Biodiversity Benefit Accounting

Guidance for Quantifying and Evaluating the Biodiversity Benefits of Water Stewardship Projects

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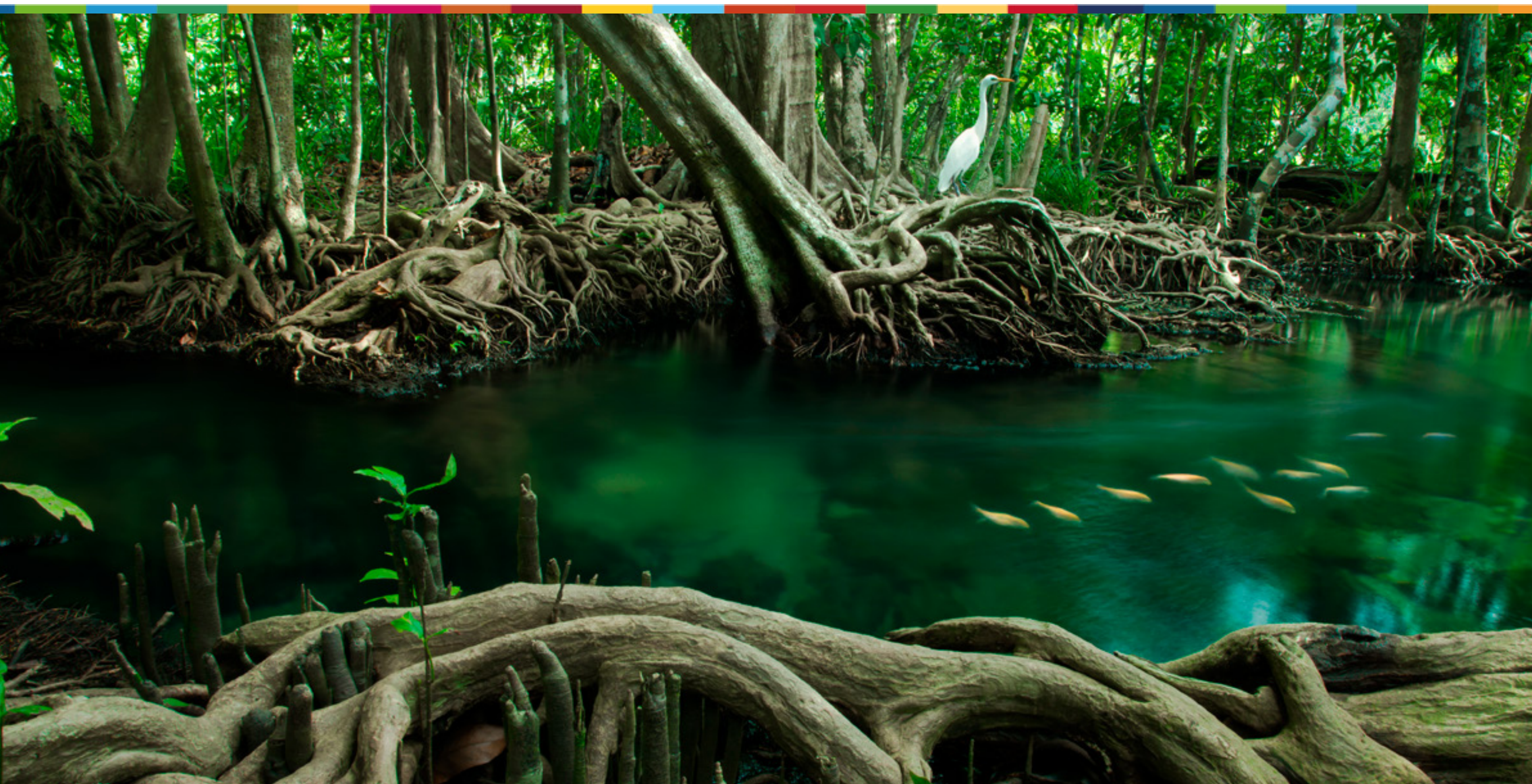

Project Team

Gregg Brill
Deborah Carlin
Pacific Institute | www.pacinst.org
United Nations Global Compact CEO Water Mandate | www.ceowatermandate.org

Rachel Lo
Laura Weintraub
Michelle Platz
Wendy Larson
Alex Curwin
Tim Dekker
LimnoTech | www.limno.com

Peter Lichtenthal
Naabia Ofosu-Amaah
Kari Vigerstol
The Nature Conservancy | www.nature.org

James Barnes
Robin Grossinger
Megan Wheeler
Second Nature Ecology + Design | www.secondnatureeco.com

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Glossary

For a full glossary of terms used in BioBA, see **Appendix 1.**

Abbreviations

BioBA	**Biodiversity Benefit Accounting**
EAG	**Expert Advisory Group**
GPS	**Global Positioning System**
LiDAR	**Light Detection and Ranging**
LULC	**Land Use/Land Cover**
NBS	**Nature-based Solutions**
NGO	**Non-governmental Organization**
NPI	**Nature Positive Initiative**
MEL	**Monitoring, Evaluation and Learning**
VWBA	**Volumetric Water Benefit Accounting**
WASH	**Water Access, Sanitation and Hygiene**
WQBA	**Water Quality Benefit Accounting**

Executive Summary

With increasing attention focused on nature-positive actions and global biodiversity targets, companies require guidance, approaches and tools that extend beyond water risk mitigation to encompass ecosystem benefits. Yet, few resources exist to account for the biodiversity benefits of corporate water stewardship projects. This Biodiversity Benefit Accounting (BioBA) guidance fills this gap by offering a framework to support companies in integrating biodiversity into corporate water stewardship initiatives. The guidance aligns with other global biodiversity accounting initiatives, including the Nature Positive Initiative (NPI) and Align project, and complements previously developed benefit quantification resources, notably guidance for Volumetric Water Benefit Accounting (VWBA) and Water Quality Benefit Accounting (WQBA).

The objectives of BioBA are to provide companies and project partners investing in corporate water stewardship activities with clear guidance on how to:

1. **Identify** biodiversity objectives for corporate water stewardship projects,
2. **Plan** for implementing biodiversity-aligned projects,
3. **Select** appropriate indicators, metrics and methods with which to evaluate the biodiversity benefits of corporate water stewardship projects, and
4. **Communicate** the biodiversity benefits of corporate water stewardship and biodiversity projects.

BioBA is intended for a variety of audiences, including corporate sponsors, project implementers and third-party benefit evaluators. BioBA is currently applicable for voluntary corporate water stewardship and biodiversity projects across a wide variety of activities and interventions in terrestrial and freshwater aquatic ecosystems at a project-site scale. It is not intended to be used to evaluate the impact of a company's operations on biodiversity at the landscape, regional or national scale.

BioBA is framed within an impact pathway that establishes the logical progression from project objectives to inputs, activities, biodiversity outputs, biodiversity outcomes and broader impacts:

OBJECTIVES →	INPUTS →	ACTIVITIES →	OUTPUTS →	OUTCOMES →	IMPACTS
Shared water and biodiversity challenges	Corporate water stewardship or biodiversity activities	Water stewardship activities with biodiversity-related interventions	Tangible changes in the conditions presumed favorable for biodiversity directly related to project implementation	Explicitly characterized direct or indirect change in biodiversity indicators resulting from project implementation	Long-term environmental, social and economic benefits resulting from project implementation

Outputs, outcomes and impacts are the overall benefits derived from biodiversity-related projects. In BioBA, outputs are tangible, direct results associated with project implementation that are presumed or quantified to beneficially affect the conditions favorable for biodiversity. Outcomes are direct or indirect changes in biodiversity resulting from project implementation; outcomes are the aggregates of outputs and other ecological and/or biophysical variables. Both outputs and outcomes are linked to a project's objective(s) and contribute to long-term biodiversity impacts. In the context of BioBA, three outcome indicators consistent with the Align project and Nature Positive Initiative's emerging framework were selected to assess biodiversity outcomes: ecosystem extent, ecosystem condition and species. The BioBA guidance provides a general methodology for evaluating ecosystem extent and collates broadly applicable resources and tools for evaluating ecosystem condition and species.

To operationalize the impact pathway, the BioBA guidance introduces a seven-step methodology to guide companies and practitioners from initial project assessment through monitoring and reporting. This methodology is practical and non-prescriptive; while the seven steps are presented linearly, in reality they may be iterative and modular depending upon project context. The seven steps include:

1. **IDENTIFY** Identify projects with potential biodiversity benefits
2. **DEFINE** Work with ecology experts and stakeholders to define biodiversity objectives
3. **PLAN** Develop a project plan aligned with the biodiversity objectives
4. **IMPLEMENT** Implement project activities and collect data
5. **QUANTIFY** Quantify outputs from activity implementation
6. **EVALUATE** Evaluate outcomes from activity implementation
7. **COMMUNICATE** Communicate biodiversity benefits

The initial step of the BioBA methodology includes a decision-making framework that assists implementers in selecting the appropriate level of biodiversity benefit analysis and reporting for a given project. In general, projects with robust biodiversity objectives and biodiversity monitoring data, including appropriate baselines, may report outcomes; other projects will likely only report outputs. The determination of whether a project aims to account for outputs and/or outcomes establishes a trajectory for the project through the remaining steps, including objective-setting, implementation, quantification of benefits, evaluation of benefits (where applicable) and reporting and communication of claims (where applicable). By enabling both output- and outcome-level accounting, BioBA provides a flexible approach that can be tailored to corporate and project priorities. Application of the seven steps is illustrated with a hypothetical case study of a wetland restoration project in Northern California, USA. Application of the seven steps is further explored in a variety of real-world corporate case studies featured in Appendix 2.

BioBA equips practitioners with a structured, science-based approach to quantify, evaluate and communicate biodiversity benefits and fills a gap in the corporate water stewardship community by enabling companies to prioritize and formalize biodiversity in their efforts. This guidance complements other benefit accounting frameworks and supports companies in taking a multi-benefit approach in their investments, commitments and targets.

Part 1: Introduction

Background

Healthy ecosystems are a crucial asset to companies, helping to minimize water-related risks through supply regulation and stability, quality protection and mitigation of the impacts of some extreme events. Yet we are in the midst of a global water crisis, in which the availability of clean water does not fully meet social, economic and environmental needs. At the same time, biodiversity loss is reaching critical levels, threatening the resilience of global ecosystems (WWF, 2024).

In response to growing water-related risks, companies are implementing water stewardship programs directed at responsible water management in operations, restoration or conservation of local watersheds and improving water access in their areas of operation. Corporate water stewardship aims to address local shared water challenges related to quantity, quality and accessibility. Some companies set water-related goals, most commonly volumetric targets typically achieved through activities that beneficially modify catchment hydrology. Companies with these types of targets quantify the volumetric water benefits of projects and track progress against their targets every year (WRI et al., 2025a). Companies are encouraged to go "beyond volumes" and look for opportunities to have a greater impact by optimizing co-benefits of corporate water stewardship projects, including biodiversity (e.g., Cynkar et al., 2025). Emerging frameworks and reporting requirements are beginning to define this responsibility and increase the need for careful planning, execution and accounting (van Rees et al., 2026) of water stewardship project benefits related to biodiversity. However, little guidance currently exists for how companies should account for biodiversity-related benefits of their water stewardship projects.

BioBA was developed in response to these recognized needs to provide standardized guidance for biodiversity and/or corporate water stewardship projects framed within a seven-step methodology that is technically robust yet pragmatic and feasible to implement. This effort is timely because many companies are in the initial stages of considering water and biodiversity as co-benefits within a single project, and they need clear resources on how to incorporate biodiversity expectations, identify appropriate and scientifically robust accounting methods and select monitoring strategies.

Corporate biodiversity efforts are rapidly evolving, supported by large international coalitions, NGOs and consultancies which are introducing new resources and approaches for biodiversity goal setting, accounting and disclosure. These resources are summarized in the BioBA Landscape Assessment (Brill et al., 2024). This BioBA guidance aligns with and complements these efforts, particularly the Nature Positive Initiative (NPI, 2024) and Align project (UNEP-WCMC et al., 2022), to ensure consistency while meeting the particular needs of water stewardship managers. The guidance also draws from the International Principles & Standards for the Practice of Ecological Restoration from the Society of Ecological Restoration (Gann et al., 2019). This guidance is expected to evolve as these biodiversity frameworks mature. Improving the understanding of how corporate water stewardship activities may provide biodiversity benefits can help strengthen the business case for investments in biodiversity and water stewardship activities. Such investments not only open the door to broader participation in global ecosystem restoration efforts but may also result in enhanced environmental, societal and economic impacts.

Objectives of BioBA

The objectives of this work are to provide companies and associated project partners investing in corporate water stewardship activities with clear guidance on how to:

1. **Identify** biodiversity objectives for corporate water stewardship projects,
2. **Plan** for implementing biodiversity-aligned projects,
3. **Select** appropriate indicators, metrics and methods with which to evaluate the biodiversity benefits of corporate water stewardship projects, and
4. **Communicate** the biodiversity benefits of corporate water stewardship and biodiversity projects.

Target audience and intended use case

BioBA is intended for a variety of audiences interested in accounting for biodiversity benefits, including:

- **Corporate sponsors:** Companies involved in selecting, designing and implementing corporate water stewardship and biodiversity projects as part of sustainability programs and tracking progress against corporate water and nature goals.
- **Project implementers and ecological partners:** Organizations implementing water stewardship and biodiversity projects, including representatives from NGOs, international organizations, utilities, government agencies, ecology and engineering specialists, civil society and advocacy groups, academia, local communities, Indigenous Peoples and other organizations that partner with companies to implement projects.
- **Third-party benefit evaluators:** Practitioners with appropriate expertise quantifying outputs and evaluating outcomes of corporate water stewardship and biodiversity projects.

In addition to these audiences, BioBA may be useful for other stakeholders and local biodiversity experts. Note that BioBA is not a technical guide for field biologists and ecologists, although examples of field resources and methods are referenced.

BioBA is designed to be applied on a project-by-project basis, at a meaningful project-level spatial scale and for projects implemented in communities and catchments outside the four walls of the organization's operations[1] as part of voluntary water stewardship programs. BioBA is applicable across most terrestrial and freshwater aquatic project types (e.g., wetland restoration, reforestation); applications to marine systems are out of scope for this initial version of the BioBA guidance. The guidance is not intended to be used to evaluate or offset the direct impact of a company's operations on biodiversity. It is not generally applicable to large-scale, entire catchments (i.e., watersheds).

[1] There may be instances in which BioBA is applied within a property boundary, including in large industrial parks or on certain campuses.

How BioBA was developed

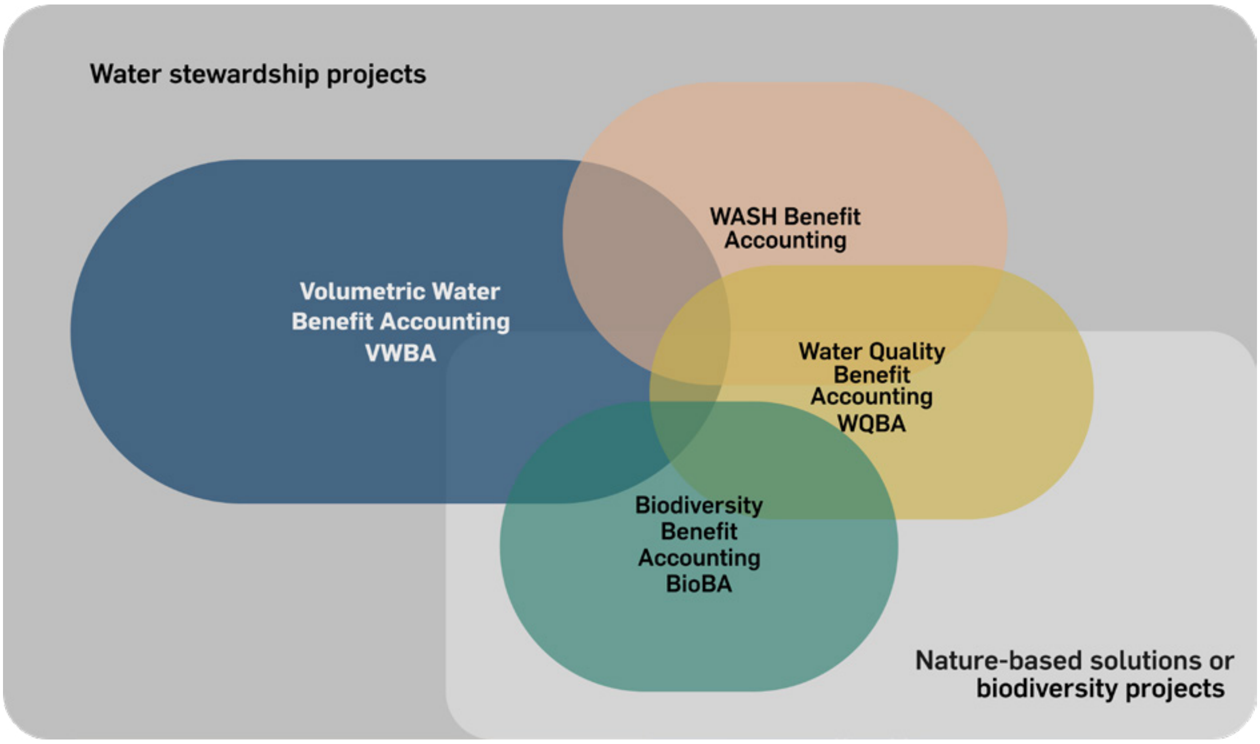
BioBA was developed in close consultation with key stakeholder groups across companies, NGOs, sustainability disclosure organizations, government agencies and academic institutions from around the world to ensure that it is:

- Practical and applicable, within the context of corporate decision-making and meets the needs of the target audience.
- Trusted and credible, informed by published scientific methods, practitioner experience and water stewardship leading practice.
- Comparable and replicable, using a standardized approach and set of indicators that can be applied equally across project types, geographies and organizations.

The work was carried out by the project team (Pacific Institute, CEO Water Mandate, LimnoTech, The Nature Conservancy and Second Nature Ecology + Design) with practitioner and technical input from eight corporate partners and Expert Advisory Group (EAG) members across the private sector, public sector, academia, NGOs, international organizations and civil society groups.

BioBA is part of a suite of guidance publications that help water stewardship practitioners quantify the multiple benefits of corporate water stewardship activities, including nature-based solutions (Brill et al., 2023). BioBA complements accounting frameworks focused on water volumes (WRI et al., 2025a), water quality (WRI et al., 2025b) and water access, sanitation and hygiene (WASH) accounting (Jacobson et al., 2024) (Figure 1). BioBA utilizes the same structure and approach developed for these guidance documents to the extent possible. For more information on how BioBA was developed, see Appendix 3.

FIGURE 1: RELATIONSHIPS BETWEEN MULTI-BENEFIT ACCOUNTING FRAMEWORKS ACROSS WATER STEWARDSHIP, NATURE-BASED SOLUTIONS AND BIODIVERSITY PROJECTS.



Methodology overview

The corporate water stewardship impact pathway, originally defined in Volumetric Water Benefit Accounting (VWBA) and Water Quality Benefit Accounting (WQBA), is foundational to the BioBA methodology (Figure 2). It describes a series of interrelated elements (defined below) starting with the identification of shared water challenges and the definition of specific biodiversity objectives associated with those challenges. Through different inputs (e.g., financial investments), project activities are undertaken to yield biodiversity benefits: outputs, outcomes and ultimately impacts. BioBA guidance focuses on accounting for the biodiversity benefits through the quantification of outputs and evaluation of outcomes; guidance is not provided on how to characterize impacts but may be developed in subsequent phases of work as the global state of this science field continues to evolve.

FIGURE 2: BIOBA IMPACT PATHWAY FOR WATER AND BIODIVERSITY-RELATED STEWARDSHIP PROJECTS.

