the protection of groundwater levels.

2.1 Stakeholder Engagement

Following guidance from the CEO Water Mandate, the stakeholder guidelines presented here consider three areas of integrity for water stewardship initiatives (participants, processes, outcomes) and their risks[7]. The stakeholder engagement process as outlined here is focused on *key local stakeholders*, defined as groups with specialized knowledge and insights relevant to the basin or hydrological science. Likewise, engagement refers to dialogue centered around clarifying and improving knowledge (science) and identifying opportunities for the efficient use of resources (collaboration).

To meet the requirements for stakeholder engagement for setting freshwater SBTs, the following three-part approach should take place **at the beginning of implementation of Step 3 methods (Figure 4):**

a) Participants: identify *key local stakeholders*

b) Process: Engage with the *key local stakeholder* groups

c) Outcomes: Select Tier 1 or Tier 2 approach for setting freshwater SBTs

Details on each of the three steps required for stakeholder engagement are found in the following sections: 2.1.1 - 2.1.3.

2.1.1 Participants: Identify key local stakeholders

Companies must first identify key local stakeholders (i.e., those with specialized knowledge and insights relevant to the basin or hydrological science). Based on the comprehensive OECD guide on stakeholders in

[7] The stakeholder process provided avoids a fully prescriptive method given the vastly different characteristics of stakeholder groups globally. We acknowledge that accessibility to stakeholder groups may vary significantly across basins and that, particularly in transboundary river basins, complex political economy dynamics in many parts of the world may hinder willingness to cooperate in collective action. Furthermore, we recommend the stakeholder process be considered through the lens of stakeholder dialogue defined by WBCSD which presents a clearly defined purpose for engagement

the water sector, we derived a list of five key basin stakeholder groups from which we **require companies to engage with (*at least two* of the following)**:

a. Water management agencies/basin authorities
b. Governmental regulators (water quantity, quality)
c. Science and academia involved in the basin
d. Local water-related NGOs or local chapters of international NGOs (WWF, TNC, etc.)
e. Local communities and/or indigenous groups or their representatives

Within each basin for which the company is setting targets, the company should identify the most relevant stakeholder groups from the list with consideration of the following six potential risk areas: partner continuity, track record, behavior, capability, representation, and intent.

2.1.2 Process: Engage with the key local stakeholder groups

Companies should use the following RACI matrix (Table 1) **as a guide to drive dialogue with the selected stakeholders and to promote transparency and accountability.** A RACI (Responsible, Accountable, Consulted and Informed) matrix is a globally recognized project management tool used to clarify roles for tasks and decisions that take place through a project, in this case target setting in a specific basin.

Table 1. RACI Matrix Step 3 Roles

Responsible	Can be assigned to multiple stakeholder groups Does the work to get the task done or create a deliverable Requires capacity to do the task, resources and ability to complete work
Accountable	Can only be assigned to one stakeholder group, typically the company as decision-making power rests in this group Delegates and reviews the work for being accurate and complete Makes sure the responsible team knows the expectations of the SBTN framework, the basin work, and completes it on time
Consulted	Can be assigned to multiple stakeholder groups Provides vital information and feedback toward the work, before decisions/targets are set Requires two-way communication throughout the project Has a stake in the outcomes because of current or future aspects of the work in the basin Generally consists of a small group of people who tend to be experts (academic or otherwise)
Informed	Can be assigned to multiple stakeholder groups Participates after decisions are made or targets are set May need to be kept in the loop regarding the project's bigger picture and progress, typically through one-way communication Generally consists of multiple people who are communally affected by finishing the tasks associated with the project's completion

A RACI matrix must be used **as a template for documenting stakeholder engagement** for reporting purposes during the Step 3 process. There are five potential risks to the engagement process that have been identified by CEO Water Mandate et al. (2019):

- Ongoing management & communication: assign roles and responsibilities early in the process using the RACI template; company provides clear communication of the engagement process, its intentions and expectations of time and outcomes.
- Unbalanced stakeholder engagement: if other potential key stakeholders arise in dialogue, consider including them as an additional participant
- Planning & design flaws: document and discuss decisions and how key stakeholders were involved in choices made
- Inadequate Monitoring and Evaluation: document the engagement process
- Financial & fiduciary risk: identify resources and risks early in the process

Companies are required to document the roles of stakeholders in the following parts of the target setting process: identification of any existing thresholds or targets (at outset of the process); identification of scientific model/approach (only needed if Tier 1 approach); collection of local data (Tier 1); and setting of thresholds/targets (Tiers 1 and 2).

2.1.3 Outcomes: Select Tier 1 or Tier 2

Engagement of key local stakeholder(s) will directly help inform the company to select either **a Tier 1 (local model) or Tier 2 (global model) approach** to target setting. There are important differences in further stakeholder engagement depending on the selected tier.

The stakeholder engagement process when using a Tier 1 (local model) will focus on accessing and obtaining necessary models and data from local stakeholders. It will likely be front-loaded to ensure an appropriate local model or scientific approach is identified upfront and that corporate data can be combined with other local data to arrive at a target. The stakeholder engagement process when using a Tier 2 (global model), will instead focus on engaging local stakeholders and ensuring alignment on the relevance and application of a global model within the watershed. Both **approaches must ground their stakeholder engagement in building trust** with the model and ultimately, the resulting targets.

2.1.4. Stakeholder Engagement Validation Criteria across both Tier 1 and Tier 2

A. Documentation of a stakeholder mapping exercise within the basin of interest, prioritizing stakeholders for engagement based on partner continuity, track record, behavior, capability, representation, and intent.
B. Documentation of engagement with at least *two key local stakeholders* and their roles in the following parts of the process via a RACI chart: identification of any existing thresholds or targets (Tiers 1 and 2); identification of scientific model/approach (Tier 1); collection of local data (Tier 1); and setting of thresholds/targets (Tiers 1 and 2).
C. In order to justify selecting either a Tier 1 (local model/threshold) or Tier 2 (global) approach, the company must provide:
    a. record of the person(s) contacted at the basin management authority (or water resources agency) for the basin in question and their response regarding existence of models/thresholds for quality and/or quantity parameters

b. In cases where no basin management authority or water resources agency exists, please provide record of request and response to relevant academic agencies or non-governmental agencies working on water issues within the basin in question

2.2 Tier 1 Water Quantity

The Tier 1 approach for water quantity is based upon the use of existing site-specific environmental flow requirements and a locally developed method (typically a hydrologic model) that defines the relationship between withdrawals and environmental flows over an extended period of time.