OBJECTIVES →	INPUTS →	ACTIVITIES →	OUTPUTS →	OUTCOMES →	IMPACTS
Shared water and biodiversity challenges	Corporate water stewardship or biodiversity activities	Water stewardship activities with biodiversity-related interventions	Tangible changes in the conditions presumed favorable for biodiversity directly related to project implementation	Explicitly characterized direct or indirect change in biodiversity indicators resulting from project implementation	Long-term environmental, social and economic benefits resulting from project implementation
Examples: • Achieve deforestation-free supply chains • Replenish water footprint of corporate operations	**Examples:** • Budget • Resources • Technology	**Examples of activities:** • Reforestation • Invasive species removal • Riparian habitat restoration	**Example of biodiversity outputs** • **Count** of trees planted or barriers removed • **Length** of streambank restored • **Area** planted, treated or protected • **Mass** (or weight) of invasive species removed or debris/trash removed	**Examples of biodiversity outcomes:** • Spatial expansion of **ecosystem extent** • Improvement in **ecosystem condition** (connectivity, structural complexity, etc.) • **Species** changes (diversity, abundance, etc.)	**Examples of biodiversity impacts** • Greater ecosystem function, processes and services for people and the environment • Improved social and economic prospects (tourism, local interest groups, etc.) • Landscape or region-scale biodiversity or ecology change

The BioBA methodology

The BioBA methodology is structured as a seven-step process (Figure 3) that is not meant to be overly prescriptive but rather to guide the kinds of actions and practices that should be followed to characterize and communicate the biodiversity benefits of a project. The steps are closely aligned with the life cycle of a corporate water stewardship project, from project conceptualization and development to implementation and long-term performance monitoring. While the seven steps are presented linearly, in reality, they may be iterative and modular depending on the project context.

FIGURE 3: THE BIOBA SEVEN-STEP METHOD.

The BioBA methodology recognizes that the process of evaluating biodiversity outcomes may require significant and often sustained investments from many parties. For this reason, the methodology begins by assessing the appropriate approach (i.e., determining whether a project aims to account for outputs or outcomes) based on project objectives and the likelihood of generating significant reportable biodiversity benefits. The seven steps are intended to be a collaborative process among companies, ecological experts and practitioners. The roles and responsibilities of companies and other stakeholders may vary by project.

Box 1: Incorporating diverse knowledge systems in BioBA

To ensure biodiversity benefit accounting is inclusive, equitable and contextually relevant, it is essential to integrate qualitative data and diverse knowledge systems, including Indigenous, local and non-Western ecological knowledge. These systems offer valuable insights into species interactions, ecosystem dynamics and landscape stewardship practices that may not be captured through conventional scientific methods alone. By respecting diverse ways of knowing (e.g., through oral histories, cultural indicators, seasonal calendars and community-led monitoring), accounting frameworks can better reflect the full range of biodiversity values and benefits. This approach enhances both the accuracy and legitimacy of biodiversity assessments, while supporting the rights, knowledge sovereignty and agency of Indigenous Peoples and local communities (see References for additional resources).

Part 2: BioBA Methodology

This section details the recommended seven-step methodology (Figure 3) for BioBA and provides guidance and complementary resources for identifying and implementing water stewardship and biodiversity activities, quantifying outputs, evaluating outcomes and reporting and communicating benefits.

Key terminology for BioBA

As mentioned, BioBA distinguishes biodiversity benefits as outputs, outcomes and impacts. Outputs reflect what was done and not necessarily what ecological change occurred; outcomes reflect ecological changes that occurred. Further distinction of these terms and others is given below; see Glossary (Appendix 1) for full definitions:

- **Outputs**: tangible, direct results associated with project implementation that are presumed or quantified to beneficially affect the conditions favorable for biodiversity within the corporate water stewardship project footprint. Outputs contribute to (or are prerequisites of) outcomes. Outputs are quantified through estimates or direct measurements; outputs are reported as numerical values with easily comprehensible units (e.g., square meters). The four most common output metrics are count, length, area and mass (or weight). Examples of possible project outputs include the area of grassland seeded, the weight of invasive plants removed and the number of trees planted.

- **Outcomes:** direct or indirect biodiversity changes resulting from project implementation and associated outputs. Outcomes contribute to (or are prerequisites of) impacts. Outcomes are evaluated through the aggregation of outputs and other ecological and/or biophysical variables. Evaluation of outcomes assesses ecosystem and/or species changes over time against a baseline through more complex analyses, such as systems or conceptual modeling and/or statistical analyses; outcomes are typically reported as changes over time. Three indicators[2] were selected to assess biodiversity outcomes: ecosystem extent, ecosystem condition (as evaluated through ecosystem structure, composition and/or function) and species (as evaluated through species richness, abundance and/or diversity). Examples of possible outcome metrics are increased sub-tropical forest cover, improvement in forest structure and function and increased bird species richness or abundance.

- **Impacts:** long-term environmental, social and economic value creation and benefits as a result of a project's outputs and outcomes. Impacts are broader, spatially and/or temporally, than outputs and outcomes. BioBA does not provide quantification or evaluation methods for impacts.

- **Indicator:** a quantitative or qualitative factor or variable that provides a simple and reliable means to evaluate the achievement of outcomes (e.g., ecosystem extent). In BioBA, there are no output indicators and three outcome indicators.

- **Metric:** a system or standard of measurement that can be used to quantify outputs as well as evaluate outcome indicators (e.g., increased/improved spatial extent [area]).

[2] Genetic diversity is a potential outcome indicator of biodiversity; however, as genetic diversity is complex, time and labor-intensive and costly to measure, it falls outside the scope of this first generation of BioBA guidance.
Global extinction risk was considered by Align (2022) and NPI (2024) as a species metric; however, as global extinction risk is an extremely broad variable spatially and temporally, it falls outside the scope of BioBA guidance. It may also be outside the scope of likely intended use of BioBA guidance by most corporate sponsors.
Ecosystem resilience was considered as an outcome metric; however, as ecosystem resilience is often extremely complex to evaluate, it was considered outside the scope of BioBA guidance.

- **Method:** a structured approach used to quantify outputs (e.g., weighing invasive vegetation removed) or evaluate outcomes (e.g., remote sensing or GIS mapping of change in ecosystem boundary).

Case study overview

Throughout this guidance, a hypothetical wetland restoration case study (based upon a real-world corporate water stewardship project) illustrates how each of the seven steps in the BioBA methodology may apply to a potential corporate water stewardship project. Background information on the case study is presented below.

Wetland restoration case study

This case study focuses on the restoration of a perennial freshwater wetland in the San Francisco Bay Area of California, USA. A culvert was installed several decades ago to drain water in the wetland to a nearby creek to increase grazing space for cattle. Because the culvert determined the depth at which water drained from the wetland, the culvert effectively limited the extent and functionality of the wetland to three acres of the eight-acre project site. The wetland currently contains some riparian woodland and wetland species such as rushes, sedges and willows. Lack of maintenance has allowed invasive plant species such as stinkwort (*Dittrichia graveolens*) to flourish, which are thought to be outcompeting native plants and causing declines in both native plant and animal diversity throughout the project site. Over time, old agricultural infrastructure such as fences, debris and trash has been illegally dumped on the site, further degrading the quality of the wetland habitat.

As part of its commitment to water stewardship and biodiversity, a company has committed to support a restoration project to improve the wetland. The proposed project actions include mechanical and manual removal of anthropogenic materials and invasive species throughout the wetland as well as raising the culvert elevation to retain water in the wetland and increase water depth and duration of ponded area across the entire eight-acre project site. As the current site topography is relatively flat and only seasonally wetted, deeper ponding within the lowest portions of the wetland and expansion of wetted areas into the existing wetland's margins are expected. Additionally, because the wetland margins are currently dominated by non-native plants, changes to the wetland hydrology are also expected to reduce the presence of invasive plants that are less tolerant to continuous inundation.

Key organizations supporting the restoration project include a corporate sponsor, the project implementer (a public-sector agency), ecological partners (local academic and consulting experts), a broader stakeholder group and third-party benefit evaluators (consultants hired by the corporate sponsor).

Step 1: Identify projects with potential biodiversity benefits

The first step in the BioBA process guides practitioners to determine whether corporate water stewardship or biodiversity projects (existing or planned) are a good fit for BioBA. If a project is applicable, practitioners select the appropriate level of accounting to meet their biodiversity and corporate objectives and account for biodiversity benefits. Step 1 should be led by corporate sponsors and supported by project implementers.

1.1 Identify applicable projects

Projects applicable for BioBA should have the potential to address biodiversity and shared water challenges. A non-exhaustive list of potential project interventions and activities, adapted from VWBA 2.0 corporate water stewardship activities, is provided in Table 1. Note that project activities are nested under broader interventions that include restoration, management, conservation/protection and creation, similar to the benefit accounting of nature-based solutions for watersheds guidance (Brill et al., 2023).

TABLE 1: RELEVANT PROJECT INTERVENTIONS AND ACTIVITIES FOR BIOBA (ADAPTED FROM VWBA).

Habitat type and intervention	Example project activities
Aquatic, riparian and wetland restoration	In-stream barrier removal, dam reoperation, floodplain reconnection, levee or berm removal, side channel reconnection, riparian habitat improvements, process-based restoration, wet meadow restoration, beaver dam analogs, water level management for habitat, wetland or peat bog protection or restoration, wetland creation and others
	Restoration and creation activities for wetlands or other aquatic habitats that store water, inclusive of invasive species removal, dredging and others
	Conservation activities that protect wetlands or other aquatic habitats that store water
Land conservation and restoration	Forest conservation, meadow conservation, grassland conservation and other activities (e.g., conservation easements) that preserve land vegetation cover
	Reforestation, grassland restoration and other activities that restore vegetation cover
Green infrastructure[3]	Rain gardens, bioswales, stormwater detention or retention ponds, pond dredging/desilting, drainage water management, blind inlets and other interventions designed to capture runoff
	Green infrastructure activities including constructed wetland treatment systems, bioretention basins and others

[3]Identifying biodiversity objectives for green infrastructure activities in some highly urban environments may be challenging due to the limited ecological functions and processes found in these areas.

Like the eligibility criteria established for VWBA 2.0 and WQBA, the following considerations may be used to identify and select projects that are likely to have biodiversity benefits (note that these considerations are not ranked by priority). A project applying BioBA should:

1. **Address shared water and biodiversity challenges and opportunities** that are relevant to the catchment or landscape, such as where the proximity of a project can support protected areas or key biodiversity areas. The project should aim to synergistically address corporate interests and the needs of stakeholders that rely upon local water and/or biodiversity resources. Projects that have maximum biodiversity benefits, spatially and temporally, should be prioritized where possible. These benefits should be in place for as long as possible (and ideally in perpetuity).

2. **Have an activity or activities that result(s) in accountable biodiversity benefit(s)**, according to the remainder of the seven-step methodology. The activities and accounting of biodiversity benefits should be backed by sound and consistent metrics, methods and principles that align with best practice.

3. **Expect to deliver changes that would not have happened without the project.** Through the lens of value creation, applicable projects will provide additionality and deliver positive change and/or prevent a negative impact beyond the without-project condition (i.e., the condition of the site if the project's activities had not been conducted). If the project is conducted for compliance purposes or as part of an environmental mitigation measure, project sponsors should go beyond the minimum requirements to create meaningful biodiversity benefits. Typically, projects applicable for BioBA will be voluntary projects that are not legally required.

4. **Draw on biodiversity expertise of project partners.** The relevant expertise of the project implementer and partners should be a consideration in project selection. Biodiversity-aligned projects require a set of skills and experiences that may extend beyond corporate water stewardship activities and are often contextually specific to the local ecosystem. This expertise may leverage additional stakeholders such as field ecologists, academic researchers and local experts or knowledge holders to collaborate closely with the company and project team and provide data on biodiversity.

5. **Engage and coordinate with local stakeholders**, especially local communities and/or experts familiar with the geographic context. In particular, community buy-in and community-led monitoring programs can strengthen the future success of biodiversity objectives by ensuring they build upon stakeholder values rather than conflict with them. Engagement should allow for multiple types of knowledge to inform project direction such as traditional ecological knowledge from Indigenous communities.

6. **Confirm trade-offs are assessed, understood and minimized.** This will ensure the project does not adversely affect specific stakeholders disproportionately nor the surrounding environment or result in reputational risk for project developers, sponsors or benefactors.

7. **Include robust ecological baselining and monitoring.** The availability of appropriate baselines is crucial to compare ecological change as a result of the project. Ecological monitoring is needed to account for benefits along the anticipated timeline and provides credibility to the communication of benefits.

8. **Confirm sufficient resources for project implementation and monitoring.** Project costs, resources and staffing may be significant due to long-term monitoring data often needed to account for biodiversity benefits.

Practitioners should apply these considerations in their own decision-making process when designing and selecting projects. The relevance of individual considerations may vary based upon a company's exposure to risk, water goals, strategic watershed objectives and project scale.

Where projects have multiple funding partners, it is essential for partners to align early on the project objectives, intended biodiversity benefits and the indicators, metrics and methods to account for these. Where partner objectives diverge (e.g., one company may wish to evaluate improvements in ecosystem condition, and another company may want to evaluate improvements in abundance for a focal species), partners must ensure that intended biodiversity benefits can be accounted separately; in these cases, separate claims or reporting may be made by the funding partners.

1.2 Determine the appropriate level of benefit accounting

After confirming a project is relevant for BioBA, practitioners should determine the appropriate level of accounting based on project implementation status (completed projects, in-progress projects and new projects) and the desire and ability to report outputs only vs. outputs and outcomes. The level of accounting establishes a trajectory for the project through the remaining steps. Five levels of accounting are summarized below:[4]

- **Completed projects – account for only outputs:** These projects are fully implemented and may provide an opportunity to characterize biodiversity benefits through retroactive assessments, assuming appropriate data has been collected throughout the project's lifespan. They are likely suited only for output-level quantification, as these projects may not have collected adequate baseline and monitoring data to justify outcome quantification.[5] Steps 2, 3 and the evaluation of outcomes in Step 6 may not be applicable to completed projects.

- **In-progress projects – account for only outputs:** These projects are currently underway and may present an opportunity for expansion of scope or monitoring to capture some biodiversity benefits but are only suited for output-level quantification and communication of benefits. Step 6 does not apply to this option.

- **In-progress projects – account for both outputs and outcomes:** If new activities are planned for in-progress projects, the collection of additional baseline and monitoring data may allow for evaluation of biodiversity outcomes and communication of benefits. It is possible that a modified biodiversity objective, additional baseline and monitoring data collection and/or the company of new activities may lead to evaluation of outcomes. All seven steps apply for this option.

- **New projects – account for only outputs:** All new corporate water stewardship projects with a biodiversity element, or new projects with biodiversity as the primary objective, should quantify outputs. It is anticipated that a majority of projects will fall in this level of accounting, as they will likely not meet requirements for outcomes accounting, possibly due to initial project objectives, budget and/or time constraints or feasibility. Step 6 does not apply to this option.

[4]It is possible for projects to shift between BioBA levels of accounting. For instance, a new project may shift from outcome-level to output-level based upon budgetary and monitoring constraints. However, a shift from output-level to outcome-level will likely require additional investments to support more robust baseline and monitoring data.

[5]Rare exceptions may apply for completed projects able to evaluate outcome-level benefits, but robust evaluation of outcomes will need to be undertaken to report or make credible biodiversity claims. In this case, Steps 2, 5, 6 and 7 of the BioBA process should be followed.

- **New projects – account for both outputs and outcomes:** When there is interest in accounting for biodiversity benefits beyond the quantification of outputs, project teams will need to design and implement robust data collection and monitoring processes to evaluate outcomes over time. All steps of the BioBA process should be followed.

Selection of an output- vs. outcome-level project may depend upon corporate strategy. In general, output-level projects require less effort and have lower complexity in data collection, monitoring and evaluation, accounting of benefits and reporting. A company may wish to fund multiple output-level projects and make biodiversity claims relatively quickly rather than invest in a small number of more expensive or complex outcome-level projects that may take several years to implement and report benefits.

Conversely, a company may wish to demonstrate long-term investment in the communities of its operational footprint and thus opt to pursue one or more prioritized outcome-level projects. Evaluation of outcomes may require trend analyses, systems or conceptual modeling and/or statistical analyses and thus may be more time-consuming, complex and costly to evaluate. Depending upon a project's objectives, budget and logistical constraints, it may not be possible to evaluate a biodiversity outcome for every project. Opportunities and limitations of output- and outcome-level projects are given in Table 2.

TABLE 2: EXAMPLES OF OPPORTUNITIES AND LIMITATIONS OF OUTPUT- AND OUTCOME-LEVEL PROJECTS.

Categories	Output-level project		Outcome-level project	
	Opportunities	Limitations	Opportunities	Limitations
Benefit accounting	Benefits are easier and quicker to quantify.	Fewer benefits can be accounted.	More benefits can be accounted.	Benefits are more difficult and take longer to evaluate.
Communication of benefits	Outputs are quantified as numeric values with easily compre-hensible dimensions (e.g., square meters). Benefits are easier to communicate.	Fewer benefits can be communicated.	More benefits can be communicated.	Outcomes are evaluated as trendlines, statistical tests or values or models. Benefits may be harder to communi-cate or must be qualified.
Spatial scale	Opportunities to evalu-ate outputs at a variety of spatial scales and geographies.	Limitations are unlikely.	Opportunities to evaluate ecosystem and species changes at broader (e.g., landscape) scales exist.	Opportunities to evaluate outcomes may not be possi-ble at small spatial scales.
Financial and time resources	Lower budget, time and effort involved.	Does not allow for evaluation of outcomes. Outputs cannot be connected to potential outcomes. Pursuing this level of accounting might demonstrate short-er-term investment in project site.	Allows for evalua-tion of longer-term outcomes. Pursuing this level of accounting might demonstrate long-term investment in project site.	More budget, time and effort involved.
Capacity and human resources	Smaller project teams allow for agile respons-es to project require-ments.	Smaller project teams and lack of local experts or specialized professionals may influence project deliverables.	Larger project teams can foster collabora-tion and build robust-ness and credibility by including local experts or specialized profes-sionals.	Local experts or special-ized professionals may be required to collect data and evaluate outcomes.
Data and knowledge impacts	Data and knowledge may be quick to collate and share.	May not contribute a significant amount of data to broader scientific efforts on ecosystems or biodi-versity.	Pursuing this level of accounting may contribute to advance-ments in science, research and knowl-edge due to long-term monitoring data.	Data and knowledge may take longer to collate and share.

Step 1 Wetland restoration case study

Implementation of BioBA Step 1 is illustrated through the hypothetical wetland restoration below.

BioBA applicability

The project considerations for BioBA applicability were examined. It was determined that this wetland restoration project is a suitable candidate for BioBA application.

BioBA project consideration	Notes
1. Addresses shared water and biodiversity challenges and opportunities.	The project is expected to improve water retention, wetland extent and ecosystem condition of a degraded wetland improving the native ecology of the site for plants and wildlife, especially riparian and wetland birds.
2. Have an activity or activities that results in accountable biodiversity benefits at the output and/or outcome level.	The site is part of a larger riparian and wetland complex in the region and is expected to provide improved connectivity for wetland function and habitat between adjacent wetlands when restored. Activities are expected to have output- and outcome-level benefits.
3. Expect to deliver changes that would not have happened without the project.	Due to the presence of the existing culvert, the proposed site changes would not have occurred without the project activities. There are no legal requirements for the corporate sponsor to engage in the project.
4. Draw on biodiversity expertise of project partners.	The project implementers include a local ecological consulting company with decades of experience in the basin and a public-sector agency which has completed similar projects in the basin.
5. Engage and coordinate with local stakeholders.	The site is close to the corporate sponsor's headquarters and would provide opportunities for employee volunteering. Local stakeholder engagement with the immediate community and neighbors is also a possibility.
6. Confirm trade-offs are assessed, understood and minimized.	The site is currently in a semi-degraded condition due to human/agricultural influence. Restoration of the area presents no significant trade-offs.
7. Include robust ecological baselining and monitoring.	A baseline assessment was undertaken to document the initial state of an area's natural environment, including its species, habitats and ecological functions. This assessment served as a starting point to measure and monitor future changes in the wetland and the effectiveness of project activities.
8. Confirm sufficient resources for project implementation and moni-toring.	Up to $35,000 will be set aside for ecological monitoring by the project implementer, which would provide five years of monitoring following project implementation to ensure that the wetland enhancement has been successful and to document project outputs and outcomes. This includes wetland and riparian habitat monitoring, invasive plant monitoring and bird surveys.