2.2.1 Define the spatial domain

Freshwater SBTs are set based upon a local context (i.e., within the basin prioritized during Step 2). Under this first step, the company defines the spatial domain (i.e., basin) over which targets will be developed. There is no fixed requirement regarding the unit of analysis (e.g., Pfafstetter-level basin) for setting Tier 1 Freshwater SBTs, as relevant spatial domain for Tier 1 targets will be largely dictated by the spatial domain of the available model. Companies can choose to consider a subset of the full model domain for setting targets, following guidance provided by the Alliance for Water Stewardship (2019) that the scope of the analysis is large enough to:

- contain the upstream land area or aquifer contributing to your sites' water source(s),
- contain the downstream areas affected by your sites' nutrient loads, and
- contain the upstream and downstream area of impacts for other actors that are contributing to the water challenge

The maximum downstream extent can be defined as the distance at which a site's actions can still be distinguished from baseline conditions, either in terms of water quantity or water quality. As noted by the CEO Water Mandate's Setting Site Water Targets Informed By Catchment Context: A Guide For Companies, consideration may also be given to: 1) using the same catchment boundaries as the appropriate water governing body, and 2) soliciting stakeholders input on appropriate spatial scope.

2.2.2 Define present day/baseline level of company's withdrawals

Under this step, the company aggregates the total water withdrawal from its activities across the specified basin and time period and records these as the baseline value. The company must define its baseline withdrawal for all its activities in each prioritized basin. For this version of the methodology, baseline level of withdrawals must be defined based upon primary data for all direct operations. For directly owned sites, the company must conduct direct measurements or obtain primary data for their water withdrawals (e.g., from their water meters). It is recognized that primary data on water withdrawals may not be readily available for certain water uses, primarily upstream agricultural suppliers. Baseline data for upstream suppliers can be based on either primary data or the secondary data sources used in Steps 1 and 2 that estimated the amount of water use based upon information on the quantity of products/commodities produced (i.e., Blue Water Footprint, specified in units of volume of blue water use per time). Baseline data should be recorded on a monthly basis whenever possible, recognizing that secondary data sources may only provide data on an annual basis.

The output from this step is baseline withdrawals, i.e., the level of a company's withdrawals against which future targets will be compared. Defining this baseline withdrawal requires specification of the time frame over which the withdrawals will be aggregated. Companies must use the average aggregate withdrawals[8] over the last five full years of operation to represent the baseline. Facilities/operations that have been in existence less than five years (or have collected data for less than five years) should use the average withdrawals over the length of their existence (or period of data collection). The five year duration used for calculating the baseline was selected to recognize and account for the ongoing investments on water reductions that companies may have implemented before setting SBTs and to help mitigate the additional (perceived or real) burden that the allocation approach used in this methodology has on companies leading efforts on reductions of water withdrawals (see section 2.2.4 Define Targets for additional information).

2.2.3 Calculate maximum allowable level of basin wide withdrawals

Under this step, the company applies an analytical method capable of relating the magnitude of withdrawals to the resulting stream flows in order to determine the maximum amount of basin wide withdrawal that will result in compliance with the desired stream flow (or groundwater recharge) regime. Two options exist for determining the maximum allowable level of withdrawals for Tier 1.

- Back-Calculation from Existing Results: This approach provides specific equations for calculating allowable withdrawals using information on environmental flow requirements and modeled (or historically observed) stream flow regimes. This option allows targets to be set without requiring new application of the Tier 1 model but lacks flexibility for considering factors such as groundwater depletion or dam operations.
- Direct Application of Model: This approach provides more flexibility in terms of consideration of groundwater and dam operations but requires the application of a Tier 1 model to explicitly demonstrate that the proposed target will result in attainment of environmental flow requirements.

Each option is described below.

2.2.3.1 Back-Calculation from Existing Results

This method provides specific equations for calculating the maximum amount of withdrawals (in terms of volume per time, such as km^3/yr) that will attain the desired environmental flow condition. It is based upon the assumption that the rate of withdrawal at any given time is directly reflected as a reduction in stream flow and therefore the necessary reduction in withdrawals is the same percentage as the desired increase in streamflow. This assumption allows the required basin wide reduction in withdrawal to be directly calculated from:

- Present day stream flows, representing current withdrawals,
- Natural stream flows, representing the absence of withdrawals, and
- The locally derived environmental flow requirements.

The amount that overall withdrawals must be reduced is based upon the concept of "excess withdrawals", i.e., the amount that present withdrawals exceed the level necessary to attain environmental flow requirements. The percentage reduction required to attain environmental flow requirements is calculated as the ratio of excess withdrawal to present withdrawal:

[8] Either by month or overall, depending on the spatial resolution selected to set targets is Section 2.2.4.

$$\% \; Reduction \; in \; Basinwide \; Withdrawal \; Required = 100 \; x \; \frac{Excess \; Withdrawals}{Present \; Withdrawals} \quad (1)$$

This concept is illustrated in Figure 5 using hypothetical hydrographs. The upper line in the figure represents the natural stream flow regime, the middle line represents the environmental flow requirements, and the lower line represents present day flows. For this example, present day flows are consistently less than the environmental flow requirements, indicating that the present level of withdrawal exceeds what is desired. The excess withdrawal for any given month is defined as the difference between the environmental flow requirement and the present day flow (for this example, 30 m^3/sec). The present withdrawal for any given month is defined as the difference between the natural stream flow and the present day flow (for this example, 50 m^3/sec). The ratio of excess withdrawal to present withdrawals is 60% (i.e., 30÷50), meaning that overall withdrawals will need to be reduced by 60% to attain environmental flow requirements.