Level of BioBA Accounting

During the planning stage, the project implementer and corporate sponsor discussed the appropriate level of accounting. This is a new project and expected biodiversity improvement within the project site is a key driver for the work. Both parties have high interest in understanding the output-level improvements as well as how these activities may improve ecosystem extent, ecosystem condition and available habitat for priority bird species. Early on in planning, it was determined that the corporate sponsor could dedicate sufficient resources for both project implementation and monitoring. Collectively, the project team decided to evaluate outcomes.

Step 2: Define the project's biodiversity objectives

Biodiversity-related project objectives inform the selection of inputs, activities and accounting of desired benefits. These objectives are typically aimed at conserving, restoring or sustainably managing ecosystems or priority species and set the stage for the remaining BioBA steps. A project may have multiple objectives depending upon ecosystem needs and corporate ambitions, and different objectives will often require unique interventions, indicators and monitoring methods. Project implementers are the primary lead for Step 2.

2.1 Engage early with ecology experts and local stakeholders

As part of the objective-setting process, project teams should, to the extent possible, identify and engage with local stakeholders to include relevant voices within a project landscape. These stakeholders may include representatives from local communities, Indigenous Peoples, government agencies, academia, NGOs and civil society and advocacy groups. Engaging with local stakeholders can create meaningful connections and early buy-in for the project and will result in more sustainable and equitable outcomes. Local experts are likely to have existing resources and knowledge that a project may utilize, and partnering with these local groups will enhance ecological understanding of local contexts and needs.

2.2 Set project objectives

To set meaningful biodiversity-related project objectives for new projects,[6] it is recommended that project teams follow the SMART approach:

- **Specific:** The objective should clearly state what the project's intended biodiversity benefits will be.
- **Measurable:** The objective should state how outputs will be quantified and outcomes will be evaluated (if relevant).
- **Achievable:** The objective should be achievable given the work planned, allocated capacity and resources and the time limit of the project.
- **Relevant**: The objective should inform the project's activities to achieve desired biodiversity benefits.
- **Time-bound:** There must be a timeframe indicated within which the objective will be achieved. Project objectives should consider ecologically relevant timescales such as vegetation growth rates or seasonal migration patterns.

In addition to the SMART approach, objective setting can consider the results of biodiversity baselines. Baselining may happen before, during or after the objective-setting step, depending upon budget, context-specific needs for baselines in order to set objectives and/or availability of baseline data at the objective-setting step. If baselining is done during or after the process, it is recommended that practitioners review the SMART goals to ensure that the project objectives are aligned with the results of the baseline assessment.

[6] Objective setting is not relevant for completed projects; in-progress projects may develop new biodiversity-related objectives where appropriate.

Step 2 Wetland restoration case study

Engage early with ecology experts and stakeholders

Before beginning the objective-setting process, the project team conducted a brief desktop review to identify key stakeholders with potential interest in the project and local expertise. The team held a public meeting to engage with state and relevant regulatory agencies, local community groups and interested parties. A leader of an advocacy group expressed interest in being more involved with the project and serving as a liaison between the corporate sponsor and the community. The corporate sponsor also reached out to several professors from nearby universities. After this period of outreach and community engagement, the corporate sponsor and project implementer summarized findings related to priority plant and bird species of interest, considerations to avoid unnecessary disturbances during implementation, available datasets and opportunities for community education after implementation.

After consulting stakeholders, the project team determined that the wetland ecosystem previously served as habitat for Yellow-breasted Chats (*Icteria virens*) and Yellow Warblers (*Setophaga petechia*), both California species of concern. Local stakeholders indicated they would like to improve the extent and condition of the wetland habitat for these two species, with the hopes of increasing the number of observations of these two birds within the project area.

Set the project objectives

The primary purposes of the project were both water replenishment and biodiversity improvement. Based upon the feedback from the stakeholder outreach, the project team collaborated to set the following SMART biodiversity-aligned objectives:

- Within a five-year project implementation period, achieve the following outputs:
    - Increase the area of permanently inundated wetland from three to seven acres through raising the elevation of the existing culvert by three feet, increasing the maximum depth of ponding from 0.5 to 3.5 feet (0.15 to 1.07 meters).
    - Remove 100% of trash and debris from the eight-acre project site using both manual and mechanical means.
    - Remove invasive species from the entire project site using manual and mechanical means as well as inundation-based control methods.
    - Plant or seed five acres of the wetland. Plant approximately 3,000 feet (914.4 meters) of riparian shrubs and trees along the wetland perimeter.
    - Install approximately 4,000 feet (1,219.2 meters) of exclusionary fencing around the project site perimeter to eliminate grazing impact and trampling of establishing wetland plants by cattle.

- Within seven years of project implementation, achieve the following outcomes:
  - Increase the ecosystem extent of established native plant species-dominated wetland within the project site from three to seven acres.
  - Improve the wetland ecosystem condition by:
    - Increasing the plant height and density (structure) of native wetland vegetation within the project area.
    - Improving the wetland structure as effective habitat for species of concern, as evaluated by increased presence observations of both priority species as a proxy.
    - Improving the wetland plant species composition from an invasive-dominated assemblage to a native-dominated assemblage within the project area, targeting an average 80% decrease in invasive species.
    - Improving the ecosystem's function by enhancing water quality through biogeochemical cycling and water filtration.

Note that due to the inundation, the project is also expected to have a volumetric water benefit of approximately 3.9 million gallons (14.8 million liters). Therefore, multiple benefits were projected for the same project footprint: two biodiversity outputs (increase in area inundated and increase in depth of ponding), two biodiversity outcomes (increase in native wetland ecosystem extent and improvement in ecosystem condition) and one volumetric water benefit (as a result of the annual volume inundated). The final project biodiversity objectives were shared with key stakeholders via email for visibility and input, and no substantial feedback or suggested revisions were received.

Step 3: Develop a project plan aligned with biodiversity objectives

After a team has developed its biodiversity objectives, the next step is to develop a project plan[7] to inform the scope and scale of the project, both spatially and temporally. Project implementers, supported by corporate sponsors and other stakeholders, are the primary lead for Step 3.

3.1 Develop the project plan

Project plans document how a project will be executed and detail the project's scope, objectives, schedule, budget, tasks, resources and deliverables to ensure all team members and stakeholders are aligned and the project stays on track. Project plans also inform the trajectory of project implementation and monitoring, accounting of benefits and communications (Steps 4-7, respectively). The project plan should consider and answer the following questions (note that bullets are not ordered by priority or sequential preference):

- What project activities should be conducted to meet the project objectives (see Table 1 for examples), and how should they be implemented?
  - How should stakeholders be appropriately engaged?
  - What baselining has been done or could be done?
    - If baselines are not available, could qualitative data, counterfactuals[8] or reference sites be used appropriately?
- What are the anticipated biodiversity benefits of the project?
  - What are preliminary/intended outputs and (if relevant) outcomes of the project?
- How will monitoring data to quantify outputs and evaluate outcomes be measured?
  - What appropriate indicators, metrics and methods could be selected to account for benefits (see Step 6)?
- How will evaluation and learning of project progress (as part of monitoring, evaluation and learning (MEL)) occur?
- What approach could the project team take to communicate biodiversity benefits (i.e., claiming vs. reporting; see Step 7)?
- What resources are required to complete the entire project, including efforts undertaken in Steps 4-7? These include but are not limited to:
  - Budget (capital and operating expenditure, staff costs, etc.)
  - Defined project team members and roles (corporate sponsors, experts, consultants, etc.)
  - Technology and equipment
- What appropriate timelines should be considered?
  - What is the project's preliminary schedule?
  - What seasonal and ecological considerations are needed (see Step 4 for more details)?
- What appropriate spatial scales should be considered (see Step 4)?

[7]Step 3 does not apply to completed projects; in-progress projects may already have a project plan in place and can be adapted to consider biodiversity objectives.

[8]Counterfactuals may be real-world control sites or hypothetical modeled scenarios. Ecological experts should be consulted to determine which counterfactual is most appropriate (see van Rees et al., 2026).

    - What are the defined project boundaries and relevant buffer zones?
- What are potential challenges and what risk management (e.g., situation analysis) can be undertaken?

3.2 Revisit the project plan as needed

Note that addressing these considerations with a project plan may be an iterative process, allowing for adaptive management. The project plan may also be a living document that is adapted along a project lifespan. Revision might be informed by lessons learned during implementation and as part of the MEL phases of the project. This document may also change due to the evolution of the project (e.g., budget), significant changes in the ecosystem (e.g., wildfire) and/or needs of the company and/or project partners (e.g., new biodiversity strategy).

Step 3 Wetland restoration case study

After establishing a set of project objectives, the project team defined a preliminary project plan with input from ecological experts. The plan summarized each activity and approach, captured appropriate budget and timeline for restoration and defined roles and responsibilities. The ecological partners anticipated that in addition to increased depth of inundation, physical removal of invasive riparian plant species would be necessary for successful restoration, and similar restoration projects in the area suggest using hand-pulling and mechanical means. A similar approach was discussed for the trash removal and culvert adjustment activities, where mechanical methods and human intervention are required. The preliminary plan documented the following sequence of activities:

- Stage 1 trash and debris removal
- Continuous removal of invasive plants throughout project duration
- Increase in culvert invert elevation height to increase the depth of wetland inundation within the project site
- Stage 2 trash and debris removal (remnants found during excavation)
- Native wetland vegetation plantings
- Native riparian shrub and tree species plantings
- Installation of exclusionary fencing for restoration site protection during establishment

The project team identified initial external challenges to the riparian project site, such as agricultural runoff that contributes to water quality degradation and invasive plant species beyond what was originally identified. Once challenges were identified, the team assessed its internal capacity to address these challenges during project implementation. To increase the likelihood of reaching the project objectives, the team discussed increasing the number of internal team members on the project and considered how they could leverage local expertise. The team also consulted local farmers and landowners to address current conditions and land-use practices that may negatively impact the water quality of the adjacent wetland.

As part of the project plan, the team selected metrics and methods based upon the intended outputs determined in Step 2:

- Area of wetland inundated as a result of the culvert height adjustment, quantified through in-situ observations of the perimeter of wetted area using a handheld GPS device and GIS-enabled mapping tools.
- Area of native wetland plants and length of native riparian plants planted, measured after project implementation using appropriate measuring tools.

- Height of maximum pond depth within the wetland, measured through in-situ measurements of pond depth or remotely sensed measurements of change in ponded water surface elevation following the culvert adjustment.

- Weight of trash and debris removed from the project site, quantified by a scale provided at the landfill where the debris was disposed.

- Weight of invasive species removed, estimated by the weight of a full bag multiplied by the total number of bags removed.

- Length of exclusionary fencing installed, quantified by counts of the number of rolls of fencing material installed.

Based upon the outcome-level metrics selected in Step 2, the project team referenced the BioBA guidance Appendix 4a to determine the best method to evaluate ecosystem extent. It was decided that evaluation of remotely sensed data would be the most cost-effective and efficient approach, verified with biannual in-situ mapping of the wetland extent using GPS survey tools. As specified in the project objectives, wetland ecosystem condition would be evaluated through an integrated assessment of ecosystem structure, composition and function (see Glossary):

- Ecosystem structure would be evaluated through an assessment of the change in native wetland plant height and density throughout the project area over time and as an effective bird habitat as a proxy.

- Wetland species composition would be evaluated through a study of change in wetland and riparian plant species composition over time.

- Ecosystem function would be evaluated through water quality testing (quarterly monitoring for dissolved oxygen, pH, nutrients and turbidity).

In-situ, quadrat-based studies along predetermined transects, conducted by qualified ecological experts, will be used to track the change in vegetation height, density and invasive/native species composition throughout the project site over time, beginning with a pre-project baseline. Quadrat studies will be conducted before project implementation and then repeated annually following project implementation for the duration of the determined monitoring period. These surveys would be conducted during peak growth each year, targeting the end of summer timeframe.

Credentialed avian specialists will conduct annual presence/absence studies of Yellow-breasted Chats and Yellow Warblers. Consultation with these specialists determined that an acoustic survey of the project site is an appropriate method to evaluate an increase in the utilization of this habitat by these two species. This approach will be coupled with annual stationary counts conducted during peak migration periods of these two species to ground truth acoustic observation data. Acoustic receivers stationed throughout the wetland prior to project implementation will record bird sounds. Artificial intelligence-based data processing tools will be used to identify and quantify the number of calls recorded from the two priority species. Additionally, stationary counts of these two priority species will be conducted at the project site, prior to project implementation as part of baselining and annually thereafter. The evaluation of collected outcome data, comparisons with baseline conditions and characterization of observed trends will be led by credentialed ecology experts.

Budget and resource allocation

The project team developed a robust budget that considered all costs associated with the different project phases. Budgets were allocated for personnel, monitoring equipment and data storage. Capital and operating costs were allocated sufficient budgets to increase project sustainability.

Timeline and collection frequency

The project team identified an appropriate timeline for data collection, considering project budget, team capacity and local conditions. It was decided that data should be collected on an annual or biannual basis during the summer months to account for vegetation growth and the seasonal presence of key species. Additional seasonal data points were also discussed, and collection will be done on an ad-hoc basis.

Gathering baseline data

After selection of intended outputs and outcomes, baseline data was collected before the project was implemented to gather initial information about the current state of the areas prior. A variety of data was collected, including spatial boundaries, vegetation cover and composition, invasive vegetation coverage and floral and faunal species identification and counts. Data was collected using satellite imagery, transects and in-situ counts and measurements.

Baselining also consisted of gathering qualitative data from local stakeholders detailing historical ecological conditions in the area. Photographs and records from a local library were used to support the historical condition and extent of this wetland. This allowed the ecological partners to understand what the wetland looked like in the past and could be used to define possible post-implementation scenarios.

The project team agreed to meet on an annual basis to review the project plan and revise it as needed, based upon key learnings across the project.

Communications

Outputs and outcomes from the project will be communicated in the company's annual environmental report. The company will report outputs and outcomes with appropriate qualifiers (e.g., the wetland extent had a statistically significant increase after the project). The project partners will also communicate the success of the project at international conferences and forums.

Revisiting the project plan

The project partners intend to revisit the project plan on an annual basis to determine if the project is proceeding according to the plan. Particular attention will be given to budget and resource allocation, quality of data collected, activity reviews or assessments and feedback from local stakeholders. Additions or revisions will be made based upon the lessons learned.

Step 4: Implement project activities and collect data

Steps 1 through 3 provide a foundation for identifying appropriate project activities, metrics and methods to account for biodiversity benefits. In Step 4, project activities are implemented, and data are collected according to the project plan. Project implementers are the primary lead for Step 4.

4.1 Implement project

Implementation for a project is uniquely dependent upon the site context and intended activities. However, several considerations for implementation will apply across most projects:

- **On-the-ground expertise**: Effective biodiversity project implementation requires qualified ecological experts with relevant field experience and technical knowledge to oversee implementation, data collection and monitoring activities. Local ecological knowledge should also be integrated where appropriate, as regional experts understand site-specific conditions, species dynamics and seasonal patterns that are critical for accurate data collection and interpretation of results.
- **Seasonality and ecological timing:** Project activities and monitoring data collection may need to be carefully timed to align with natural ecological cycles and seasonal windows. Project teams should identify appropriate implementation windows that maximize project success while minimizing ecosystem disruption. Some timeline considerations include:
    - Times of the year that are sensitive for species, such as breeding and migratory seasons.
    - Seasons or climate cycles where it may be unfeasible to implement projects, such as during winter or monsoon seasons. Other project activities may depend upon wet vs. dry conditions.
    - Anticipated rate of vegetation growth, which may substantially vary from one plant species to the next. For example, to establish healthy saplings, native revegetation activities typically take a minimum of two years, although it can take 20 or more years for a forest to fully establish; it can take up to five years for riparian vegetation to establish; and it takes several years for planted seedlings to mature, flower, set seed and establish a healthy population.
- **Spatial scale:** Project activities and monitoring data collection should be undertaken at appropriate spatial scales. For instance, if a project's objective is to improve a forest ecosystem over a large area (e.g., 2,500 acres), monitoring methods may be adequately served by annual satellite imagery to evaluate changes in ecosystem extent as a result of the project. Conversely, if a project's objective is to improve ground orchid populations over a smaller area (e.g., five acres), monitoring methods may need to leverage on-the-ground transects or quadrats that cover finer spatial scales.
- **Adaptive implementation strategies:** Projects involving ecological restoration often require flexible approaches that can adjust to changing conditions (i.e., adaptive management). For example, habitat restoration may need to be phased over multiple years to allow ecosystem processes to stabilize between interventions (e.g., erosion control measures), yet the unpredictability of ecological processes can create unexpected ecological circumstances (e.g., fires and other severe weather events). Project teams should be prepared to adjust implementation timelines and methods based upon real-time ecological feedback and monitoring results.

Project teams may need to accept some level of uncertainty related to project implementation timelines, which could affect the monitoring and evaluation of benefits, as well as reporting and communication elements.

- **Prioritization**: Given budget and logistical constraints, project teams may need to prioritize activities based upon their objectives, potential for biodiversity benefits and feasibility of implementation. High-impact activities that address primary threats may take precedence over enhancement activities. Teams should also consider the sequence of activities such as addressing hydrological issues before habitat creation.

4.2 Collect and manage data

Project-specific biodiversity data is critical to ensure that activities are completed as planned and that biodiversity benefits can be credibly accounted for. Below are recommended best practices for data collection and management:

- **Data collection:** Based on the project plan, data collection should be systematic, consistent and well-documented. For instance, equipment should be well-calibrated and relevant field protocols should be followed (e.g., GPS coordinates recorded for all monitoring locations to enable precise repeat sampling) and appropriate scales should be chosen (e.g., measuring river reaches in meters or kilometers). The most relevant and up-to-date science, often in the form of manuals or guidance, should be used to collect data. Teams may apply quality control by regularly checking for monitoring errors, verifying data against known standards and reviewing results regularly to identify and correct issues. Some examples of data collection best practices include:
    - Identifying and using appropriate record keeping (e.g., hand-written field notes, spreadsheets, GIS data points, citizen science apps, etc.)
    - Leveraging traditional and ecological knowledge systems to supplement any data collected through quantitative methodologies
    - Training data collectors in quantitative and qualitative data collection
    - Using photo documentation from established points to provide valuable supplementary evidence of changes in landscape and/or habitat state
    - Using local survey datums and appropriate coordinate reference systems that do not distort area when mapping
    - Defining an appropriate spatial and temporal resolution of remote sensing imagery
- **Data management:** Teams should establish clear protocols for data entry, quality control and backup procedures. For instance, scientists can use cloud-based data storage for ease of access and real-time sharing.

4.3 Share implementation progress within project team

Progress updates shared among project partners are critical for building trust, increasing transparency and accountability and providing opportunities for feedback. Projects require regular progress reporting within the team and with relevant stakeholders to communicate implementation milestones, preliminary results and any adaptive management decisions. Communications at this sub-step are typically internal and distinct from external communications (Step 7).

Step 4 Wetland restoration case study

Project implementation

The project team implemented the activities based upon the project plan developed in Step 3, which had accounted for migratory and breeding seasons of the Yellow-breasted Chats and Yellow Warblers. In order of priority, activities implemented included trash and debris removal, mechanical and hand-removal of invasive plants, adjustment of culvert height and native vegetation plantings. Following implementation of these activities, project monitoring via *in-situ* quadrat surveys was conducted biannually by trained local ecologists to evaluate the ecosystem structure and species composition. The acoustic sampling methods were undertaken weekly during the breeding season by avian specialists to evaluate the presence/absence of the two bird species as a proxy for evaluating ecosystem structure. Trained field technicians undertook water quality testing quarterly.

The project team directed its staff, local communities and volunteers from the corporate sponsor with work related to debris removal, invasive species removal and native vegetation plantings. A local engineering firm designed and constructed the culvert modification. The local ecological experts undertook continuous monitoring to ensure appropriate methods and technologies were employed at relevant time periods.

All collected data was stored in a cloud-based database. Protocols for data entry, quality control and backups were developed and enforced. Corporate sponsors were provided with bi-monthly updates via email on implementation progress and early findings from the data collection efforts.

Step 5: Quantify outputs from activity implementation

In Step 5, practitioners quantify outputs as a result of the successful implementation of project activities.[9] The selected metrics for output quantification should be directly aligned with the project's objectives and the activity or activities implemented. Third-party benefit evaluators are the primary leads for Step 5; project implementers support this step.

5.1 Confirm biodiversity output metrics and methods are appropriate

In Step 3, practitioners identify the intended biodiversity outputs and select the appropriate metrics and methods to quantify these. In Step 5, practitioners should confirm the biodiversity outputs and selected metrics and methods are still appropriate in light of how the project progressed. Four output metrics are considered most relevant to corporate water stewardship activities (see Table 1): count, length, area and mass (or weight).[10] Other output metrics could be considered where appropriate. Caution should be taken to avoid double counting a single specific output across more than one benefit accounting framework; for instance, a volume of water that has been quantified under VWBA should not be expressed as an additional volumetric output in BioBA. It is recommended that practitioners use VWBA to quantify volumetric benefits and WQBA to quantify water quality benefits in tandem with BioBA to quantify biodiversity benefits.

5.2 Quantify and document biodiversity outputs

Following project implementation, the metrics and methods confirmed in Step 5.1 are used to quantify outputs. Table 3 provides definitions and examples of how these four outputs may be quantified. After outputs are quantified, they should be appropriately documented for communications (Step 7).

[9] Although BioBA is presented sequentially, output metrics can be quantified during (Step 4) or after implementation (Step 5), depending upon the project.

[10] Some output metrics may have nested dimensions.

TABLE 3: DEFINITIONS AND EXAMPLES OF BIOBA OUTPUTS.

Output	Definition	Example of metric	Example quantification method
Count	The quantity of a feature related to a project activity. Reported as a number, density, proportion, etc.	Number of invasive plants/ species removed; number of native plants/trees planted or native animals reintroduced; number of barriers/ structures removed; number of connectivity passageways installed; number of green roofs/bioswales/GI practices installed; stand density.	Direct count from humans in the field; estimated count from a sample or sub-area (e.g., quadrat) and extrapolation to the whole project footprint; estimated count from photo quadrat; counts of fauna from camera traps; counts from acoustic assessments.
Length	The measurement of distance. Reported as a unit of length/ width/depth.	Length of stream reconnected; length of streambank stabilized; depth of floodplain inundated.	Direct measurement using a measuring tape, stick or wheel; indirect measurement using secondary or geospatial data, like online mapping tools.
Area	The extent or measurement of a surface. In BioBA, area refers to the total surface area of habitat (land and/or water) directly impacted by a corporate water stewardship activity. Reported as a unit of length squared. For projects with multiple points (patches) of application, the total project area (footprint) is the sum of the individual patch areas.	Area planted, seeded or revegetated; area cleared;[11] area inundated.[12]	Direct measurement using a measuring tape, stick or wheel to calculate area using geometric formulas; direct measurement by traversing the project perimeter utilizing a GPS-enabled device to record project boundaries and calculate the project area; indirect measurement using secondary or geospatial data, like online mapping tools.
Mass (weight)	The amount of matter (or the relative amount of mass), reported in units of mass or weight, such as grams, pounds or tons.	Mass or weight of invasive plants/species removed; mass or weight of debris/ contamination removed; mass or weight of natural material applied (soil management).	Direct mass or weight using a calibrated scale or weighing separate loads and summing up the total of each load; estimated mass or weight using the weight of one output load multiplied by the number of total loads.

[11] Note: In cases where area as an output is communicated using terms such as "area restored," "area managed," "area protected" and "area created," care should be taken in defining the context of these broad terms to avoid conflating direct outputs with ecosystem extent and ecosystem condition outcomes. For instance, "five acres were planted with native vegetation" is an appropriate output that does not speak to the overall ecosystem restoration success, which should be evaluated by outcome indicators such as changes in ecosystem extent and condition over time. The Society for Ecological Restoration clearly defines the different states of ecosystem recovery (e.g., rehabilitation, remediation and restoration) with terminology that may be more suited to communications of outcomes (see Gann et al., 2019).

[12] In some cases, it may be feasible to quantify area inundated vs. volume inundated. When a volume inundated is quantified (VWBA 2.0), a volumetric water benefit can and should be expressed.

Step 5 Wetland restoration case study

After project implementation was completed, the project team quantified the six biodiversity outputs. Details of the outputs and quantifications are provided in the table below.

Output	How was the output quantified?	What is the biodiversity benefit output?
Wetted area created	Scientists from the public-sector agency inspected the inundated area at the end of the five-year implementation period following culvert modification and observed that seven acres of the project site demonstrated some level of seasonal inundation, and five of those seven acres demonstrated permanent inundation at various depths throughout the year.	Five acres of permanently wetted wetland.
Depth of inundation	Scientists from the public-sector agency used high-resolution survey equipment to determine that the inverted elevation of the modified outfall structure had increased by three feet (0.9 meters). Assuming no significant regrading to the existing wetland bathymetry occurred during culvert modification, the scientists were able to confirm using pre- and post-project LiDAR datasets that the surface elevation of the water had increased by three feet in response to this culvert elevation change.	Three feet (0.9 meters) of additional water depth created in the deepest sections of the wetland area.
Weight of trash removed	Volunteers collected and removed old fence posts, discarded barbed wire and trash from the entire project site. Removed material was taken to a local landfill, and the landfill scale was used to quantify the total weight of material removed prior to disposal.	200 lbs. (90.7 kg) of trash were removed over two stages.
Weight of invasive species removed	Stinkwort, a highly invasive plant, was removed by staff and volunteers throughout the project implementation period. During removal, stinkwort was collected in equal-sized trash bags. Because a scale on site was not present, one bag was taken offsite to a location where it could be weighed. The weight of the bag was multiplied by the number of total trash bags to estimate the total weight of trash removed.	1000 lbs. (453.6 kg) of invasive species were removed (50 bags).
Area of native wetland plants and length of native riparian plants planted	Project implementers quantified both the area of wetland seeded and the total length of riparian edge planted throughout the project implementation process using a measuring wheel.	Five acres of the wetland were planted and seeded with native species. 3,264 feet (995 meters) of native riparian shrubs and trees were planted along the perimeter of the newly wetted edge.
Length of exclusionary fence installed	Project implementers quantified the total length of fencing installed along the project perimeter by counting the number of rolls of fencing installed and multiplying that by the length of fencing included in one roll of fencing material.	4,297 feet (1,309.7 meters) of exclusionary fencing were installed along the perimeter of the project area.

Step 6: Evaluate outcomes from activity implementation

In Step 6, practitioners evaluate outcomes as a result of the successful implementation of project activities, building upon the quantification of project outputs in Step 5. Selecting appropriate biodiversity indicators and evaluating biodiversity outcomes for a project is highly context-specific; the indicators, metrics and methods used to evaluate change will differ from one project to the next depending upon the objectives. Direct monitoring and evaluation of change in an ecosystem's state[13] enable more robust evaluations of meaningful change in biodiversity indicators (UNEP-WCMC et al., 2023). Third-party benefit evaluators are the primary leads for Step 6; project implementers and ecological partners support this step.[14]

6.1 Confirm biodiversity outcome indicators, metrics and methods are appropriate

In Step 3, practitioners identify the intended biodiversity outcomes and select the appropriate metrics and methods to evaluate these. In Step 6, practitioners should confirm that the biodiversity outcomes indicators and selected metrics and methods are appropriate. Table 4 provides definitions of the three biodiversity outcome indicators as well as examples of metrics and evaluation methods. Additional details on methods for evaluating outcome indicators is provided in Appendix 4.

TABLE 4: DEFINITIONS, EXAMPLE METRICS AND EXAMPLE METHODS OF THE THREE OUTCOME-LEVEL BIODIVERSITY INDICATORS.

Indicator	Definition	Example metrics	Example quantification method
Ecosystem extent	The spatial area or coverage of a particular ecosystem without necessarily considering the quality of the area being assessed.	Increased/improved spatial extent (area) of an ecosystem of interest.	High-resolution GPS mapping of the change in ecosystem boundary over time or other GIS-based frameworks. Refer to Appendix 4a for more information.
Ecosystem condition	The quality of a particular ecosystem relative to a predetermined reference state, considering three dimensions: ecosystem structure, ecosystem composition and ecosystem function (see Glossary for definitions).	Increase in the canopy volume and structural complexity within a forest habitat over time (ecosystem structure); increase in priority species presence or absence (ecosystem composition[15]); improved water filtration or increase in pollination activity (ecosystem function).	Analysis of LiDAR and remote sensing data to evaluate canopy volume and structural complexity; analysis of camera trap data to evaluate species presence/ absence; water quality testing; field-based measurements, remote sensing or model-based estimation to evaluate pollination activity. Refer to Appendix 4b for more information.
Species	The flora and fauna within a given ecosystem and their overall health and viability.	Increase in priority species abundance, richness or diversity over time.	Quantitative field surveys of change in species abundance over time; Shannon's diversity index, Simpson's diversity index or other diversity indices to evaluate species diversity.[16] Refer to Appendix 4c for more information.

[13] In some instances, validated models (possibly based on partial, historical or alternative datasets) could be used in place of direct monitoring or to complement monitoring efforts.

[14] While project implementers and ecological partners likely have the required expertise to evaluate outcomes, third-party benefit evaluators are suggested to ensure impartiality and avoid conflicts of interest.

[15] Depending upon how project teams choose to evaluate species richness or abundance within their project plan, richness or abundance as a metric likely falls under ecosystem composition (as a proxy for evaluating ecosystem condition) but may be used to calculate indices of diversity as a species-level biodiversity indicator in some cases.

[16] Many species diversity indices and metrics exist; local ecological expertise should be leveraged when selecting a species diversity index and the methods through which to evaluate it.

Outcomes are more complex to characterize than are outputs because they require direct and indirect evaluation of changes in the state of an ecosystem (i.e., likely multiple ecological and/or biophysical factors); evaluation of outcomes may be the aggregate ("sum of the parts") of outputs and other ecological and/or biophysical variables. The selected indicators, metrics and methods for outcome evaluation should be directly aligned with the project's objectives and the activity or activities implemented. The three indicators of biodiversity outcomes identified by this guidance are broadly applicable across many project types. They are also consistent with indicators established by other leading biodiversity initiatives (UNEP-WCMC, 2022; NPI, 2024).

6.2 Evaluate and document biodiversity outcomes

Following project implementation, the indicators, metrics and methods confirmed in Step 6.1 are used to evaluate outcomes. Evaluation of outcomes may include trend analyses, systems or conceptual modeling and/or statistical analyses. Outcomes can be observed as upward- or positive-trending changes over time: increased, improved or enhanced outcome indicators. In some cases, the outcomes may be maintained trends or no change in ecosystem extent, condition or species (e.g., a conservation project that purchased land and protected it from development would aim to result in no change in ecosystem extent). There may also be some instances where decreasing trends are a desired outcome. For example, in Cape Town, South Africa, a project objective to improve water security also aims to decrease the ecosystem extent of invasive alien plants. While ecosystem extent of native vegetation may increase in parallel, the primary focus of this project is to evaluate a decrease in invasive alien plants.

It can be exceedingly difficult to directly attribute trends to a singular project or activity. Companies should carefully document outcomes and consider the level of certainty with which they attribute observed biodiversity benefits to the activity or activities undertaken when developing internal or external communications about project benefits (see Step 7 for guidance on communicating biodiversity benefits). The following sub-sections provide more detail on evaluating the three BioBA outcome indicators: ecosystem extent, ecosystem condition and species.

Evaluation of ecosystem extent

Changes in ecosystem extent are generally the least complex of the three outcome indicators to evaluate, as relatively simple spatial measurements and geospatial tools can be used in combination with in-field assessments to aid these analyses. Because extent assesses area coverage of a particular ecosystem without necessarily considering the condition of the ecosystem or the species utilizing it (UNEP-WCMC et al., 2022), evaluation of this indicator requires the least amount of effort of the three BioBA indicators. Thus, this indicator will likely be used for most corporate water stewardship and biodiversity projects that aim to evaluate outcomes. Appendix 4a provides a general methodology for evaluating ecosystem extent, including additional resources for BioBA practitioners to use.

Evaluation of ecosystem condition

Evaluations of changes in ecosystem condition are more complex than the evaluation of ecosystem extent, as metrics for ecosystem condition will be unique to local project contexts and because this indicator is often a composite of several metrics. Guidance from the Align project pertaining to measuring change in ecosystem condition recommends integrating measurements across three core dimensions of ecosystem condition. Table 5 provides example metrics and methods for evaluating the three core dimensions of ecosystem condition.

TABLE 5: CORE DIMENSIONS OF ECOSYSTEM CONDITION WITH EXAMPLE METRICS (ADAPTED FROM THE ALIGN PROJECT (UNEP-WCMC ET AL., 2023)).

Dimension of ecosystem condition	Example metrics	Potential methods for evaluating the metrics
Ecosystem structure	Three-dimensional complexity; fragmentation/connectivity	Height distribution, canopy cover; fragmentation indices
Ecosystem composition	Species assemblages within the ecosystem; species presence/absence	Species presence/absence (typically multiple species, see Evaluation of Species below); species evenness
Ecosystem function	Net primary productivity; pollination activity; biogeochemical cycling; water filtration; habitat provision	Model-based estimation of pollination activity; area and depth of erosion over time

Evaluating change along each of these three ecosystem condition dimensions may require in-field monitoring over years to decades following activity implementation, depending upon the indicator, to sufficiently characterize progress towards or achievement of the project's goals. This integrated approach for evaluating ecosystem condition helps capture the multidimensional facets of the indicator and thus may yield more robust causality between a project's activities and desired change in ecosystem condition.

As measurement approaches for ecosystem condition vary in their underlying methods (UNEP-WCMC et al., 2023), this BioBA guidance does not include new methods for evaluating ecosystem condition. Appendix 4b provides resources related to metrics of ecosystem condition and associated methods for evaluating ecosystem condition.

Evaluation of species

Species is often the most complex outcome indicator to measure. For the purposes of BioBA, evaluations are likely to focus on priority (e.g., rare, threatened, endemic, iconic, etc.) or indicator (e.g., keystone) faunal or floral species rather than on a broad list of species. Sufficient numbers of observations and sample sizes are needed to make sound, bias-free conclusions about lasting changes in population dynamics that account for short-term fluctuations and challenges associated with species detection (McCabe, 2011). While species presence or absence may be used as an indicator of ecosystem condition (and are often at a multi-species scale), deeper assessments of the population dynamics of priority or indicator species are needed to establish explicit connections between a project's activities and species abundance or other species metrics. Caution must be taken before attributing species changes to project activities through a causal linkage. Changes to species abundance and diversity are metrics that may fall under a species-level outcome evaluation, although more nuanced assessments in species-level outcomes may be utilized depending upon the project's objectives and monitoring capabilities.

As the evaluation of species is context-dependent and there is currently no universally applicable method, the BioBA guidance does not include new methods for evaluating species. Appendix 4c provides resources related to these metrics and associated methods for evaluating species.

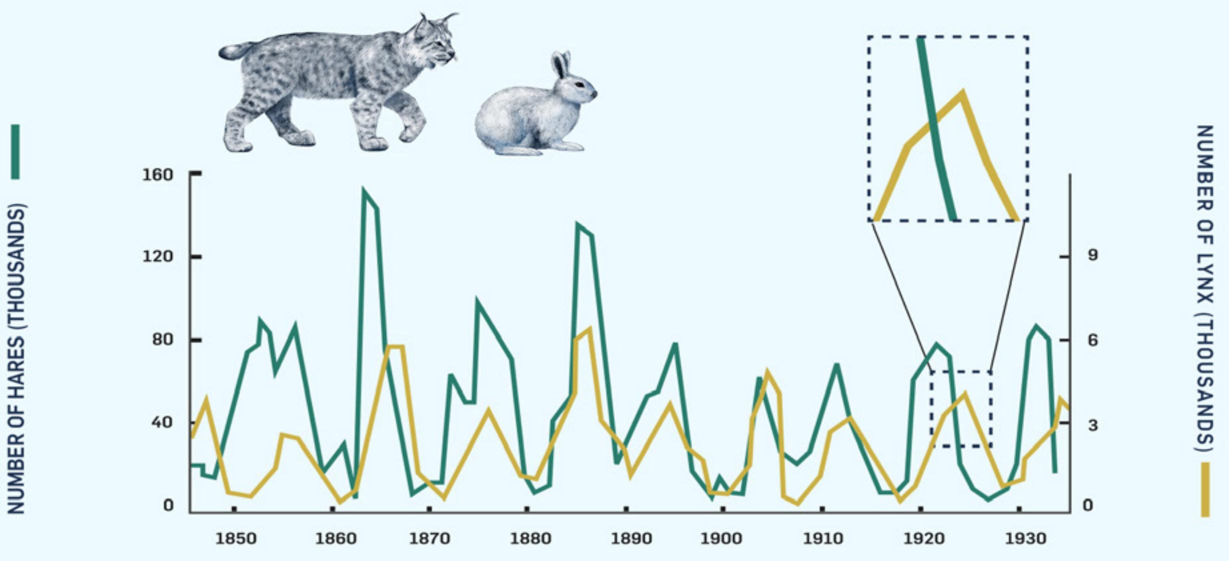
Box 2: Additional considerations for outcome evaluations

The credibility of outcomes will be strongest if data evaluation considers long-term trends to ensure that biodiversity outcomes were a result of the project interventions rather than due to external factors. Ecosystems are dynamic and continuously changing due to the vast number of fluctuating, interconnected factors within them: changes in temperature, weather patterns, biogeochemical cycles, floral/faunal life cycles, seasonality, anthropogenic influences, etc. Thus, ecological and biophysical data is often noisy (having random, unclear or unpredictable fluctuations) and with broad variability. While external factors may confound data evaluations or cannot always be ruled out as the cause of some biodiversity improvements, the advantage of looking at long-term trends developed through consistent data collection over time is the ability to differentiate between short- and long-term environmental variability.

Because biodiversity outcomes may take many years or decades to be fully realized, BioBA recommends that practitioners track and report trends over time to evaluate progress towards achieving outcomes in the interim. Tracking and reporting trends over time may also inform whether adaptive management (as part of project implementation) is needed to achieve objectives.

The importance of long-term trends is evident in an example from North America that considers the population dynamics of snowshoe hare (*Lepus americanus*) and lynx (*Lynx canadensis*). These species are tightly coupled through a predator-prey relationship, where snowshoe hare often provides the primary food source for lynx (Figure 4). The complexity of seasonal ecological conditions can mask this relationship in the short term but is strikingly clear over longer periods of time (MacLulich, 1937). If data were only collected at a few time points or over a brief period (see inset in Figure 4), this ecological connection would not be evident.

FIGURE 4: EXAMPLE OF THE SNOWSHOE HARE AND LYNX DEMONSTRATING THAT SHORT-TERM DATA IS NOT SUFFICIENT TO SEE TRENDS (SEE INSET) (MACLULICH, 1937).