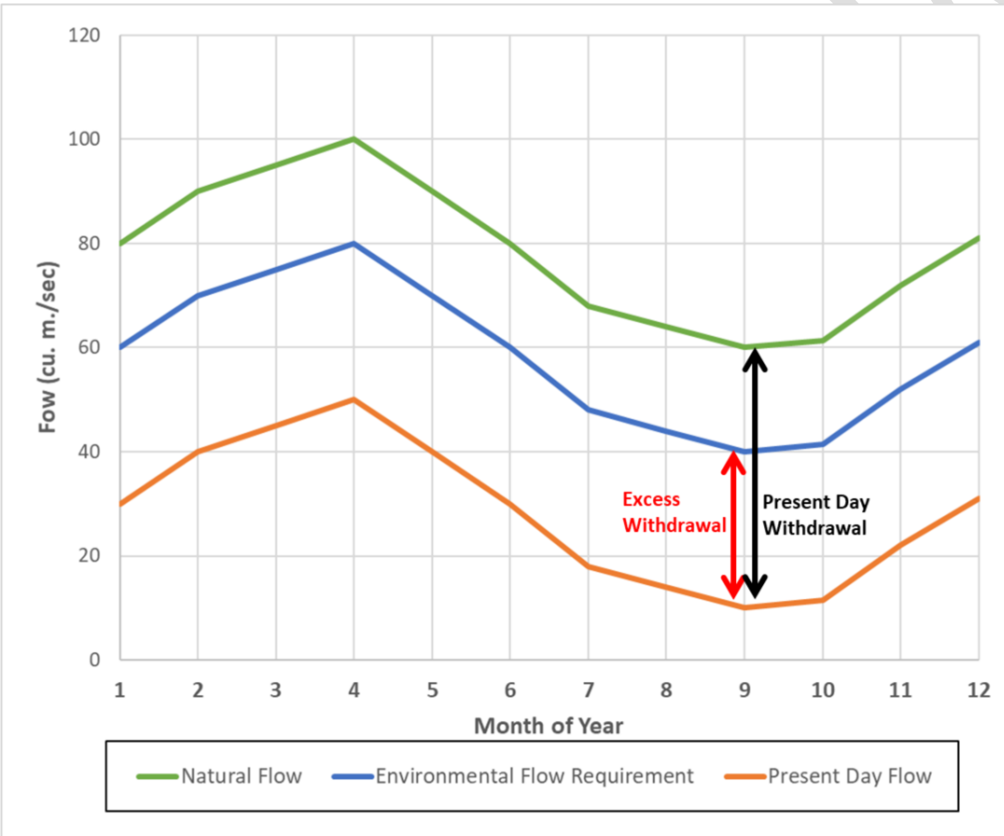

Figure 5. Illustration of Concept for Determining Required Reduction in Withdrawals

Equation 1 can be expressed in terms of stream flows because of the assumption that the rate of withdrawal at any given time is directly reflected as a reduction in stream flow. This assumption allows excess withdrawal to be calculated as "environmental flow requirement minus present day flow" and present day withdrawal to be calculated as "natural stream flow minus present day flow". Substituting these terms into Equation 1 gives:

$$\% \; Reduction \; in \; Basinwide \; Withdrawal \; Required = 100 \; x \; \frac{(Environmental \; Flow \; Requirement - \; Present \; Day \; Stream \; Flow)}{(Natural \; Stream \; Flow - Present \; Day \; Stream \; Flow)} \quad (2)$$

Equation 2 must be applied over the entire period for which flows are available, with results tracked for each month. The maximum percent reduction provided by Equation 2 over that period is used in the next step in conjunction with the present day level of withdrawal to define company specific freshwater SBTs.

The Back-Calculation approach assumes that water withdrawals are the dominant cause of non-attainment of desired flow conditions. Basins where dams affect attainment of environmental flow requirements require consideration of dam operations when setting targets and are better suited to the Direct Application of Model approach described below.

Section 2.2.4 describes the conversion of the maximum basin wide level of withdrawal determined from Equation 2 into the company's target maximum amount of withdrawal.

2.2.3.2 Direct Application of Model

The second option for defining maximum allowable withdrawals applies in cases where a Tier 1 model is available to be applied for purposes of evaluating specific reduction scenarios. For this option, the company defines its maximum allowable level of withdrawal by demonstrating that the desired stream flows (and/or aquifer level, if appropriate) will be attained for their targeted level of withdrawal over the entire period of simulation. This option avoids the simplifying assumption of the Back-Calculation approach as it does not require the assumption that the rate of withdrawal at any given time is directly reflected as a reduction in stream flow. This makes the approach suitable for situations where protection of groundwater levels is an important consideration. Second, this approach is better suited for situations where pressures other than withdrawals (e.g., dams) are responsible for the non-attainment of environmental flow requirements, as it allows the effect of alternate dam operations to be considered.

For sites where groundwater depletion exists, a stepwise approach will be required to ultimately achieve environmental flow requirements (Figure 6):

1. If groundwater levels are declining, define and implement the necessary reduction in withdrawal to stop the decline.
2. If groundwater levels are stable (vary with climate but without negative decadal trend) but beneath levels where they connect with surface water, define and implement the necessary reduction in withdrawal to recover levels to achieve connectivity.
3. If groundwater levels are stable and connected to surface water, set surface water targets to achieve locally defined environmental flow requirements.

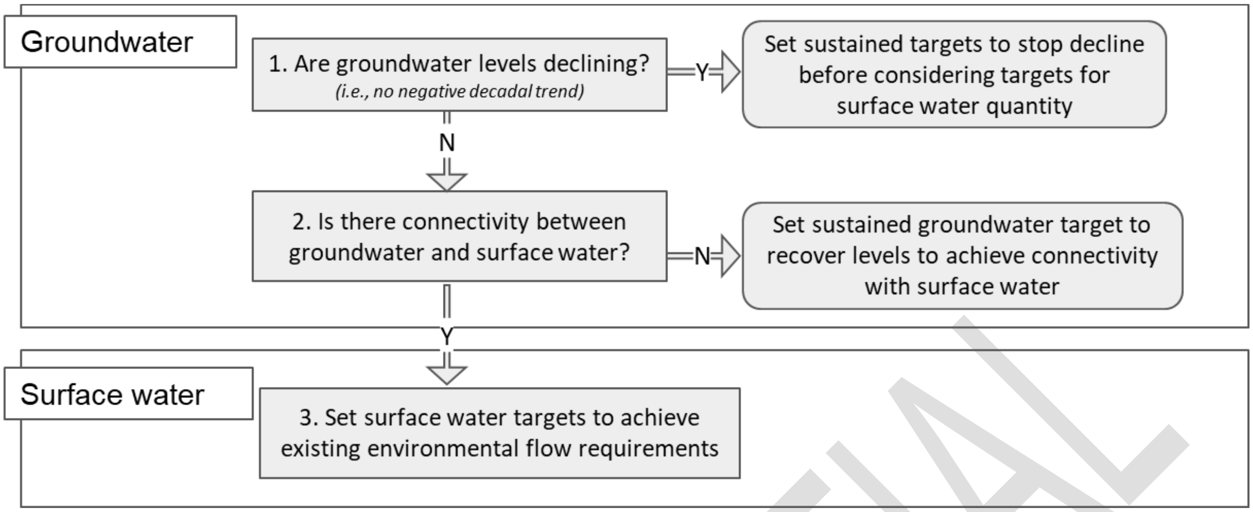

Figure 6. Decision tree for setting water targets considering groundwater trends and levels