Similarly, trends in outcome indicators may experience high variability from one observation to the next due to a combination of interacting environmental factors. Project teams should be cautious when using short-term data in evaluating outcomes, because correlations may not equal causation nor be apparent. However, long-term datasets will allow more explicit connections to be drawn between the project's activities and evaluated outcomes. Ideally, qualified scientists and experts with robust technical training and experience in biology, ecology, environmental sciences and/or statistics should lead the interpretation of complex assessments supporting outcome-level biodiversity benefit. Project teams should leverage this expertise in the communication of benefits so that companies do not overstate or exaggerate contributions to biodiversity improvements (see Step 7).

Step 6 Wetland restoration case study

As a result of the implemented project activities and outputs, ecosystem extent and ecosystem condition within the project site were expected to improve; improving priority or indicator species was not part of the project objectives. The project team engaged its ecological partners to conduct evaluations of data collected under Step 4. It was determined that outcomes could be evaluated for several indicators. Additional details are summarized in the table below.

Outcome	How was the outcome evaluated?	What is the biodiversity outcome?
Ecosystem extent	Wetland ecologists conducted an evaluation of change in wetland extent over time using a combination of remotely sensed data and periodic in-situ mapping of wetland vegetation extent using high resolution survey equipment to delineate the perimeter of the wetland ecosystem. GIS tools were used to measure and document the increase in native wetland ecosystem extent over the five years following project implementation.	Over the monitoring period, the project observed a 47% increase in the total extent of native wetland vegetation within the project site. Collected data indicated minimal change in wetland ecosystem extent in the first two years following project implementation, followed by more substantial increases in wetland extent observed in years three to five following the project interventions.
Ecosystem condition	Change in ecosystem condition was evaluated through an integrated evaluation of ecosystem structure, composition and function. Changes in ecosystem structure and ecosystem composition were evaluated through annual quadrat-based studies of wetland vegetation height, density and species richness at the project site (as part of pre-project baselining and after the project was implemented for five years). Additionally, annual presence/absence studies using acoustic monitoring and stationary counts were undertaken during breeding seasons of the two priority bird species as a proxy to evaluate improvement in ecosystem structure. Changes in ecosystem function through improved water quality, biochemical cycling and water filtration were evaluated by water quality tests (quarterly monitoring was conducted for dissolved oxygen, pH, nutrients and turbidity).	Ecological experts concluded that the wetland ecosystem condition had been improved at the project site when compared with pre-project baseline conditions. Data from vegetation analyses concluded that within the project site, native wetland plant height and density increased by 32% and 47%, respectively, as compared with the pre-project baseline. Further, the species composition evaluations concluded that invasive species within the project site decreased by 70% over five years as compared with the pre-project baseline. Following five years of project implementation, sightings of priority bird species within the project area increased by 20% as compared with the pre-project baseline. Quarterly water quality monitoring over five years suggested a 30% increase in dissolved oxygen levels, 25% reduction in nitrogen concentration and 20% reduction in phosphorus concentration.

Step 7: Communicate biodiversity benefits

Corporate water stewardship and biodiversity projects frequently yield multiple benefits. While both VWBA 2.0 and WQBA guidance provide clear principles for volumetric and water quality reporting and claims, communicating biodiversity benefits requires additional nuance and caution and should be aligned with any legal or compliance requirements within an organization. This section offers guidance on when and how companies can credibly report or claim biodiversity benefits, how to communicate project activities, outputs and outcomes and how to align with broader biodiversity-related reporting and strategies. Corporate sponsors are the primary leads for Step 7; project implementers and third-party evaluators support this step.

7.1 Decide between reporting vs. claiming biodiversity benefits

Communications of biodiversity benefits encompass reporting, claims and other messaging; it is critical to distinguish between claims and reporting (whether public or internal). Claims refer to definitive statements about biodiversity benefits directly attributable to a company's funded or implemented activities. These should be evidence-based, conservative and representative of actual outputs and outcomes in relation to company contributions. Reporting refers to broader, less prescriptive documentation or communications of activities, outputs, outcomes and expected impacts. Reporting is valuable for transparency, stakeholder engagement and learning - even when benefits are not yet fully measurable or directly attributable to a single activity funded by a company. Practitioners should decide whether the outputs and/or outcomes will be reported or if a formal claim will be made as part of communication efforts. It should be up to the discretion of the company to report vs. claim biodiversity benefits. Corporate strategy, available resources, the project plan and other factors may influence this decision; BioBA does not require companies to make claims. Table 6 further distinguishes between claims and reporting.

TABLE 6: DISTINCTIONS BETWEEN REPORTING AND CLAIMS OF BIODIVERSITY BENEFITS.

Reporting	Claims
External or internal documentation of activities, potential contribution of efforts towards biodiversity improvements and intended impacts	External statements of delivered benefits typically referenced as progress towards a corporate target
May include aspirational goals or activities that are in progress or were achieved. Potential benefits (outputs and outcomes) may also be reported	Must be based upon validated outputs and outcomes and proportional attribution
Framed in terms of what is being pursued or monitored as a result of the project and corporate contribution	Framed in terms of what has been achieved as a result of the project and corporate contribution
Used to demonstrate transparency and alignment with nature-positive strategies	Subject to scrutiny and reputational risk

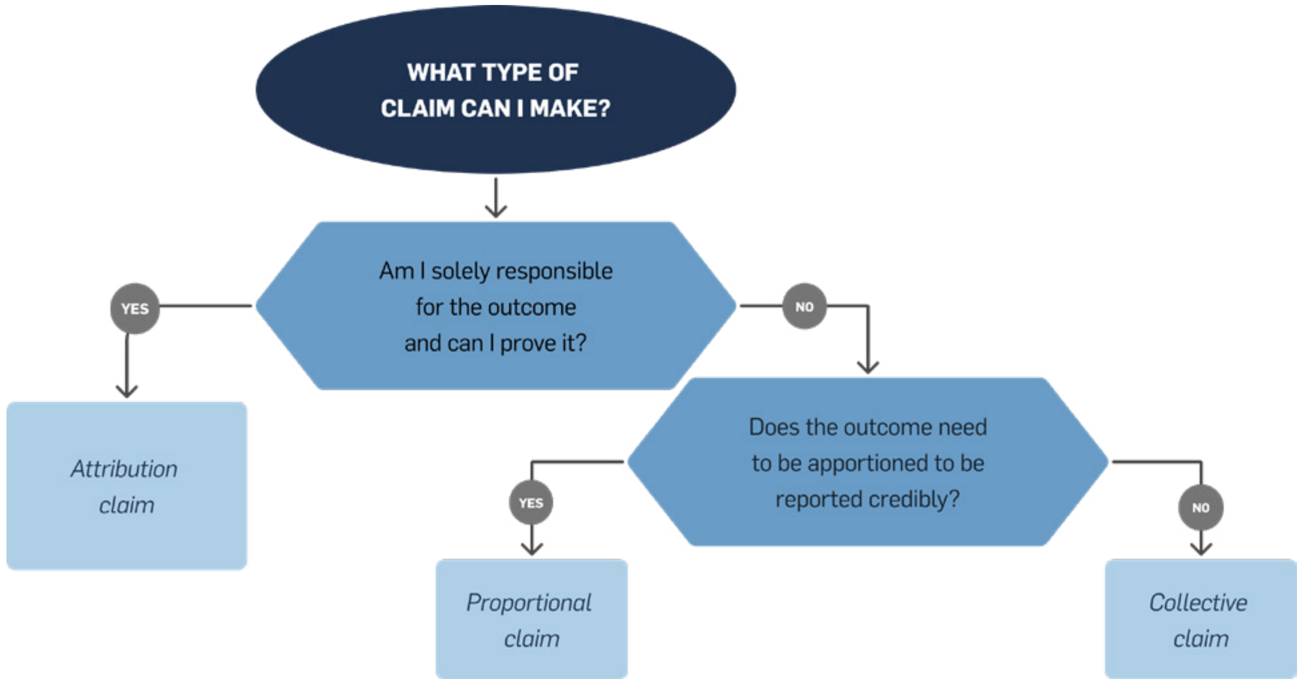
7.2 Communicate reported or claimed biodiversity benefits

Companies can communicate a project's implemented activities and associated outputs and outcomes, provided these are framed appropriately and avoid overstating ecological results attributed to a company's role. Communication of biodiversity benefits could:

- Clearly state the project activities as well as location, scale and timelines
- Clearly state how benefits accrue spatially and/or temporally based upon ecological functions and processes
- Be supported by robust, transparent data and/or supporting evidence (e.g., baseline assessments, post-implementation assessments, monitoring data, stakeholder testimonials)
- Be qualified based upon implementation progress, monitoring results and current involvement of the company
- Result in sharing data on open-access platforms, such as EcoAtlas or public repositories and databases, contributing to broader ecological and scientific knowledge
- Demonstrate that benefits are proportionately attributed to the company's role in the project

Biodiversity claims may require more nuance and consideration. At the time of publication, BioBA does not have explicit guidance for companies to make formal biodiversity claims as part of either regulatory or voluntary reporting and disclosure frameworks. ISEAL (2023) provides guidance for companies to establish claims. Claims may take many forms, based upon the role of the company in the project. ISEAL describes the differences between collective, proportional and attribution claims, and it outlines when it is appropriate for companies to use these several types of claims (Figure 5). Companies should only consider making claims when there are quantified outputs and evaluated outcomes. These outputs and outcomes should be validated by third-party benefit evaluators to ensure the credibility of claims.

FIGURE 5: TYPES OF CLAIMS COMPANIES COULD CONSIDER (SOURCE: ISEAL, 2023).



Step 7 Wetland restoration case study

The company has a public-facing commitment to water stewardship and biodiversity, which was a driver to fund the restoration project to enhance the wetland. Although the water commitment is a quantitative volumetric target, the biodiversity commitment is qualitative. The corporate sponsor does not wish to make a specific biodiversity claim regarding biodiversity benefits. Rather, the focus is to report biodiversity benefits and frame the messaging as its contributions to the benefits rather than stating that its efforts are the sole cause of beneficial outcomes internally and externally.

Before restoration activities commenced, the corporate sponsor posted a blog on its website outlining the overarching goals and objectives of the project, stating that restoration activities would include trash/debris removal, culvert modifications, invasive species removal and planting and seeding of native vegetation.

After restoration activities concluded, the company posted another blog to its website and sent a newsletter to project partners identifying the immediate project outputs that resulted from the activities, including the pounds of trash that were removed, the pounds of invasive species removed and the acreage of area that received native seeding. The company reiterated the goal outputs for the depth and area of permanent inundation. The monitoring plan was briefly outlined. An excerpt from the blog is given below:

> *In 2024, Company X supported the restoration of seven acres of a perennial freshwater wetland in the San Francisco Bay Area of California by removing invasive species, trash and debris, modifying a culvert and planting native vegetation. This is expected to improve priority bird and amphibian species and breeding habitat and support groundwater recharge. Since implementation of the project, monitoring by local NGOs has documented an increase in focal bird species diversity, including Yellow-breasted Chats and Yellow Warblers. While many factors contribute to these improvements, the project has likely played a supportive role in this outcome.*

Annual reporting from monitoring efforts included descriptions of the identified project outputs following project implementation, followed by annual updates on changes observed related to the identified project outcomes and progress towards achieving project objectives. The project was highlighted as an example in the company's annual sustainability report.

At the end of the seven-year monitoring period, the company released a final report detailing project purpose, objectives, implementation activities and monitoring results. It is here that the company reported final results related to project outcomes, stating that due to the conducted evaluation, the wetland ecosystem condition has been improved to support native wetland species that rely upon permanent inundation for survival. Specific outcomes reported included:

- The observed 47% increased extent of native wetland ecosystem within the project area as compared with the project site baseline and counterfactual site.

- Observed improvements in the three ecosystem condition dimensions monitored as part of the project's MEL elements, including:

    - Conclusions from the vegetation structure analyses that observed that within the project site, native wetland plant height and density increased by 32% and 47%, respectively, as compared with the pre-project baseline and counterfactual site over this same time frame.
    - Conclusions from the wetland vegetation species composition analyses suggested a 70% decrease in invasive species within the project site as compared with the pre-project baseline.
    - Conclusions from habitat function evaluations observed a 20% increase in the presence of priority bird species as compared with both the pre-project baseline and counterfactual site.

References to supporting data related to each of these outcome communications were provided. The outcome-level results were highlighted as a case study in the company's annual sustainability report. The project team also shared results during presentations at both water stewardship and ecological science conferences.

Conclusion

BioBA's value lies in bridging the gap between corporate sustainability commitments and science-based biodiversity accounting. By aligning with global frameworks such as the Nature Positive Initiative, the Align project and Society for Ecological Restoration and other benefit accounting methods, BioBA situates biodiversity within the broader context of multi-benefit corporate water stewardship. The approach helps organizations move "beyond volumes" to capture the ecological co-benefits that drive resilience, ecosystem restoration and community well-being.

The BioBA methodology is structured as an actionable seven-step process and offers options for the most appropriate level of accounting, ranging from output-level quantification to more advanced outcome-level evaluation. This flexibility makes BioBA both practical and scalable, ensuring relevance across geographies, project types, ecosystems, spatial and temporal scales and corporate capacities.

The BioBA guidance represents a significant step forward in enabling companies to credibly quantify, evaluate and communicate the biodiversity benefits of their water stewardship projects. Developed collaboratively with corporate partners, NGOs and technical experts, BioBA fills a critical gap by providing a standardized yet flexible framework that integrates biodiversity considerations into corporate action for nature and water.

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Additional resources

For guidance on engaging with and leading project design with local groups, including Indigenous Peoples, additional references include the Pacific Institute's and CEO Water Mandate's Stakeholder Engagement Guidelines for NBS, TNFD's Guidance on engagement with Indigenous Peoples, Local Communities and affected stakeholders or SBTN's Stakeholder engagement and science-based targets for nature.

For more information on project selection considerations, a useful reference is the Society for Ecological Restoration's International Principles And Standards For The Practice Of Ecological Restoration.

For more information on conducting situation analyses, a useful resource is Foundations of Success' how-to guide Developing High-Level Work Plans and Budgets Using the Open Standards.

For guidance on monitoring and evaluation, a useful resource is Foundations of Success' how-to guide Designing Monitoring and Evaluation Approaches for Learning.

For assistance with identifying an ecological expert for projects in a region of interest, please check out the Restoration Resource Center CERP Directory.

Part 3: Supporting Materials

- **Appendix 1:** Glossary
- **Appendix 2:** Additional case studies
- **Appendix 3:** How BioBA was developed
- **Appendix 4:** Methods to evaluate outcomes
    - **Appendix 4a:** Ecosystem extent
    - **Appendix 4b:** Ecosystem condition
    - **Appendix 4c:** Species

Appendix 1: Glossary

Activity - Actions that are undertaken during project implementation (e.g., planting trees) that yield outputs, outcomes and ultimately impacts.

Adaptative management - A structured, iterative process of robust decision making in the face of project uncertainty, with an aim to reducing and/or responding to this uncertainty over time and that is informed by monitoring, evaluation and learning.

Approach - How an activity is undertaken. For instance, invasive plants may be eradicated by hand-pulling, chemical, biological or mechanical approach.

Basin - See "catchment."

Baseline - A minimum or starting point with which to compare other information spatially and/or temporally (e.g., for comparisons between past and present or before and after an intervention) (UNEP-WCMC et al., 2022). Baselining is the process of assessing baselines.

Biodiversity - The variability among living organisms, including from terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity, 1992).

Biodiversity benefit - The output(s) and outcome(s) resulting from a biodiversity or water stewardship project. Impacts may also be considered biodiversity benefits.

Catchment - The area of land from which all surface runoff and subsurface waters flow through a sequence of streams, rivers, aquifers and lakes into the sea or another outlet at a single river mouth, estuary or delta (adapted from AWS 2019). Also referred to as a "watershed." It is important to consider that catchments

- Include associated groundwater areas, but surface and subsurface waters often have different catchment boundaries and degrees of connection;
- May include the totality or portions of water bodies, such as lakes or rivers;
- Are also referred to as watersheds, basins or subbasins; and
- May be interconnected with infrastructure, so interventions in one can result in benefits or detriments in another.

Ecosystem - A dynamic complex of plants, animals, microorganisms and their non-living environment, interacting as a functional unit (e.g., deserts, coral reefs, wetlands and rainforests (EETEC, RSPB, PWX, 2015)).

Ecosystem composition - Variety and assemblage of biotic and abiotic elements in a specific area (includes species richness, abundance and diversity) (adapted from Noss, 1990).

Ecosystem condition - The quality of an ecosystem measured in terms of its abiotic and biotic characteristics. Condition is assessed with respect to an ecosystem's composition, structure and function which underpin the ecological integrity of the ecosystem (United Nations et al., 2021).

Ecosystem extent - The spatial area or coverage of a particular ecosystem without necessarily considering the quality of the area being assessed (adapted from UNEP-WCMC et al., 2022).

Ecosystem function - The collective ecological and evolutionary processes in an ecosystem, including gene flow, disturbance and nutrient cycling (adapted from Noss, 1990).

Ecosystem structure - The physical organization or pattern of a system, from habitat complexity as measured within communities to the pattern of patches and other elements at a landscape scale (Noss, 1990).

Evaluation (of outcomes) - The assessment of changes or trends in ecosystem extent, ecosystem condition and species over time against a baseline through complex analyses such as systems or conceptual modeling and or/statistical analyses. In BioBA, evaluation is used to account for biodiversity outcomes.

Evaluation (of MEL) - The process of assessing the effectiveness of a project to inform future decisions. Evaluation occurs at periodic intervals, such as significant midpoints or milestones, to provide "pulse checks" that determine whether the project objectives have been, are or will be achieved. Periodic evaluations allow for refinement of the project plan or real-time adaptive management, if necessary. Evaluation leverages monitoring data to answer what and why certain results occurred and to what extent the project was a contributing factor.

Impacts - Long-term environmental, social and economic value creation and benefits as a result of a project's outputs and outcomes. Impacts are broader, spatially and/or temporally, than both outputs and outcomes.

Indicator - A quantitative or qualitative variable that provides reliable means to measure the condition, trend or performance of project activities related to biodiversity. In BioBA, there are no output indicators and three outcome indicators: ecosystem extent, ecosystem condition and species. An indicator can be measured through one metric or multiple metrics (OECD/DAC, 2002).

Inputs - Investments in projects that address shared water and biodiversity challenges in a specific area.

Intervention - Actions [...] involving management, restoration or protection of biodiversity, ecosystems or ecosystem services or involving the creation or management of artificial ecosystems (University of Oxford, 2019).

Learning - The process of using data and results from monitoring and evaluation to adapt or improve the current project, future projects, corporate strategy and reporting and communications. Learning occurs throughout the project as well as during post-quantification and evaluation efforts.

Mitigation - Action(s) taken to reduce the magnitude, frequency or extent of a negative impact (GRI, 2022).

MEL (monitoring, evaluation and learning) - An integrated system used by organizations to systematically track project progress, assess impact and use insights to improve ongoing and future initiatives. See definitions of monitoring, evaluation and learning for more.

Method - A structured and repeatable approach used to quantify, qualify or otherwise assess the biodiversity-related outputs or outcomes of a project.

Metric - A quantified value of an indicator (e.g., cubic meters recharged). There can be multiple metrics for one indicator.

Monitoring - The ongoing collection of data throughout the project to track progress towards objectives. Monitoring data can support the quantification of outputs and is necessary for the evaluation of outcomes. Monitoring activities will occur as part of project implementation following data collection.

Objectives - A clear statement(s), goal(s) or target(s) for intended biodiversity or ecological results that a project seeks to achieve.

Outputs - Tangible, direct results associated with project implementation that are presumed or quantified (as informed by local ecological expertise) to beneficially affect the conditions favorable for biodiversity within a project.

Outcomes - Direct or indirect biodiversity change resulting from project implementation and associated outputs, often in the form of trends. In BioBA, outcome indicators are ecosystem extent, ecosystem condition and species.

Quantification - The process of measuring or calculating the physical extent or amount of an activity or observed condition, typically using numerical units. In BioBA, outputs are generally quantified.

Priority species - A broad term used to encompass threatened and endangered species, species that may be of high concern within local contexts, indicator species or species that are culturally or economically important.

Shared water challenge - A water-related issue, concern or threat shared by the site and one or more stakeholders within the catchment(s). Examples include physical water scarcity, deteriorating water quality and regulatory restrictions on water allocation (AWS 2019).

Species - A unit of biodiversity and classification and taxonomic rank of an organism.

Species abundance - The number of individuals per species in an area (NPI, 2024).

Species diversity - See biodiversity. Species diversity is more complex than species richness and includes a measure of the number of species in a community and a measure of abundance of each species, usually described by an index.

Species richness - The number of species within a given sample, community or area (Hassan et al., 2005).

Sponsor - The organization (e.g., a company) that funds some or all of the water stewardship or biodiversity project or activity, with the intent of reporting on biodiversity benefits or making claims based on its investment.

Stakeholders - Stakeholders are persons or groups directly or indirectly affected by a project as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively (TNFD, 2023).

Watershed - See "catchment."

Appendix 2: Further Case Studies

This appendix provides four examples of how BioBA may be applied to four real-world corporate water stewardship projects. All projects are currently ongoing (i.e., implementation and/or monitoring in progress) but expected to result in biodiversity outcomes given current or planned monitoring efforts.

Case study #1	Invasive alien vegetation management and agricultural best management practices (BMPs)
Activities	Agricultural BMPs, invasive alien vegetation removal, land protection and restoration on a model farm in South Africa.
Shared water and biodiversity challenges addressed	Ecosystem health, plant and animal biodiversity and water security threatened by invasive vegetation growth.
Project description	South Africa's Western Cape province is a highly biodiverse area, consisting predominantly of fynbos, a unique and endangered shrubland biome that contains rare and endemic threatened floral and faunal species. Water scarcity, changing fire regimes and invasive alien vegetation has impacted native habitat and a lack of native habitat. Alien vegetation crowds out native plants and is estimated to result in a water loss of 50 to 75 million liters of water per year, with a threat of a loss of over 200 million liters per year if the spread of invasives is not controlled. Invasive alien vegetation species can also change the local fire regime by altering the frequency and intensity of fires. The project is located on a 2,500-ha barley farm in the Western Cape's Overberg region, where 65% of the farmland is arable. The project aims to improve sustainability and biodiversity across the site, primarily through removal of invasive alien vegetation through chainsawing, chipping and controlled burning. Secondary activities include land protection and sustainable agricultural practices.
Location	Klein River catchment, Western Cape, South Africa
Project start date	2024
Project end date	Ongoing (implementation)
Without-project condition	The project area's lowland region was impacted significantly by invasive alien vegetation, including *Acacia* and *Eucalyptus* species, castor oil plant and other weeds. The project area's mountain region was significantly impacted by invasive alien vegetation, including *Hakea* and pine species.
With-project condition	The project area has a desired future condition of native fynbos habitat with no invasive alien vegetation, to allow the existing native seedbank (typically renosterveld and other fynbos species) to reestablish.
Biodiversity outputs, methods and assumptions (anticipated)	**Output: Area – 80 ha (of 160 ha total) lowland region cleared of invasive alien vegetation.** **Methods for quantification:** Data was collected throughout 2.5 field survey days, supplemented by drone mapping of the landscape and GIS and satellite maps of patches and watercourses. **Considerations for quantification:** • Ground-truthing of drone mapping may confirm that invasive alien vegetation was completely cleared in the designated area.
	Area – 210 ha (of 592 ha total) mountain region cleared of invasive alien vegetation. Methods for quantification: Data collected consisted of a vegetation map with on-the-ground surveys verifying floral species of interest. **Considerations for quantification:** • No additional considerations needed.

Biodiversity outcomes, methods, and assumptions (anticipated)	**Ecosystem extent – decreased1 invasive alien vegetation extent.** **Methods for evaluation:** Drone mapping and GIS and satellite maps. Field surveys to confirm that invasive alien vegetation has been cleared sufficiently for native seedbank to reestablish. **Considerations for evaluation:** • Consider whether each of the distinct habitat types (i.e., lowland versus mountain) are individual outcomes or consider overall changes in ecosystem extent across the project site as a single outcome. • Explore opportunities to increase ecosystem extent by integrating fynbos corridors and nodes into farmland, degraded land or other areas.
	Ecosystem condition – improved ecosystem composition2 (lowland and mountain regions) **Methods for evaluation:** Plant biodiversity surveys, camera traps. **Considerations for quantification:** • Selection of appropriate plant survey baselines, counterfactuals or reference sites • Frequency of camera trap checks • Number, frequency and duration of plant surveys will inform data collection as some species can only be recorded during certain periods in the year (e.g., after high rainfall events, after fires, during flowering • Conditions of treated areas will need to be monitored over a number of years to determine the rate of renewal for invasive alien species.
Complementary indicators	**Volumetric benefits:** The team used a water runoff losses model to calculate estimate 4 million liters of water saved annually. The project did not do a formal volumetric water benefit quantification, but using VWBA guidance, the volumetric water benefit can be quantified as reduced consumption (reduced evapotranspiration) and calculated using the Consumption method (VWBA 2.0). **Socio-economic benefits:** This project provides socioeconomic benefits through income to local invasive clearing teams and business opportunities for local contractors and wood cutters. For example, during 2025, 414 workdays were provided to local communities (within a 50km radius of the farm) through the invasive-clearing work.
Comments	Removal of invasive alien vegetation can provide long-term water and biodiversity benefits. The company can communicate biodiversity benefits (outputs and/or outcomes) for years that there is annual evidence that invasive removal activities have been implemented and continue to be delivering anticipated benefits (e.g. conditions for native seedbank to reestablish are still good). The duration of benefit communication should be representative of the company's on-going contributions to the activity or activities (e.g. in-kind or monetary contributions to project implementation, O&M, etc.). This project is ongoing and monitoring data are not yet available. Therefore, no final biodiversity benefit quantifications or evaluations have been undertaken to date. The project could consider quantifying additional project outputs, such as mass and weight of invasive biomass removed or number of invasive trees or plants removed. Removal of livestock fencing was mentioned as a recommendation from local ecological experts, but project materials did not indicate if the length of fencing removed was a project output. Increases in species abundance, richness or diversity are not mentioned explicitly as project objectives, but project documentation mentions some endemic floral and faunal species and the project area's significance as a corridor for leopards. The project team can elaborate if direct changes to specific focal species will be expected or if improvements in ecosystem condition for leopard habitat is a project objective.

Case study #2	Traditional agriculture and wetland restoration
Activity	Implementation of the "Chinampa-Refuge System" model for wetland restoration in Mexico, including installation of biofilters, canal restoration, invasive species exclusion and tree planting.
Shared water and biodiversity challenges addressed	Declining Xochimilco wetland habitat due to urbanization, pollution and habitat degradation, leading to a critical decline in biodiversity, most notably for the axolotl (Ambystoma mexicanum), an amphibian endemic to these canals.
Project description	The Xochimilco wetland is a UNESCO World Heritage site and Mexico City's last remnant of the Valley of Mexico's historic lagoon system. This urban wetland delivers essential ecosystem services, including water replenishment, flood regulation and habitat for diverse flora and fauna. It also sustains the "Chinampa" agricultural system, a centuries-old practice that produces culturally significant crops. To address these challenges, an NGO, local university and local chinamperos (farmers) are implementing the "Chinampa-Refuge System." This model integrates traditional farming with ecological engineering—specifically biofilters and semi-permeable barriers—to restore hydrological function, improve water quality and create sanctuaries for native biodiversity.
Location	Lake Xochimilco, Mexico City, Mexico
Project start date	April 17 2023
Project end date	Fully implemented; monitoring.
Without-project condition	The project area is undergoing significant decline of wetland function due to urbanization, pollution and habitat degradation.
With-project condition	Restoration efforts in this socio-ecosystem focus on improving water quality in the Chinampa refuges, which enhances local crop production and species habitat quality.
Biodiversity outputs, methods and assumptions (anticipated)	**Output: Count – 12 new biofilters installed and functioning.** **Methods for quantification:** The presence of biofilters is recorded through direct human observation and ground-truthing. Water quality is monitored inside and outside the Chinampas (before and after passing through the biofilters) to detect changes across multiple biological and physico-chemical parameters.
	Output: Count – 40 biofilters maintained and functioning. **Methods for quantification:** The presence of biofilters is recorded through direct human observation and ground-truthing. Water quality is monitored inside and outside the Chinampas (before and after passing through the biofilters) to detect changes across multiple biological and physicochemical parameters.
	Output: Count – 300 trees planted. **Methods for quantification:** Ground-truthing, physical counts, survival and mortality rates. **Considerations for quantification:** • Pre/post remote sensing/drone photography of forest cover.
	Output: Count – seven chinampa refuges constructed. **Methods for quantification:** Chinampa refuges are recorded through direct human observation and ground-truthing. Water quality is monitored inside and outside the Chinampas (before and after passing through the biofilters) to detect changes across multiple biological and physicochemical parameters.
	Output: Length – 2,462 meters of canal and edge restoration. **Methods for quantification:** Ground-truthing. **Considerations for quantification:** • Clearly define the parameters for successful canal and edge restoration. • Support quantification via remote sensing with ground-truthing linear distances and pre/post photography.

<table>
<tr><td rowspan="2">Biodiversity outcomes, methods, and assumptions (anticipated)</td><td>Outcome: Ecosystem Condition – improved ecosystem function.
Water quality is linked to ecosystem function for this habitat through improvement of canal water quality. Water quality supports population resilience, with likely co-benefits to other aquatic species in the canal.
Methods for evaluation:
Water Quality Monitoring Framework: Monitoring is led by two specialists from the Ecological Restoration Laboratory and one from the Institute of Ecology. The program is structured around the wetland's two climatic cycles:
• Dry season: November-April.
• Rainy season: May-October.
Each season includes systematic sampling inside and outside every refuge, with eight measurements per Chinampa annually. On a monthly basis, 20 Chinampa-refuges are monitored, with weekly visits to five sites to ensure full coverage</td></tr>
<tr><td>Outcome: Species – increased species abundance of the axolotl.
The anticipated outcome of the project is to directly increase species abundance of axolotls.
Methods for evaluation:
Species detection via eDNA and traditional netting.
Assessment of the abundance of the Axolotl population is part of a long-term and extremely rigorous scientific research project led by Dr. Luis Zambrano. More details can be found in published papers, including: Link and Link.</td></tr>
<tr><td>Complementary indicators</td><td>Water quality: This project has anticipated water quality co-benefits that are closely linked with the project's biodiversity objectives. Water Quality Benefit Accounting (WQBA) can be used to quantify any relevant water quality benefits to the aquatic habitats.

Social/cultural: This project engages with local chinamperos (farmers) to link their livelihood and with restoration efforts. This includes engaging with at least three new families (35 people) annually, plus 75 indirect beneficiaries, through sustainable agriculture, market access, and capacity-building— including a Trainer of Trainers program for long-term impact. At the time of the report, 20 local producers had been engaged.</td></tr>
<tr><td>Comments</td><td>The company can communicate biodiversity benefits (outputs and/or outcomes) for years that there is annual evidence that restoration activities have been implemented and continue to be delivering anticipated benefits (e.g., reduction in water quality pollutants). The duration of benefit communication should be representative of the company's on-going contributions to the activity or activities (e.g. in-kind or monetary contributions to project implementation, O&M, etc.).

In general, more methodological detail on how outputs and outcomes will be monitored, evaluated and documented would strengthen future corporate reporting (e.g., photo records of biofilters installed), along with a more clearly stated Monitoring, Evaluation, and Learning (MEL) plan following SMART-objective setting or similar planning framework.

The company is a partial funder of the project and should take caution with reporting or claiming total biodiversity benefits; the ISEAL guidance (2023) or VWBA 2.0 on proportional and attributional claims could be referenced.</td></tr>
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Case study #3	Floodplain inundation and restoration
Activities	Levee breaching, floodplain inundation and restoration in the Great Valley Grasslands State Park, California.
Shared water and biodiversity challenges addressed	Lack of historic floodplain habitat for juvenile salmonids and other wildlife, invasive vegetation encroachment and impairment of groundwater recharge, water supply/flood control.
Project description	The 2,826-acre Great Valley Grasslands State Park has the largest expanse of grasslands within California's Central Valley and is part of the largest contiguous habitat mosaic of wetlands remaining in the state. Levees constructed by cattle ranchers for livestock grazing in the 1950s have disconnected the San Joaquin River from its historic floodplains, preventing periodic floodplain inundation and allowing invasive vegetation to proliferate. The project will breach and remove strategic sections of levees and a culvert to establish natural floodplain function and restore 220 acres of historical habitat for anadromous salmon, steelhead, and other fish and wildlife.
Location	San Joaquin River Basin, California, United States of America
Project start date	September 2023
Project end date	January 2026 (implementation); Monitoring is ongoing
Without-project condition	The project area was degraded due to the levees preventing floodplain connectivity, historic livestock grazing and proliferation of invasive vegetation.
With-project condition	The project area has a desired future condition of reconnected floodplain, removed invasive vegetation, and replanted native vegetation. The reconnected floodplain improves habitat conditions for juvenile salmonids and other wildlife.

Biodiversity outputs, methods and assumptions (anticipated)	**Output: Count – 14 consecutive days of inundation for a two-year recurrence interval flow.** **Methods for quantification:** ground-based and aerial photography weekly during flooding periods. **Considerations for quantification:** • Number of flood events in a year needed to meet the 14-consecutive day threshold. • Monitoring duration (i.e., number of flooding seasons that inundation extent will be measured after implementation).
	Output: Count – two levee breaches. **Methods for quantification:** None stated. Assumed to be human observation. **Considerations for quantification:** • Specifications to determine if the levee has been breached sufficiently (e.g., notched depth, rate of erosion, etc.). • Method to determine length of levee removed and eroded (e.g., measuring wheel). • Monitoring duration to determine sufficient rates of erosion (i.e., that the levee is naturally eroding over an appropriate timescale without human intervention.
	Output: Count – one culvert removal. **Methods for quantification:** None stated. Assumed to be human observation. **Considerations for quantification**: • Specifications to determine if the culvert has been removed sufficiently (e.g., presence-absence of culvert material, etc.).
	Output: Length – water depth greater than one foot. **Methods for quantification:** Piezometer network with continuous water level monitoring. **Considerations for quantification:** • Number of piezometer measurements needed to meet 1 foot threshold over specified duration. • Monitoring duration (i.e., number of flooding seasons that inundation extent water depth will be measured after implementation).
	Output: Length – length of levee reach removed (length to be determined). **Methods for quantification:** None stated. **Considerations for quantification:** • Specifications to determine whether the levee has been breached sufficiently (e.g., notched depth, rate of erosion, etc.). • Method to determine length of levee removed and eroded (e.g., measuring wheel). • Monitoring duration to determine sufficient rates of erosion (i.e., that the levee is naturally eroding over an appropriate timescale without human intervention.
	Output: Area – 120 acres inundated floodplain. **Methods for quantification:** Ground-based and aerial photography weekly during flooding periods. **Considerations for quantification:** • Number of flood events monitored per year. • Monitoring duration (i.e., number of flooding seasons that inundation extent will be measured after implementation). • Method for detecting inundated area (e.g., pixel counts, GIS calculations, etc.). • Quantification of inundation extent (e.g., average inundation extent of all composite images in a year, maximum inundation extent per year, etc.).

Biodiversity outcomes, methods, and assumptions (anticipated)	**Outcome: Ecosystem extent – increased wetland, grassland and riparian forest woodland habitat.** **Methods for evaluation:** Ground-based and aerial photography, Real-Time Kinematic (RTK) GPS modeled inundation validation and ground-based vegetation surveys (long-term plots). **Considerations for evaluation:** • Verify ecosystem extent via ground-truthing (i.e. *in-situ* measuring with measuring wheel or total station) or other methods after evaluating geospatial data. • Consider whether each of the distinct habitat types are individual outcomes or consider overall changes in ecosystem extent across the project site as a single outcome.
	Ecosystem condition: Improved ecosystem structure, composition and function **Methods for evaluation - ecosystem structure:** • Evaluate increases in channel complexity indices. Increases in channel complexity indices will be evaluated by imagery and topographic data channel complexity assessment (BACI design) and bathymetric surveys. The project monitoring plan does not specify a target increase in complexity indices or quantifiable performance measure. • Evaluate reductions in channel margin water temperatures. Channel margin water temperatures will be measured by continuous monitoring pre- and post-project by floodplain-channel margin temperature loggers and longitudinal river temperature profiles. The project monitoring plan does not provide exact temperature performance measures. **Considerations for quantification - ecosystem structure:** • Select appropriate channel complexity indices based on local context and decide an appropriate monitoring and evaluation timeframe (e.g., for how many years after project completion does channel complexity need to be evaluated). • Set target channel margin water temperature reductions before project completion and determine if actual with-project temperatures meet targets. • Select appropriate trends or statistical analyses for evaluation of both channel complexity indices and channel margin water temperatures (e.g., regression of time series). **Methods for evaluation - ecosystem composition:** • Evaluate vegetation percentage composition. The anticipated ecosystem composition metrics of the project are to minimize disturbance of sensitive habitats and species and increase in ratio of native to nonnative vegetation. **Considerations for evaluation - ecosystem composition:** • Use and identify appropriate baselines and with-project monitoring data. • Consider appropriate durations (i.e., how long will post-project monitoring data need to be collected) and collection time (i.e., when will data be collected in a year, and for how long). • Identify or classify sensitive habitats and specific species to be evaluated. • Select appropriate trends or statistical analyses for evaluation of changes in native to nonnative vegetation (e.g., regression of time series). **Methods for evaluation - ecosystem function:** • Evaluate fish strandings. The monitoring plan did not provide methods for evaluating minimized fish strandings. • Evaluate zooplankton density elevated in floodplain compared to river channel. The monitoring plan does not provide key performance measures, target zooplankton density increases, or relevant baselining information. **Considerations for evaluation - ecosystem function**: • Use and identify appropriate baselines and with-project monitoring data of fish strandings and zooplankton density. • Consider appropriate durations (i.e., number of years for post-project monitoring data collection) and collection time (i.e., season or month(s) for data collection, and collection period length). • Measure decreases in fish strandings as number of fish stranded or dead as a proxy. • Select appropriate trends or statistical analyses for evaluation of changes in fish strandings and zooplankton density (e.g., regression of time series).

Complementary indicators	**Volumetric benefits:** The volumetric water benefit can be quantified as the increased inundation volume and calculated using the inundation method (VWBA 2.0). **Water quality:** Water Quality Benefit Accounting (WQBA) can be used to quantify any relevant water quality benefits to the aquatic habitats.
Comments	Levee removal activities can provide long-term water and biodiversity benefits. The company can communicate biodiversity benefits (outputs and/or outcomes) for years that there is annual evidence that restoration activities have been implemented and continue to be delivering anticipated benefits (e.g. inundation and water depth meet objectives, observation that juvenile salmonids continue to use floodplain habitat). The duration of benefit communication should be representative of the company's on-going contributions to the activity or activities (e.g. in-kind or monetary contributions to project implementation, O&M, etc.). This project is ongoing and monitoring data are not yet available. Therefore, no final biodiversity benefit quantifications or evaluations have been undertaken to date. The company is a partial funder of the project and should take caution with reporting or claiming total biodiversity benefits; the ISEAL guidance (2023) or VWBA 2.0 on proportional and attributional claims could be referenced. Area seeded and number of plants and trees planted are mentioned in the project plan, but no methods are provided for output quantification. Area and count outputs could be quantified if desired. Increases in species abundance, richness or diversity are not mentioned explicitly in the monitoring plan, but project documentation mentions some floral and faunal species. The project team can elaborate if direct changes to specific focal species will be expected.