While it is recognized that the reduction in withdrawal required by either of the first two above steps may be extensive, companies must set their targets to satisfy all the above steps to be able to claim they have set Science-based Targets.

2.2.4 Define targets

At this point in the process, the company defines a target level for its withdrawals consistent with the maximum allowable level of basin-wide withdrawals defined above in Equation 2 or as a result of direct application of model as described in section 2.2.3.2. Conversion of allowable basin-wide withdrawals into company-specific targets requires a decision on how the reduction burden will be shared among water users in the process referred to by SBTs as allocation. Many different approaches are available for determining a company's fair share of the allocation. The allocation approach called "equal contraction of efforts", which assumes that all water users in the basin will reduce their withdrawals by the same percentage, is to be used for purposes of this initial version of the method[9].

Results from Equation 2 (or from direct application of the model) are converted into the company's maximum amount of withdrawals (in terms of volume per time, such as km^3/yr) that will attain the desired state of nature. This is accomplished by multiplying the required percentage reduction with the company's present day level of withdrawal (in the same units of volume per time):

$$Target\ Withdrawal = \frac{100 - \%\ Reduction\ in\ Withdrawal\ Required}{100}\ x\ Present\ Day\ Level\ of\ Withdrawal \qquad (3)$$

The allocation approach of "equal contraction of efforts" effectively gives every stakeholder the same level of reduction ambition, defined as a percentage, relative to their starting position (i.e., the moment when they calculate their baseline). This allocation approach was chosen for its simplicity, as the only input data required is the baseline level of impacts, rather than considering additional social, economic, technological, or political aspects that could be considered as allocation factors but that are impractical to request for this version of the methodology. The equal contraction of efforts approach has, however, the potential to

[9] Alternative allocation approaches will be considered in future versions of this method.

penalize companies leading on water reduction ambitions *before* calculating the baseline. To mitigate this problem, companies should define their baseline taking into account the last 5 years of impacts, as explained in the preceding section 2.2.2 *Define present day/baseline level of withdrawal*. Future iterations of this methodology will consider other allocation approaches.

Companies can use annual or finer time periods for their targets related to water quantity. If companies choose to set their targets on an annual basis, the required reduction must be equal to the largest reduction required across all individual months. For example, if the required reductions are 50% for certain months of the year and zero for other months, a company could set targets on an annual basis requiring a blanket 50% reduction across the entire year. It could also set monthly targets and require reductions only for those months where they are necessary (without increasing withdrawals in any of the other) months). The decision to use monthly vs. annual targets may depend upon the sector, e.g., agricultural irrigation withdrawals that vary widely on a seasonal basis may be better suited to monthly targets than some types of direct operations whose water withdrawals are relatively constant over the course of the year. Water quantity targets based on aquifer protection should be specified on an annual basis.

The target will be stated in the form of "Company X will reduce its water extraction in the _ basin to _ km^3/yr by the year _" for situations where the target is set on an annual basis. For cases where monthly targets are used, the target will be stated in the form of "Company X will reduce its water extraction in the _ basin to _ km^3/month for each of the following months. The reductions will occur by the year _."

Illustrative Example: Setting a Tier 1 SBT for Nature: Freshwater Quantity Using Results from a Locally Calibrated Hydrologic Model and Locally Determined Environmental Flow Requirements

Local environmental flow requirements and results from a site-specific hydrologic model are available in the basin containing its operations, so a company chooses to set an SBT for Water Quantity using these tools and the "Back-Calculation from Existing Results" approach. They begin by calculating the cumulative pressures of their operations over the spatial domain considered in the model. They have one facility that directly monitors their water use for irrigation, withdrawing water at a rate of 8 km^3/month. They also have an agricultural supplier in the basin for which they used secondary data (i.e., Blue Water Footprint) to calculate water use of 2 km^3/month. The sum of these two numbers results in a cumulative water withdrawal of 10 km^3/month.

Existing environmental flow requirements had been specified on a monthly basis. Hydrologic model results were available representing the natural stream flow regime and present day stream flow regime and were compiled into monthly averages. These values are shown in the table below along with the required reduction percentage for each month calculated using Equation 2. Note that only a single year is shown here for the sake of brevity, actual model results will span many years to capture the range of environmental conditions.

Local Environmental Flow Requirements and Model-Predicted Flows by Month

For this example, no reductions are required for ten months of the year, because present day stream flows exceed environmental flow requirements for those months. Should the company choose a single annual target, they would base it on the most stringent monthly reduction in the table above (33%). Application of Equation 3 indicates that, with a present day pressure of 10 km^3/month and a required reduction of 33%, they have a target of 6.7 km^3/month for their aggregate withdrawals across all operations. Alternately, they could specify monthly targets using each month's required reduction percentage in Equation 3.

2.2.5 Tier 1 Water Quantity Target Validation

The validation process for Tier 1 freshwater SBTs for quantity consists of ensuring that:

- Models and thresholds were developed by an authorized basin agency. An authorized basin agency is a national, regional, state or local government agency that has the authority to make decisions on the allocation of water resources. Examples include basin management authorities, water resource management agencies, and catchment councils.
- Documentation was provided demonstrating that the existing flow requirements considered the desired state of nature (and not just human needs).
- The spatial domain (i.e., basin) of the target was explicitly identified based on the spatial domain defined in the model.
- All company operations (direct and upstream) that materially affect water quantity in the spatial domain were identified as defined in Step 1 (of the SBTN Framework).
- Baseline water withdrawals were aggregated across all company operations in the basin, using the last five years (or period of existence, if less than five years) of data.

- The specified required percent reduction in withdrawals was calculated in one of the following ways:
  - The company's reduction was set using basin-wide percent reductions as calculated using Equation 2.
  - The results from a hydrologic model and allocation scheme approved by an authorized basin agency demonstrate that the level of withdrawal used to set the company's targets complies with local environmental flow requirements.
- Targets were calculated using Equation 3 and specified in terms of maximum water extraction in terms of volume of water per time, to be achieved within a specified time frame.
- Progress on the target (in Steps 4 and 5 of the SBTN Framework) will be based on changes to gross withdrawals, unless explicit demonstration was provided that any credited return flows are present in the stream at the location, time and quality that they are being applied.

2.3 Tier 2 Water Quantity

The Tier 2 approach for setting water quantity targets is based upon the use of location-specific results from three global hydrologic models and a suite of methods for defining environmental flow requirements as described by Hogeboom et al. (2020).

2.3.1 Define the spatial domain

Under this first step, the company defines the spatial domain over which targets will be developed for a given location. The spatial domain for Tier 2 freshwater SBTs for quantity are dictated by the scale of data provided from the global model of the Water Footprint Network (Hogeboom et al. 2020), i.e., HydroSHEDS level 6 basins.

2.3.2 Define present day/baseline level of company's withdrawals

Similar to Tier 1, the company aggregates the total withdrawals from its activities across the specified spatial domain (i.e., basin) and time period and records the baseline value. The company must define its baseline withdrawal for all its activities in each prioritized basin. For this version of the methodology, baseline level of withdrawals must be defined based upon primary data for all direct operations. For directly owned sites, the company must conduct direct measurements or obtain primary data for their water withdrawals (e.g., from their water meters). It is recognized that primary data on water withdrawals may not be readily available for certain water uses, primarily upstream agricultural suppliers. Baseline data for upstream suppliers can be based on either primary data or the secondary data sources used in Steps 1 and 2 that estimated the amount of water use based upon information on the quantity of products/commodities produced (i.e., Blue Water Footprint, specified in units of volume of blue water use per time). Baseline data should be recorded on a monthly basis whenever possible, recognizing that secondary data sources may only provide data on an annual basis.

The output from this step defines the baseline level of withdrawals, i.e., the level of withdrawals against which future targets will be compared. Companies must use the average aggregate level of withdrawals[10] over the last five years of operation to represent the baseline. Facilities/operations that have been in existence less than five years should use the average level of withdrawals over the length of their existence.

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[10] Either by month, or overall, depending on the spatial resolution of targets selected in Section 2.3.4.

The five year duration was selected to provide some consideration for companies that have already begun reducing their withdrawals.

2.3.3 Calculate maximum allowable level of basin wide withdrawals

For Tier 2 water quantity targets, the company uses results from global hydrologic models and environmental flow requirements described by Hogeboom et al (2020) to define the maximum amount of withdrawals that will attain the desired stream flows. The dataset referenced below and required to complete this step will be provided in an easy-to-use format by the time of public release of the final method at the beginning of 2023. The approach is similar to that described for Tier 1, where the required reduction percentage is based upon the ratio of excess withdrawals to present day withdrawal. The method of calculation can be described as a four-step process:

1. Define natural stream flow regime: For the basin in question, the natural flow regime should be defined based on data from Hogeboom et al (2020), who extracted results from three global hydrologic models[11] to define ensemble mean monthly flow regimes for streams world-wide in the absence of any withdrawals for the period 1971-2010.
2. Define environmental flow requirements: The environmental flow requirements should then be defined based on the "ensemble mean" provided by Hogeboom et al (2020). Hogeboom et al (2020) calculated mean results of three widely accepted methods[12] for establishing environmental flow requirements to be set aside in each basin to ensure proper aquatic ecosystem functioning (Oki and Kanae, 2006; Vörösmarty et al., 2010) on a monthly basis for the period 1971-2010.
3. Define present day withdrawals: Present day withdrawals are then extracted from Hogeboom et al (2020), who extracted monthly average water consumption for the period 1971-2010 from the PCR-GLOBWB model.
4. Calculate required percent reduction: Finally, the company will calculate the required reduction percentage based upon the ratio of excess withdrawals to present day withdrawals. Excess withdrawals are defined as the difference between the environmental flow requirements and present day stream flow. Present day stream flows are defined as the difference between natural stream flows and present day withdrawals. Equation 4 combines the above definitions to calculate the percentage reduction in basin wide withdrawals required to attain environmental flow requirements.

$$\%\ Reduction\ in\ Basinwide\ Withdrawal\ Required = 100\ x\ \frac{(Environmental\ Flow\ Requirement -\ Natural\ Stream\ Flow + Present\ Day\ Withdrawal)}{Present\ Day\ Withdrawal} \quad (4)$$

Companies must apply Equation 4 for each month of the time series provided by Hogeboom et al (2020) to determine the maximum required reduction percentage.

[11] The global hydrologic models used were H08 (Hanasaki et al., 2008); PCR-GLOBWB (Wada et al., 2014); and WaterGAP (Müller Schmied et al., 2016].

[12] The methods used to define environmental flow requirements are described in Pastor et al. (2014), Richter et al. (2012) and; Smakhtin et al. (2004).

2.3.4 Define targets

In this step, the company defines a target level for their withdrawals consistent with the maximum allowable basin wide withdrawals defined above. This is conducted by applying the following equation using the required reduction percentage from Equation 4 in conjunction with the baseline level of withdrawal.

$$Target\ Withdrawal = \frac{100 - \%\ Reduction\ in\ Withdrawal\ Required}{100}\ x\ Present\ Day\ Level\ of\ Withdrawal \qquad (5)$$

The targets set using Equation 5 assume the same "equal contraction of efforts" allocation approach as described above for Tier 1 in section 2.2.4.

Tier 2 water quantity targets are specified as annual or monthly values, as discussed above for Tier 1 targets. If companies choose to set their targets on an annual basis, the required reduction must be equal to the largest reduction required across all individual months.

The target will be stated in the form of "Company X will reduce its water extraction in the _ basin to _ km^3/yr by the year _" for situations where the target is set on an annual basis. For cases where monthly targets are used, the target will be stated in the form of "Company X will reduce its water extraction in the _ basin to _ km^3/month for each of the following months. The reductions will occur by the year _."