Case study #4	Peatland restoration
Activity	Restoration of three historically drained peatland ranges in Finland achieved by eliminating drainage ditches and removing selected trees to re-establish hydraulic connectivity and support native peatland vegetation.
Shared water and biodiversity challenges addressed	Reduced extent of peatland vegetation due to low water levels, reduced extent of native peatland biotopes, lack of habitat for peatland reliant wildlife including willow grouse, reduction in carbon sequestration, reduced water supply/flood control ecosystem services
Project description	Finland contains significant peatland areas, but drainage caused by forestry and strip-mining for fuel have degraded these habitats. The project goal was to implement drainage ditch infilling and tree clearing within the Vorlokki, Nahkapuro, and Matosuo restoration areas to raise the groundwater elevation within these historically drained peatlands to near-natural levels, thus re-establishing hydraulic connectivity and flow to support natural ecological processes and native vegetation.
Location	Northern Finland
Project start date	September 2023
Implementation end date	July 2024 (monitoring ongoing)
Without-project condition	The project area was degraded due to drainage ditches artificially lowering the water level and hydrologic connectivity of the peatlands.
With-project condition	Restored peatland plots with near-natural hydrology, raised water table and the return of native peatland dependent flora and fauna.
Biodiversity outputs, methods and assumptions (anticipated)	**Output: Count – number of drainage ditches blocked.** **Methods for quantification:** Number of infilled ditches counted in the field by project implementers or mapped using a hand-held GPS device. **Considerations for quantification:** • Specifications to determine if the blockages to drainage ditches were successful.
	Output: Length – water depth/surface water elevation (m or cm below ground surface elevation) **Methods for quantification:** Continuous water level monitoring using pressure gauges and water quality sondes at specified permanent monitoring stations throughout the restoration area. **Considerations for quantification:** • Number of monitoring locations and distribution throughout the three restoration sites. • Duration of monitoring period (years). • Continuous monitoring to account for seasonal fluctuations in groundwater elevation.
	Output: Area – acres of restored peatland. **Methods for quantification**: Ground-based surveys and aerial photography showing the increased extent of peatland. **Considerations for quantification:** • Delineation method for identifying the area of different biotopes. • Temporal period in which surveying occurs (seasonal variation on peatland hydrology).

	Outcome: Ecosystem extent – increase in extent of desired native biotopes within restoration areas (m^2). **Methods for evaluation**: Change in spatial extent over time using ground-based and/or aerial photography, or repeat perimeter measurements using Real-Time Kinematic (RTK) GPS. **Considerations for evaluation**: • Establish detailed pre-restoration baseline of biotope extent, which should be referenced to determine change in extent over time. • Clarify in the project objectives and monitoring plan whether to evaluate each of the distinct habitat types as individual outcomes or to consider overall changes in ecosystem extent across the project site as a single outcome.
Biodiversity outcomes, methods, and assumptions (anticipated)	**Outcome: Ecosystem condition – improved ecosystem structure, composition and function associated with project objectives.** **Methods for evaluation - ecosystem structure:** • Change in tree stand structure (# of living/dead standing trees) assessed across a series of circular (radius 10 m) plots on each site to document the number of both living and dead trees (+/- live trees). • Change in peat layer thickness over time (+/- mm). **Considerations for quantification - ecosystem structure:** • Because the restoration target is to transition from non-native tree-domination back to moss-dominated or peatland species-dominated (rich fens), a "loss of structure" is the desired outcome. • Select appropriate trends or statistical analyses for evaluation of loss of structure over time (e.g., regression of time series)[1]. **Methods for evaluation - ecosystem composition:** • Change in percent (%) cover of desired plant species and/or abundance (individuals/area) within permanent monitoring stations (1 m^2 sample plots). **Considerations for evaluation - ecosystem composition**: • Conduct vegetation composition measurements at the restoration and reference (counterfactual) sites, to be repeated two, five, 10 and 15 years after restoration. • Consider the expected timeline for the reappearance of near-natural vegetation (projected timeline to achieve ecosystem recovery) is between 10-20 years. • Select appropriate trends or statistical analyses for evaluation of plant species cover over time (e.g., regression of time series). **Methods for evaluation - ecosystem function:** • Measurable change in peat layer thickness* over time (+/- mm) within permanent monitoring stations. **Considerations for evaluation - ecosystem function:** • Measure peat thickness at the restoration and reference (counterfactual) sites, and repeat two, five, 10 and 15 years after restoration. • Establish a peat level baseline. If not done before implementation, it may be possible because the rate of peat accumulation in Finland is slow (average 0.3 mm/year, max 3 mm/year). • Consider total number and spatial distance between peat thickness monitoring points within each of the three restoration areas to effectively characterize change across each managed area. • Select appropriate trends or statistical analyses for evaluation of peat thickness over time (e.g., regression of time series).
Complementary indicators	**Volumetric benefits:** The volumetric water benefit can be quantified as the increased recharge volume and calculated using the Recharge method (VWBA 2.0). **Water quality:** Water Quality Benefit Accounting (WQBA) can be used to quantify any relevant water quality benefits to the aquatic habitats.

* Peat layer thickness can also be used to evaluate ecosystem structure.

Comments	This project is ongoing and monitoring data are not yet available. Therefore, no final biodiversity benefit quantifications or evaluations have been undertaken to date. The company can communicate biodiversity benefits (outputs and/or outcomes) for years that there is annual evidence that restoration activities have been implemented and continue to be delivering anticipated benefits (e.g. water elevation, acres of peatland, thickness of peat). The duration of benefit communication should be representative of the company's on-going contributions to the activity or activities (e.g., in-kind or monetary contributions to project implementation, O&M, etc.). The target elevation was not specified, but peatland restoration guidelines suggest water table of 5-10 cm below surface for maximal peat accumulation). Additional guidance on best management practices for ecological restoration in drained peatlands has been published by the Finland Forestry department (2014). Outcome-level indicators are proposed based on the project's location, objectives and actions implemented. Increases in species abundance, richness or diversity are not mentioned explicitly in the monitoring plan, but the peatland butterfly and willow grouse are mentioned as focal species. The project team can elaborate if direct changes to specific focal species will be expected.

Appendix 3: How BioBA Was Developed

The BioBA guidance was developed as a two-phased approach:

Phase 1: Scope refinement and landscape assessment

Phase 1 focused initially on identifying and refining the scope of this work through interviews with corporate partners. Learnings from the scope refinement process provided directionality and boundaries for the BioBA guidance and informed the development of a comprehensive Landscape Assessment, which provides an in-depth review of the business case for corporate engagement, and the current state of play in terms of biodiversity commitments and frameworks, indicators and metrics for measuring impacts and measurement approaches. The assessment included a determination of elements considered in-scope and out-of-scope for BioBA guidance.

The interviews with corporate partners confirmed that these companies view biodiversity as a key part of a corporate water stewardship journey. An essential takeaway from the interviews was a strong interest in guidance with standardized approaches to measure progress and impacts, support target setting and connect the dots between programs and benefit accounting frameworks. Further engagements with the EAG helped to inform the direction, scope and content of the Landscape Assessment.

Phase 2: Methodology and guidance development

Based upon the bounds set in place by the Landscape Assessment, the BioBA team developed ideas and content for a BioBA methodology based upon team conversations, further literature review and aligned with parallel biodiversity initiatives, including NPI, Align and SER. Other important considerations guided BioBA development:

1. **Biodiversity is more complex and contextual than water.** The diversity and complexity of life across global ecosystems means that there are no universal metrics for assessing or modeling biodiversity, unlike for water volume or quality (UNEP-WCMC et al., 2023). Rather, there are a vast number of context-specific metrics for characterizing biodiversity, depending upon a project's objectives, activities and impacted ecosystem(s). BioBA therefore provides programmatic guidance and detailed examples of a process for selecting appropriate biodiversity indicators, metrics and methods rather than a set of generic metrics and associated methodologies.

2. **Not all corporate water stewardship projects produce quantifiable and reportable biodiversity benefits.** Many corporate water stewardship projects focus on other dimensions of water stress such as sanitation, access or hygiene and generally do not have quantifiable biodiversity benefits. Some corporate water stewardship projects have ancillary biodiversity benefits that may or may not be practical to document, depending upon the project budget and level of effort required to collect biodiversity data. A select set of these projects will lend

themselves to the evaluation of robust, scientifically defensible biodiversity benefits because of the nature of the project, its design and the level of implementation.

3. **Project-related biodiversity objectives should be consistent with local contexts and priorities.** A wide range of possible biodiversity objectives may exist for a given region, including restoring distinct types of ecosystems, increasing the population of certain species and improving the quality or condition of different ecosystem components. Biodiversity objectives should be identified in the preliminary stages of a project, informed by local expertise, achievable using recognized restoration or implementation pathways and consistent with regional ecological goals and plans.

4. **BioBA should be informed by and aligned with emerging biodiversity guidance.** Leading international organizations have developed (or are in the process of developing) guidance documents for biodiversity reporting, crediting and accounting (e.g., NPI and Align); some early versions of these guidance documents are already being recognized as accepted frameworks for biodiversity benefit accounting by the scientific community. BioBA draws from these guidance documents, identifying relevant content and building upon it to provide practical guidance tailored specifically for corporate water stewardship.

This process culminated in a draft BioBA guidance that was shared with corporate partners and the EAG for review. The BioBA team solicited specific feedback on key elements of the guidance and addressed reviewer comments throughout document revisions. These engagements ensured consensus on direction and technical content and confirmed that the project was meeting expectations. The final guidance was launched and continues to evolve based upon current science and best practices in corporate water stewardship and biodiversity.

Appendix 4: Methods to Evaluate Outcomes

Appendix 4a: Evaluating ecosystem extent

Ecosystem extent is the spatial area or coverage[17] of a particular ecosystem without necessarily considering the quality of the area being assessed (ecosystem condition). It encompasses the physical range of habitats that make up terrestrial and freshwater aquatic ecosystems. Biodiversity objectives related to ecosystem extent often involve ecosystem expansion, such as through wetland restoration or creation, native vegetation plantings for forest or grassland restoration and conservation and management of existing areas. These interventions and activities can lead to changes in spatial extent of the target ecosystem(s), which can be measured on the ground or remotely.

Ecosystem extent as an outcome differs from area as an output, as ecosystem extent evaluates change over time, often reported through observed trends, while area as an output relates to the physical footprint (i.e., the aerial extent of land or water) over which corporate water stewardship activities were implemented. Area as an output is static and will not change over time unless additional project activities are implemented. Conversely, ecosystem extent as an outcome is dynamic and may change over time, potentially shrinking within or expanding beyond the bounds of the initial project area.

Various methods for evaluating change in ecosystem extent exist and will differ from project to project depending upon the local habitat. Coordination with credentialed ecology experts will be key for selecting appropriate survey methods and analyses with which to evaluate changes in ecosystem extent. A generalized methodology to evaluate ecosystem extent is provided below.

1. Determine how the baseline and post-project ecosystem extent will be measured.

Evaluation of ecosystem extent is based upon classification of a project site's baseline and post-project land use/land cover (LULC)[18] or ecosystem type. Common methods to evaluate ecosystem extent include field-based approaches, use of remote sensing data or a combination of the two:

- **Field-based approaches**

Repeated field surveys can characterize the change in ecosystem extent of the project site and surrounding area over time. Field measurements may be collected using GPS devices, a surveyor's measuring wheel or transect tapes (Goodin et al., 2018). In some ecosystems such as marshes, permanent transect lines can be established throughout the project

[17] For determining the ecosystem extent of lotic systems (i.e., rivers and streams), it may be more appropriate to use the dimension of length instead of area. For instance, reporting that 500 feet of riverine habitat increased due to streambank restoration may be more appropriate than reporting the square footage of increased habitat.

[18] "Land cover" and "land use" are distinct, although "land cover" and "land use/land cover (LULC)" are sometimes used interchangeably. Land cover indicates a physical land type, encompassing vegetative characteristics or man-made constructions (e.g., forest, savanna, open water). Land use indicates how people use the land, involving an element of human activity (e.g., agriculture, urban development, conservation). Land cover can be determined by analyzing satellite and aerial imagery, but land use is determined by field observations or enumeration (NOAA, 2024). Some land cover classification datasets group land use and land cover into a single classification.

site using marked posts or stakes driven deep into the ground. These transect points can be revisited each year and used to measure changes in ecosystem extent.

- **Use of remote sensing data**

Use of remotely sensed data generally involves the classification of pixels over the project site and the immediate surrounding area. Ecological partners should decide upon the number of images needed per year over a duration of time that is relevant to ecological timescales (e.g., tree growth rate) and local conditions; this decision will influence, or be influenced by, the remote sensing dataset used (see Box 3). The rate of change in land cover type can then be calculated from the difference in pixel counts between years, divided by the number of years over which pixel count evaluations were conducted (Goodin et al., 2018). Evaluations may conclude that the ecosystem extent is:

- Increasing (i.e., pixel count of the target ecosystem is increasing over time)
- Stable (i.e., no observable change in target pixel count over time)
- Decreasing (i.e., pixel count of focal ecosystem is decreasing over time)

It may be useful to leverage LULC types, often obtained from remote sensing datasets, as a proxy for ecosystem classifications (these datasets may also be used to evaluate ecosystem condition; see Appendix 4b). Identification of land cover/LULC types in a project site allows teams to map the physical footprint of ecosystems at different time points, revealing patterns of degradation, fragmentation or recovery. By comparing land cover of an area over time, project teams can detect spatial shifts in ecosystem boundaries, quantify losses or gains and assess the impacts of human activities or natural disturbances.

Some common land cover/LULC systems include the U.S. Geological Survey's National Land Cover Database, the FAO Land Cover Classification System and the MODIS Land Cover Type/Dynamics. Tools such as the GLAD lab maps, Esri Sentinel-2 Land Cover Explorer, Dynamic World and Google Earth Engine are web-based applications that provide access to annual global LULC maps derived from raw or processed satellite imagery. Leveraging online geospatial tools is a cost-effective and relatively uncomplicated way to evaluate ecosystem extent.

When reporting LULC classes, it is important to consider the scale, objectives and ecological context of the restoration project. Classification systems vary in complexity, from broad categories (e.g., forest, wetland, urban) to highly detailed categories (e.g., distinguishing between emergent vs. woody wetlands or native vs. invasive vegetation). For most restoration projects, a balance should be struck between ecological relevance and data availability. Coarser classifications may suffice for landscape-scale assessments, while finer classifications are more appropriate for site-level monitoring or projects targeting specific habitat types. Project teams should document the classification system used, its resolution and any assumptions or limitations, especially when combining remote sensing with field-based or ground-truth data.

Box 3: Considerations and challenges of spatial land cover and LULC datasets

When assessing ecosystem extent outcomes using spatial data, there are several key considerations and challenges that teams should be aware of:

- **Spatial resolution:** Applying the appropriate spatial resolution is important for accurately determining baseline and post-project land cover or LULC types. High spatial resolution imagery provides detailed information with more pixels per unit area, which is useful for detecting fine-scale changes or evaluating projects with smaller footprints. However, high spatial resolution imagery often comes at a tradeoff with lower temporal resolution, for example:
    - **Landsat** imagery provides ~30m spatial resolution with a 16-day revisit cycle.
    - **MODIS** imagery offers ~500m spatial resolution with a two-day revisit cycle.

Datasets with lower spatial resolution may limit the ability to distinguish between similar ecosystem types. This is a particular concern with wetlands and related aquatic ecosystems that may be small in scale (e.g., vernal pools) and/or contain relatively non-distinct ecosystem boundaries (e.g., emergent wetlands). Furthermore, in some cases, even high spatial resolution datasets may be unsuited to classify baseline and post-project land cover/LULC types (e.g., within and between raster pixels). For instance, true-color drone-based aerial imagery might capture only green pixels that do not distinguish between restored vs. invasive vegetation. In both cases, ground-truthing in the form of species identification surveys combined with GPS-based extent measurements may be needed to verify changes in ecosystem extent observed using remotely sensed data.

To address limitations in spatial resolution, combining and harmonizing multiple data sources may be effective. Data collected from drones may also be used to fill in some data gaps. Relatively coarser datasets like LANDSAT and MODIS can provide valuable context or long-term trend data, while finer-scale sources can enhance detail and accuracy. Tradeoffs exist with different datasets, including spatial and temporal resolution, accessibility, availability of data (e.g., some geographies have a disproportionate quantity and quality of data), type of remote sensing bands (range of electromagnetic wavelengths) and inconsistencies and discrepancies in classification systems. Some examples include:

- **Sentinel-2** (10-60m): Offers finer spatial resolution at a five- to 10-day temporal resolution and is freely available.
- **National Agriculture Imagery Program (NAIP)**: Provides 1-m resolution, four band imagery, updated every three years, for the continental United States during agricultural growing seasons and is freely accessible.
- **National Insect and Disease Survey database:** Supplies 15 m resolution data on forest health and canopy condition for the United States, freely available.

- **Aerial or terrestrial LiDAR**: Provides high-resolution detail on vertical structure and vegetation composition, making it highly suitable for three-dimensional ecological assessments. May require extensive and specialized resources to install and use.
- **Spatial scale:** Although project teams should aim to detect land cover for baseline and post-project conditions at the project scale, it may be necessary to expand the spatial area of interest to a wider geographic scope than the project site. For instance, a project site with a mosaic of land cover/LULC types may make it difficult to classify the project site's baseline land cover/LULC type. Expanding the geographic scale and identifying land cover/LULC types of areas adjacent to the project site may provide additional context.
- **Temporal resolution:** Selecting data based upon temporal resolution is important in considering inter-annual, intra-annual or seasonal trends or fluctuations such as changes in inundation or vegetation cycles. For instance, slow vegetation growth may require datasets that are updated regularly and consistently over time (years to decades) to validate changes accurately. It is also important to consider seasonal variations, which may also skew extent observations or aid in differentiating between species of interest (e.g., senescent and evergreen species).
- **Data quality:** Cloud coverage can often obscure satellite imagery, particularly in tropical or temperate regions, reducing data usability. Trees and other upper canopy vegetation can also hinder the detection of understory vegetation or land use beneath the canopy. Investigating alternative options, such as LiDAR, may address these issues.
- **Lack of dataset relevancy:** Some project sites may not fit into broad land cover/LULC classifications. For instance, a broad "forest" land cover may not distinguish between types of forests, like deciduous or woodland. In these cases, ground truthing as described below may be necessary to classify ecosystem extent.

In many cases and depending upon the context of the project, use of spatial datasets will often need to be combined with ground-truthed surveys and measurements to validate findings. Ground-truthing helps identify and correct classification errors, especially in complex ecosystems where remote sensing data is unclear. Ground-truthing can address challenges related to cloud cover, canopy cover and datasets with coarser resolution. However, ground-truthing can be expensive and time-consuming, and relevant budgets need to be made available where possible.

2. Determine trends in ecosystem extent

Following classification of baseline and post-project LULC change, project teams will need to conduct analyses that link changes (e.g., percentage change over time) to project activities. Scientists or experts should conduct the appropriate statistical tests, models and/or data analysis, such as spatial autocorrelation, nearest neighbor analysis, ANOVAs and regressions (e.g., linear and logistic regressions). For instance, a regression model may determine if there is statistical significance between revegetation activities from the project and percent change in land cover type.

Appendix 4b: Evaluating ecosystem condition

While no universal standard exists for ecosystem condition assessment, this appendix provides resources for practical methods to assess ecosystem condition in biodiversity and water stewardship projects. These resources can be adapted across different spatial and temporal scales as well as project and intervention types. SER also provides general principles and standards for guiding ecological restoration (Gann et al., 2019).

While BioBA does not provide a universal approach for evaluating ecosystem condition, an example timeline for a rapidly maturing ecosystem (e.g., grassland restoration seeded with native species) is provided below:

- Pre-project implementation: Select appropriate metrics and methods to evaluate ecosystem condition and conduct a baseline assessment of pre-project conditions. Baseline assessments may leverage counterfactuals, reference sites and historic qualitative data.