Illustrative Example: Setting a Tier 2 Freshwater SBT for Quantity Using Global Hydrologic Models and Environmental Flow Requirements

No site-specific hydrologic model or local environmental flow requirements have been developed in the catchment containing its operations, so our company chooses to set an SBT for Water Quantity using a Tier 2 approach. They determine that they have a single supplier located in the basin defined by Hogeboom et al (2020) with a calculated Blue Water Footprint of 6 km^3/month. They extract monthly time series information on basin wide withdrawals, natural stream flows and environmental flows requirements from the database provided by Hogeboom et al (2020). These values are shown in the table below along with the required reduction percentage for each month calculated using Equation 4 (note that only a single year of results of are shown for purposes of this example, while the actual Hogeboom data set spans decades).

Required Reductions based Upon Local Environmental Flow Requirements and Model-Predicted Flows

The company chooses a single annual target, based upon the most stringent monthly reduction in the table above (35%). Application of Equation 3 indicates that their SBT for water with a present day withdrawal of 6 km^3/month and a required reduction of 35% results in a target of 3.9 km^3/month to be applied for the entire year**. T**hey also had the option of choosing a monthly target, where each month's target would be based on that month's required reduction percentage.

2.3.5 Tier 2 Water Quantity Target Validation

The validation process for Tier 2 freshwater SBTs for quantity consists of ensuring that:

- Written documentation is provided that demonstrates that an adequate search was conducted for existing models and thresholds. Specific criteria for this documentation consist of:
    - A record of the person(s) contacted at the basin authority (or water resources agency) for the basin in question and their response regarding existence of models/thresholds for quality and/or quantity parameters
    - In cases where no basin management authority or water resources agency exists, a record of request and response to relevant academic agencies or non-governmental agencies working on water issues within the basin in question.
- The spatial domain (i.e., basin) of the target was explicitly identified based on the spatial scheme provided by the Water Footprint Network based on Hogeboom et al (2020).
- All company activities in direct operations or upstream that materially affect water quantity in the spatial domain were identified.
- Baseline water withdrawals were defined for each activity, using the last five years (or period of existence, if less than five years) of data.
- The specified required percent reduction in basin wide withdrawals were calculated using Equation 4 with the flows for the basin provided by Hogeboom et al (2020).
- Targets were calculated using Equation 5 and specified in terms of maximum water extraction in terms of volume of water per time, within a specified time frame.

3 Setting Site-Specific Freshwater SBTs for Quality

This section describes the process for setting site-specific freshwater SBTs for Quality and is divided into sections corresponding to Tier 1 and Tier 2 approaches. Discussions specific to each tier are provided for the target-setting steps of: 1) Define the spatial domain (i.e., basin), 2) Define present day level of company's loads, 3) Calculate maximum allowable level of basin wide loads, and 4) Set targets. For this version of the method, water quality targets are being specified only for the nutrients nitrogen and phosphorus. Future versions of the methods are expected to consider a wider range of water quality issues.

3.1 Stakeholder Engagement

The requirements provided above in Section 2.1 on Stakeholder Engagement for setting site-specific freshwater SBTs for Quantity are equally applicable for setting site-specific freshwater SBTs for Quality.

3.2 Tier 1

The Tier 1 approach for water quality is based upon the use of a locally calibrated water quality model and site-specific concentration thresholds for nutrients (or other nutrient-related endpoints such as chlorophyll).

3.2.1 Define the spatial domain

Freshwater SBTs are set based upon a local context (i.e., within a basin(s) prioritized during Step 2). Under this first step, the company defines the spatial domain (i.e., basin) over which targets will be developed. There is no fixed requirement regarding the unit of analysis (e.g., Pfafstetter-level basin) for setting Tier 1 Freshwater SBTs, as relevant spatial domain for Tier 1 targets will be largely dictated by the spatial domain of the available model. Companies can choose to consider a subset of the full model domain for setting targets, following guidance provided by the Alliance for Water Stewardship (2019) that the scope of the analysis be large enough to:

- contain the upstream land area or aquifer contributing to your sites' water source(s),
- contain the downstream areas affected by your sites' water withdrawals, and
- contain the upstream and downstream area of impacts for other actors that are contributing to the water challenge

The maximum downstream extent can be defined as the distance at which a site's actions can still be distinguished from baseline conditions, either in terms of water quantity or water quality. As noted by the CEO Water Mandate's Setting Site Water Targets Informed By Catchment Context: A Guide For Companies, consideration may also be given to: 1) using the same catchment boundaries as the appropriate water governing body, and 2) soliciting stakeholders input on appropriate spatial scope.

3.2.2 Define present day/baseline level of company's nutrient loads

Under this step, the company's goal is to calculate its total present day load of nutrients from all their facilities/sourcing areas in the basin of interest. To do this, they aggregate the nutrient loads (i.e., mass N or P per time, such as kg P/year) from their activities across the specified spatial domain and time period and record the baseline value. For example, a company with three facilities or sourcing areas in a basin sums the nutrient loads across those facilities or sourcing locations and reports the cumulative load in units of mass of nutrient per time (e.g., kg P per year). Baseline loads should be compiled both for nitrogen and phosphorus and be based on primary data for all point source discharges. Loads calculated from primary data are in units of mass per time (e.g., kg P/year); for point source discharges they are calculated by multiplying discharge flows (i.e., volume per time) by discharge concentration (mass per volume.)

It is recognized the primary data on nutrient loads is difficult to obtain from agricultural operations due to the diffuse nature of nonpoint source runoff. Tier 1 models can serve as one source of secondary data for defining baseline nutrient loads, as they must consider all nutrient loads to the water body being modeled. If the existing Tier 1 model explicitly provides estimates of the loads specific to a company's operations, this information should be used for purposes of defining the baseline load. For this version of the methodology, baseline data for agricultural sources may also be based on the secondary data sources used in Steps 1 & 2 that estimated the amount of water pollution based upon information on the quantity of products/commodities produced (i.e., Grey Water Footprint, specified in units of volume of water per time). Baseline data should be recorded on a monthly basis whenever possible, recognizing that secondary data sources may only provide data on an annual basis.

The output from this step is the baseline nutrient load, i.e., the load against which future targets will be compared. Defining this baseline nutrient load requires specification of the timeframe over which the nutrient loads will be aggregated. Companies must use the average aggregate nutrient loads over the last five years of operation to represent baseline nutrient loads. Facilities/operations that have been in existence less than five years should use the average load over the length of their existence. The five year duration used for calculating the baseline was selected to provide some consideration for companies that have already begun reducing their nutrient loads.

3.2.3 Calculate maximum allowable level of basin wide nutrient loads

Under this step, the company applies an analytical method capable of relating the magnitude of nutrient loads to the resulting water quality in order to determine the maximum amount of basin wide nutrient load that will result in compliance with the specified water quality threshold. Two options exist for calculating the maximum allowable level of nutrient loads for Tier 1:

- Back-Calculation from Existing Results: The option provides specific equations for calculating allowable loads using information on existing recognized nutrient thresholds and model results for present day nutrient concentration. This option allows targets to be set without requiring new application of the Tier 1 model but lacks flexibility for considering factors such as nutrient-related water quality thresholds specified in terms other than nutrient concentration.
- Direct Application of Model: This approach provides more flexibility in terms of the use of water quality indicators other than nutrient concentration but requires application of the Tier 1 model to explicitly demonstrate that the proposed nutrient loading target will result in attainment of water quality consistent with the threshold concentration representing the desired water quality.

3.2.3.1 Back-Calculation from Existing Results

This method provides specific equations for calculating the maximum amount of nutrient load (in terms of mass per time, such as kg/yr) that will attain the desired instream nutrient concentration. It is based upon the assumption that instream nutrient concentrations at any given time are directly proportional to the rate of nutrient load. This assumption allows the required basin-wide reduction in load to be directly calculated from output from the water quality model representing present-day nutrient concentrations (which will be provided by essentially all Tier 1 models) and threshold nutrient concentration representing the maximum concentration consistent with the desired state of nature.

The extent to which basin-wide nutrient loads must be reduced in order to meet the desired nutrient concentration is based on the same concept of comparing the ratio of excess pressure to present-day pressure described above for freshwater SBTs for Quantity. For quality, pressures are expressed as nutrient concentration (by assuming a proportional relationship between loads and concentrations) and the resulting equation is:

$$\%\ Reduction\ in\ Basinwide\ Load\ Required = \frac{Present\ day\ nutrient\ concentration - Threshold\ nutrient\ concentration}{Present\ day\ nutrient\ concentration} \quad (6)$$

Equation 6 is applied over the entire time period of existing Tier 1 model results to determine the largest individual required reduction percentage. Note that the temporal resolution of the threshold nutrient concentration may vary by basin (e.g., specified as an instantaneous, never to be exceeded value; as a seasonal average; or as an annual average) and that the temporal resolution required for this assessment should be consistent with the temporal resolution considered by the threshold. The percent reduction provided by Equation 6 is used in the next step in conjunction with the present-day level of nutrient loads to define company specific freshwater SBTs.

3.2.3.2 Direct Application of Model

The second option for defining maximum allowable nutrient loading applies in cases where a locally recognized Tier 1 model and water quality thresholds are available to be applied for purposes of evaluating specific reduction scenarios. For this option, the company defines its maximum allowable level of nutrient loading by demonstrating with model results that the desired water quality concentration will be attained for their targeted level of nutrient loading over the entire period of simulation. This option avoids the simplifying assumption of the Back-Calculation approach that nutrient concentrations are proportional to nutrient loads. It also allows for targets to be set considering water quality thresholds reflecting nutrient pollution other than instream nutrient concentration (e.g., chlorophyll, dissolved oxygen).

3.2.4 Define targets

In this step, the company defines a target level for their nutrient loads consistent with the maximum allowable basin-wide load defined above. This is accomplished by multiplying the required percentage reduction (either as calculated via Equation 6 or via direct model application) with the present day nutrient load:

$$Target\ Load = \frac{(100 - \%\ Reduction\ in\ Basinwide\ Load\ Required)}{100}\ x\ Present\ Day\ Load \quad (7)$$

The targets set using Equation 7 assume the same “equal contraction of efforts” allocation approach as described earlier for water quantity in section 2.2.4.

Companies can use annual or finer time periods for their targets, as long as the selected percent reduction reflected in the target is consistent with the most stringent required reduction. For example, if the threshold nutrient concentration only applies to the summer growing season and the required reductions are 25%, companies could set targets on an annual basis requiring a blanket 25% reduction across the entire year.

They could also set targets on a seasonal basis and require reductions only for those months where the threshold concentration is applicable.

The target will be stated in the form of "Company X will reduce its nutrient load in the _ basin to _ kg P (or N)/yr by the year _" for situations where the target is set on an annual basis. For cases where seasonal targets are used, the target will be stated in the form of "Company X will reduce its nutrient load in the _ basin to _ kg P (or N)/month for each of the following months. The reductions will occur by the year _."

3.2.5 Tier 1 Water Quality Target Validation

The validation process for Tier 1 freshwater SBTs for quality consists of ensuring that:

- Models and thresholds were developed by an authorized basin agency. An authorized basin agency is a national, regional, state or local government agency that has the authority to make decisions on the allocation of water resources, including regulating pollutant loads. Examples include basin management authorities, water resource management agencies, and catchment councils.
- The spatial domain (i.e., basin) of the target was explicitly identified based on the spatial domain defined in the model.
- All company operations (direct and upstream) that materially affect water quality in the spatial domain were identified.
- Baseline nutrient loads were defined for each operation, using the last five years (or period of existence, if less than five years) of data.
- The specified required percent reduction in basin-wide loads was used if available from the model application, otherwise percent reductions were calculated using Equation 6 or direct model application as described in section 3.2.3.2.
- Targets were calculated using Equation 7 and specified in terms of maximum nutrient load in terms of mass of nutrient per time, within a specified time frame.

3.3 Tier 2

The Tier 2 approach for setting water quality targets is based upon the results of global water quality modeling conducted by McDowell et al. (2020a).

3.3.1 Define the spatial domain

The company first defines the spatial domain (i.e., basin) over which targets will be developed. The spatial domain for Tier 2 freshwater SBTs for quality are dictated by the scale used in the global modeling of McDowell et al. (2020a) and correspond to the third level of HydroBASINS.

3.3.2 Define present day/baseline level of company's nutrient loads

Similar to Tier 1, the company aggregates the total nutrient load from its activities across a given spatial domain (i.e., basin) and time period and records the baseline value. The output from this step defines the baseline load, i.e., the level of nutrient load against which future targets will be compared. Baseline loads should be compiled both for nitrogen and phosphorus and be based on primary data whenever it is available. Loads calculated from primary data are in units of mass per time (e.g., kg P/yr) and calculated by multiplying discharge flows (i.e., volume per time) by discharge concentration (mass per volume). It is recognized that primary data on nutrient loads may not be readily available for certain activities, primarily agricultural. For this version of the methodology, baseline data for upstream suppliers can be based on the secondary data sources used in Steps 1 and 2 that estimated the amount of water pollution based upon information on the quantity of products/commodities produced (i.e., Grey Water Footprint, specified in units of volume of water per time). Baseline data should be recorded on a monthly basis whenever possible, recognizing that secondary data sources may only provide data on an annual basis.

Companies must use the average aggregate nutrient load over the last five years of operation to represent baseline pressure. Facilities/operations that have been in existence less than five years should use the average load over the length of their existence. The five year duration used for calculating the baseline was selected to provide some consideration for companies that have already begun reducing their nutrient loads.

3.3.3 Calculate maximum allowable level of basin wide nutrient loads

For Tier 2 water quality targets, the company uses results from the global water quality model of McDowell et al (2020a) to define the maximum amount of nutrient load that will attain the desired instream concentration. The required percent reduction in nutrient loads for Tier 2 is based upon results from the modeling work described in McDowell et al (2020a). Their work defined:

- Present day total nitrogen and total phosphorus concentrations for basins worldwide
- Which nutrient (nitrogen or phosphorus) is the limiting factor (i.e. in lowest supply relative to needs) for algal growth in each basin. They determined the limiting nutrient by comparing the predicted nitrogen:phosphorus (N:P) ratio to the Redfield ratio (Redfield et al, 1963) of 7. Predicted N:P ratios greater than 7 were taken as an indication of phosphorus limitation; N:P ratios less than 7 were taken as an indication of nitrogen limitation.
- Global concentration threshold values for total nitrogen (0.70 mg-N/l) and total phosphorus (0.046 mg-P/l) representing acceptable levels of algal growth. These concentrations were based upon a literature review of studies defining site-specific nitrogen and phosphorus thresholds related to periphyton growth.

The extent to which basin wide loads must be reduced in order to meet the desired state of nature is based on Equation 6 described above for Tier 1. All of the data required to apply Equation 6 can be obtained from McDowell (2020b). Note that Equation 7 is applied only for the site-specific limiting nutrient as identified by McDowell (2020a).

3.3.4 Define targets

In this step, the company defines a target level for their nutrient loads consistent with the maximum allowable load defined above. The reduction percentage provided by Equation 6 for the site-specific limiting nutrient is multiplied by the present day load to define the maximum allowable load for purposes of target setting (Equation 7). Equation 7 is based upon the same “equal contraction of efforts” allocation approach described in Section 2.2.4. Tier 2 water quality targets are specified as annual values. The target will be stated in the form of “Company X will reduce its nutrient load in the _ basin to _ kg P (or N)/yr by the year _”.

Illustrative Example: Setting a Tier 2 Freshwater SBT for Quality Using a Global Water Quality Model and Global Nutrient Thresholds

No site-specific water quality model or local nutrient concentration thresholds have been developed in the catchment containing its operations, so our company chooses to set an SBT for Water Quality using a Tier 2 approach. They determine that they have a single facility located in the basin that discharges nitrogen at a rate of 71 kg/year and phosphorus at a rate of 11 kg/year. They determine the basin in which their facility is located and extract site-specific information on present day nutrient concentrations and the limiting nutrient from McDowell et al (2020a). These values are as follows:

N concentration = 1.1 mg/l
P concentration = 0.06 mg/l
Limiting nutrient is phosphorus

Because phosphorus is the limiting nutrient, they apply Equation 6 to define the required reduction percentage using the site-specific predicted total phosphorus concentration of 0.06 mg/l and the global phosphorus threshold provided by McDowell et al (2020a) of 0.046 mg/l. The required reduction percentage is 23% ([0.06 – 0.046] ÷ 0.06).

Tier 2 water quality targets are specified on an annual basis, so application of Equation 7 indicates that their SBT for water quality for a present day pressure of 11 kg/year and a required reduction of 23% results in a target of 8.5 kg phosphorus/year.

3.3.5 Tier 2 Water Quality Target Validation

- Written documentation is provided that demonstrates that an adequate search was conducted for existing models and thresholds. Specific criteria for this documentation consist of:
    - A record of the person(s) contacted at the basin authority (or water resources agency) for the basin in question and their response regarding existence of models/thresholds for quality and/or quantity parameters
    - In cases where no basin management authority or water resources agency exists, a record of request and response to relevant academic agencies or non-governmental agencies working on water issues within the basin in question.
- The spatial domain (i.e., basin) of the target was explicitly identified based on the spatial scheme provided by McDowell et al (2020a).
- All company operations (direct and upstream) that materially affect water quality in the spatial domain were identified
- Baseline nutrient loads were defined for each operation, using the last five years (or period of existence, if less than five years) of data.
- The specified required percent reduction in basin wide loads was calculated using Equation 6.
- Targets were calculated using Equation 7 and specified in terms of maximum nutrient load in terms of mass of nutrient per year, within a specified time frame.

4 Key Assumptions

The appropriateness of these Step 3 methods is contingent upon several assumptions, both generally and specific to water quantity and quality targets.

2. 4.1 General Assumptions

- The targets set with available models will be a sufficiently precise indication of a given company's individual responsibility to safeguard nature in line with society's interests.

3. 4.2 Water Quantity Assumptions

- For the Back-Calculation method, the rate of withdrawal at any given time is directly reflected as a reduction in stream flow
- Tier 2 environmental flow requirements derived to ensure proper aquatic ecosystem functioning will also provide sufficient water for human needs.

4.3 Water Quality Assumptions

- Global Tier 2 nutrient thresholds based upon acceptable periphyton growth are sufficiently accurate to provide guaranteed societal benefits relative to nutrient control.
- For Tier 2, instream nutrient concentrations are directly proportional to nutrient loads.

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