- One to four years after project implementation: Shortly after project implementation, collect monitoring data that generally focuses on rapid-response metrics that utilizes quick, efficient data collection (e.g., presence/composition/survival of key pioneer species; quick water quality tests for pH or turbidity). Findings from early monitoring should determine if adaptive management strategies are needed for the project area.

- Five-plus years after project implementation: Collect monitoring data to evaluate long-term trends in ecosystem condition. Project teams can consider collecting fewer ecosystem condition metrics at this point, and the sampling frequency of metrics may be reduced. Evaluate long-term trends of ecosystem condition and continue to incorporate findings into adaptive management strategies and communication materials as needed.

Table A4b-1 provides example resources of general ecosystem condition methods and corresponding example tools and guides that can be used for various project activities (refer to Table 1). These methods are organized into the three dimensions of ecosystem condition: structure, composition and function. Depending upon the objectives of the project, local context and resources available, one or more of these dimensions may be assessed to evaluate ecosystem condition.

TABLE A4B-1: EXAMPLE ASSESSMENT METHODS FOR MULTIPLE DIMENSIONS OF EVALUATING ECOSYSTEM CONDITION BASED UPON PROJECT ACTIVITIES. SUPPORTING TOOLS AND GUIDANCE ARE PROVIDED.

Example project activities	Example assessment methods			Example tools and guides
	Ecosystem structure	Ecosystem composition	Ecosystem function	
Habitat and intervention types: Aquatic, riparian and wetland restoration or conservation				
In-stream barrier removal	**Hydrologic alteration assessment** (Richter et al., 1996) **Longitudinal connectivity assessment** (Cote et al., 2008; Wohl, 2017)	**Fish community monitoring** (Karr 1981; Burckhardt et al., 2010; Gardner et al., 2013) **Macroinvertebrate community monitoring** (Mahan et al., 2021; Sallenave, 2023)	**Fish passage assessment** (Tummers et al., 2016; Washington Department of Fish and Wildlife, 2019) **Periphyton biomass monitoring** (Gaiser, 2009; Huang et al, 2018)	Gulf of Maine Council on the Marine Environment: Stream Barrier Removal Monitoring Guide The Nature Conservancy: Indicators of Hydrologic Alteration Software American Rivers/Trout Unlimited: Exploring Dam Removal: A Decision Making Guide US EPA: Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers
Dam reoperation	**Hydrologic alteration assessment** (Richter et al., 1996) **Stream temperature monitoring** (Thompson, 2005; Leach et al., 2023)	**Fish community monitoring** (Karr, 1981; Burckhardt et al., 2010) **Macroinvertebrate community monitoring** (Mahan et al., 2021; Sallenave, 2023)	**Downstream habitat quality assessment** (Poff et al., 1997; Leibowitz et al., 2019) **Fish passage assessment** (Tummers et al., 2016; Washington Department of Fish and Wildlife, 2019)	The Nature Conservancy: Indicators of Hydrologic Alteration Software US EPA: Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers
Floodplain reconnection	**Hydrologic alteration assessment** (Richter et al., 1996) **Wetland delineation** (Environmental Laboratory, 1987)	**Avian survey** (Ralph et al., 1995; Canterbury et al, 2000; Conway, 2011; Wilson et al., 2019) **Vegetation composition surveys** (USDA, 1999); **Floristic quality assessment** (Lopez and Fennessy, 2002; Freyman et al., 2015)	**Peak flow attenuation assessment** (Federman et al., 2013; Roni et al., 2019)	The Nature Conservancy: Indicators of Hydrologic Alteration Software American Rivers: Reconnecting Rivers to Floodplains American Fisheries Society: Monitoring Stream and Watershed Restoration Universal FQA Calculator

Side channel reconnection	**Hydrologic alteration assessment** (Richter et al., 1996) **Longitudinal connectivity assessment** (Cote et al., 2008; Wohl, 2017)	**Fish community monitoring** (Karr 1981; Burckhardt et al., 2010) **Macroinvertebrate community monitoring** (Herbst and Kane, 2009; Sallenave, 2023)	**Downstream habitat quality assessment** (Poff et al., 1997; Leibowitz et al., 2019) **Periphyton biomass monitoring** (Gaiser, 2009; Huang et al, 2018)	The Nature Conservancy: Indicators of Hydrologic Alteration Software U.S. Department of the Interior: Side Channel Evolution and Design: Achieving Sustainable Habitat for Aquatic Species Recovery US EPA: Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers
Riparian habitat improvements	**Proper functioning condition assessment** (Dickard et al., 2015; Swanson et al., 2017) **Vegetation cover assessment** (Causton, 1988; Merritt et al., 2017)	**Proper functioning condition assessment** (Dickard et al., 2015; Swanson et al., 2017) **Vegetation composition surveys** (USDA, 1999); **Floristic quality assessment** (Lopez and Fennessy, 2002; Freyman et al., 2015) **Audubon's Bird Friendliness Index** (Michel et al., 2020)	**Proper functioning condition assessment** (Dickard et al., 2015; Swanson et al., 2017) **Net primary productivity** (Fahey & Knapp, 2007)	US Forest Service: National Riparian Protocol University of California, Berkeley Center for Forestry: Monitoring the Effectiveness of Riparian Vegetation Restoration American Fisheries Society: Monitoring Stream and Watershed Restoration Universal FQA Calculator
Beaver dam analogs	**Hydrologic alteration assessment** (Richter et al., 1996) **Stream temperature monitoring** (Thompson, 2005; Weber et al., 2017; Leach et al., 2023)	**Fish community monitoring** (Karr 1981; Burckhardt et al., 2010) **Macroinvertebrate community monitoring** (Sallenave, 2023)	**Wetland functional assessment** (Smith et al., 1995) **Periphyton biomass monitoring** (Gaiser, 2009; Huang et al, 2018)	The Nature Conservancy: Indicators of Hydrologic Alteration Software Utah State University: Beaver Restoration Assessment Tool US EPA: Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers

Water level management for habitat	**Water level monitoring** (Cowardin et al., 1979)	**Avian survey** (Ralph et al., 1995; Conway, 2011; Wilson et al., 2019) **Macroinvertebrate community monitoring** (Sallenave, 2023) **Amphibian survey** (Brown et al, 2012; US EPA, 2002) **Fish community monitoring** (Karr 1981; Burckhardt et al., 2010) **Audubon's Bird Friendliness Index** (Michel et al., 2020)	**Wetland functional assessment** (Smith et al., 1995)	U.S. Army Corps of Engineers: Water Level Management for Enhanced Fish and Wildlife Habitat Production in Upper Mississippi River Navigation Pools BECOMEd tool
Wetland creation or conservation activities	**Wetland delineation** (Environmental Laboratory, 1987) **Hydric soil assessment** (USDA NRCS, 2025)	**Avian survey** (Ralph et al., 1995; Conway, 2011; Wilson et al., 2019) **Amphibian survey** (Brown et al, 2012; US EPA, 2002) **Vegetation composition surveys** (USDA, 1999; Lacoul & Freedman, 2006) **Floristic quality assessment** (Lopez and Fennessy, 2002; Freyman et al., 2015) **Audubon's Bird Friendliness Index** (Michel et al., 2020)	**Wetland health monitoring via remote sensing** (Klemas, 2011; Guo et al., 2017; Tough et al., 2025) **Wetland functional assessment** (Bartoldus, 1994; Smith et al., 1995) **Net primary productivity** (Fahey & Knapp, 2007)	NOAA, USACE, USFWS and NRCS: An Introduction and User's Guide to Wetland Restoration, Creation, and Enhancement EPA: Wetland Bioassessment Fact Sheets Mitsch & Gosselink, 2007: Wetlands, 5th edition Universal FQA Calculator Water Research Commission Minnesota Pollution Control Agency: Rapid Floristic Quality Assessment Manual
Peat bog restoration or conservation activities	**Peat bog hydrology assessments** (Holden et al., 2011; Price et al., 2016)	**Sphagnum moss community monitoring** (González and Rochefort, 2014; Laatikainen et al., 2025) **Audubon's Bird Friendliness Index** (Michel et al., 2020)	**Wetland functional assessment** (Smith et al., 1995) **Carbon sequestration efficiency** (Yu, 2012; Mander et al., 2024) **Net primary productivity** (Fahey & Knapp, 2007)	University of Latvia and European Commission: Best Practice Book For Peatland Restoration And Climate Change Mitigation Canadian Sphagnum Peat Moss Association and New Brunswick Department of Natural Resources and Energy: Peatland Restoration Guide Minasny et al., 2023: Mapping And Monitoring Peatland Conditions From Global To Field Scale

Habitat and intervention type: Land restoration and conservation				
Reforestation or forest conservation activities	**Forest structural complexity** (Causton, 1988; Camarretta et al., 2020) **Forest Landscape Integrity Index** (Grantham et al., 2020) **Soil quality recovery** (Muñoz-Rojas, 2018)	**Vegetation composition surveys** (USDA, 1999) **Biodiversity conservation monitoring** (Gardner, 2010) **Audubon's Bird Friendliness Index** (Michel et al., 2020)	**Carbon sequestration monitoring** (Keith et al., 2009; Bernal et al., 2018) **Seed dispersal studies** (Derhé, 2016) **Net primary productivity** (McNaughton et al., 1989; Fahey & Knapp, 2007)	World Resources Institute: Global Forest Review Nature4Climate: Reforest Better U.S. Forest Service: Forest Inventory and Analysis The Northeast Upland Habitat Technical Committee and Massachusetts Division of Fisheries & Wildlife: Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife: A Guide for the Northeast Climate Focus and World Resources Institute: Restoration Monitoring Tools Guide Forest Integrity Assessment Tool (FIAT)
Meadow restoration or conservation activities	**Vegetation structure analysis** (Peach & Zedler, 2006)	**Vegetation composition surveys** (USDA, 1999) **Floristic quality assessment** (Jog et al., 2006; Lopez and Fennessy, 2002; Freyman et al., 2015) **Pollinator community monitoring** (Ollerton, 2017; O'Connor et al., 2019) **Audubon's Bird Friendliness Index** (Michel et al., 2020)	**Plant-pollinator interactions** (Forup and Memmott, 2005) **Nutrient cycling assessment** (Jiang et al., 2016; Reed et al, 2022) **Net primary productivity** (McNaughton et al., 1989; Fahey & Knapp, 2007)	US Forest Service: Comparison of Meadow Assessment Protocols Universal FQA Calculator
Grassland restoration or conservation activities	**Vegetation structure analysis** (Causton, 1988; Scasta et al., 2016) **Soil quality recovery** (Muñoz-Rojas, 2018)	**Pollinator community monitoring** (Ollerton, 2017; O'Connor et al., 2019) **Avian monitoring** (Ralph et al., 1995; Askins et al., 2007; Wilson et al., 2019) **Audubon's Bird Friendliness Index** (Michel et al., 2020) **Vegetation composition surveys** (USDA, 1999; Andrade et al., 2019) **Floristic quality assessment** (Jog et al., 2006; Freyman et al., 2015)	**Nutrient cycling assessment** (Baer et al., 2002) **Carbon sequestration efficiency** (De Deym et al., 2010; Yang et al.; 2019; Bai and Cotrufo, 2022) **Net primary productivity** (McNaughton et al., 1989; Fahey & Knapp, 2007)	The Northeast Upland Habitat Technical Committee and Massachusetts Division of Fisheries & Wildlife: Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife: A Guide for the Northeast Universal FQA Calculator

Habitat and intervention types: Green infrastructure creation				
Rain gardens/bio-retention basins	**Inlet/outlet monitoring** (Tetra Tech & City of Grand Rapids, 2019) Substrate characterization (Deeb et al., 2020; Bouzouidja et al., 2020; Novotný et al., 2023)	**Vegetation composition** (Tetra Tech & City of Grand Rapids, 2019; Dudrik et al., 2024)	**Infiltration rate monitoring** (Asleson et al., 2009; Tetra Tech & City of Grand Rapids, 2019) Pollutant/nutrient removal efficiency (Sharma and Malaviya, 2021; Kumar and Singh, 2024; Huang et al., 2025)	Georgetown Climate Center: Green Infrastructure Toolkit University of Colorado Boulder EarthLab: Using Remote Sensing to Evaluate Green Infrastructure European Union Climate Adapt: Green Factor Tool US EPA: Guiding Principles for Constructed Treatment Wetlands: Providing for Water Quality and Wildlife Habitat Constructed Wetlands for Wastewater Treatment GIWiz National Stormwater Calculator Stormwater Management Model Bioretention Design Handbook
Bioswales	**Inlet/outlet monitoring** (Tetra Tech & City of Grand Rapids, 2019) **Substrate characterization** (Xiao and McPherson, 2011; Deeb et al., 2020; Bouzouidja et al., 2020; Novotný et al., 2023)	**Vegetation composition** (Tetra Tech & City of Grand Rapids, 2019; Brodsky et al., 2019)	**Infiltration rate monitoring** (Tetra Tech & City of Grand Rapids, 2019) **Pollutant/nutrient removal efficiency** (Shetty et al., 2019)	
Stormwater detention ponds	**Inlet/outlet monitoring** (Tetra Tech & City of Grand Rapids, 2019) **Substrate characterization** (Deeb et al., 2020; Bouzouidja et al., 2020)	**Vegetation composition** (USDA, 1999; Tetra Tech & City of Grand Rapids, 2019) **Amphibian presence surveys** (Hamer et al, 2012)	**Infiltration rate monitoring** (Tetra Tech & City of Grand Rapids, 2019)	
Stormwater retention ponds	**Urban retention pond index** (Keyvanfar et al., 2021) **Substrate characterization** (Deeb et al., 2020; Bouzouidja et al., 2020) **Inlet/outlet monitoring** (Tetra Tech & City of Grand Rapids, 2019)	**Vegetation composition** (USDA, 1999; Lacoul & Freedman, 2006; Tetra Tech & City of Grand Rapids, 2019) **Amphibian presence surveys** (Hamer et al, 2012)	**Infiltration rate monitoring** (Tetra Tech & City of Grand Rapids, 2019) **Urban retention pond index** (Keyvanfar et al., 2021)	
Constructed wetland treatment systems	**Hydrologic connectivity** (Hunt et al., 1999; Arnold et al., 2001; EPA, 1999) **Substrate characterization** (Bouzouidja et al., 2020; Wang et al, 2020; Ji et al, 2022; Yang et al., 2022)	**Vegetation composition** (USDA, 1999; Lacoul & Freedman, 2006; Tetra Tech & City of Grand Rapids, 2019) **Faunal surveys** (Knight et al., 2001; Hsu et al., 2011; Hamer et al, 2012; Conway, 2011)	**Contaminant removal** (Imfeld et al., 2009; García et al., 2010)	

Note: process-based restoration is a project activity listed in Table 1, but it is not included here as exact activities are context specific.

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Appendix 4c: Evaluating species

The following metrics to evaluate species are considered in scope[19] for BioBA, as they are commonly used in ecological assessments:

Species richness[20]: The number of distinct species within a given sample, community, or area.

Species abundance: The number of individuals per species in an area.

Species diversity: The variability among living organisms. Species diversity considers species richness and abundance and is usually described by an index.

Note that species richness and abundance may also be used to evaluate ecosystem condition (see Appendix 4b), depending upon the species of interest. Table A4c-1 provides non-exhaustive examples of sampling methods for gathering species-relevant data needed to evaluate species richness and abundance.

TABLE A4C-1: SAMPLING METHODS TO EVALUATE SPECIES RICHNESS AND ABUNDANCE FOR DIFFERENT BIOTIC GROUPS.

Focal biotic group	Sampling methods for species richness and abundance
Fish	Electrofishing, netting (drift, seine, gill), mark-recapture, camera trapping
Amphibians	Call surveys/acoustic monitoring, visual encounter surveys, coverboard surveys, mark-recapture, dip-netting, call index, transect encounter rates
Reptiles	Visual encounter surveys, coverboard surveys, pitfall or funnel traps, mark–recapture, transect encounter rates
Birds	Call surveys/acoustic monitoring, visual encounter surveys, camera trapping, mist nets, banding surveys
Mammals	Visual encounter surveys, camera trapping, call surveys/acoustic monitoring, trapping, track surveys, scat surveys, scent stations
Pollinators	Transect netting, pan traps, malaise traps, timed floral visitation surveys, visitation frequency, colony counts (for bees)
Aquatic macroinvertebrates	Netting (kick, Surber, drift), leaf pack and riffle sampling, larval density counts, biomass sampling
Vegetation (or sessile species)	Quadrat/transect inventory, stratified random plots, floristic quality assessment, photo interpretation, percent cover estimates, biomass sampling, pollen surveys

[19] The following metrics of species are considered out of scope of most BioBA projects, potentially due to cost and complexity in gathering data:

- Genetic, phylogenetic and evolutionary diversity, e.g., taxonomic uniqueness
- Species status and threat, e.g., global extinction risk
- Species fitness and functional role, e.g., clutch size, hatchling viability, mortality or recruitment rates, dispersal ability
- Species distribution, e.g., area of occupancy

[20] Species richness may be difficult to assess, such as when species accumulation curves are needed despite intensive sampling. In areas with significant invasive species, it may not be a useful metric.

TABLE A4C-2 PROVIDES MORE SPECIFIC METHODS TO EVALUATE SPECIES RICHNESS, ABUNDANCE AND/OR DIVERSITY BASED UPON PROJECT ACTIVITIES. NOTE THAT THIS IS A NON-EXHAUSTIVE LIST, AND PRACTITIONERS ARE ENCOURAGED TO FIND CONTEXT-SPECIFIC METHODS, DEPENDENT UPON PROJECT SCALE, GEOGRAPHY/ECOSYSTEM TYPE AND FOCAL SPECIES OF INTEREST.

Example project activities	Example assessment methods of species richness and abundance
Habitat and intervention types: Aquatic, riparian and wetland restoration or conservation	
In-Stream Barrier Removal	**Fish** Distribution And Abundance Of Stream Fishes In Relation To Barriers: Implications For Monitoring Stream Recovery After Barrier Removal (Gardner et al., 2013) Short-Term Effects of Low-Head Barrier Removals on Fish Communities and Habitats (Bubb et al, 2021)
Beaver Dam Analogs	**Fish** Nature-based fish habitat enrichment of non-damming beaver structures positively affects fish species richness and density (Pander et al., 2025)
Side Channel Reconnection	**Macroinvertebrates** Responses of Aquatic Macroinvertebrates to Stream Channel Reconstruction in a Degraded Rangeland Creek in the Sierra Nevada (Herbst and Kane, 2009)
Floodplain Reconnection	**Fish** Succession of fish diversity after reconnecting a large floodplain to the upper Danube River (Pander et al., 2015)
Riparian Habitat Improvements	**Vegetation** Riparian vegetation composition and diversity shows resilience following cessation of livestock grazing in northeastern Oregon, USA (Kauffman et al., 2022) Effects of Ecological Restoration on Degraded Riparian Plant Communities (Jiang and Qin, 2024)
Wetland Creation or Conservation Activities	**Amphibians** A Place to Call Home: Amphibian Use of Created and Restored Wetlands (Brown et al., 2012)
Peat Bog Restoration or Conservation Activities	**Insects** The effect of peatland drainage and restoration on Odonata species richness and abundance (Elo et al., 2015)
Habitat and intervention type: Land restoration and conservation	
Meadow Restoration or Conservation Activities	**Pollinators** Monitoring insect pollinators and flower visitation: The effectiveness and feasibility of different survey methods (O'Connor et al., 2019) The Restoration of Plant–Pollinator Interactions in Hay Meadows (Forup and Memmott, 2005)
Grassland Restoration or Conservation Activities	**Vegetation** Effects of Restoration on Plant Species Richness and Composition in Scandinavian Semi-Natural Grasslands (Lindborg and Eriksson, 2004)
Reforestation or Forest Conservation Activities	**Birds** Bird community shifts related to different forest restoration efforts: A case study from a managed habitat matrix in Mexico (MacGregor-Fors et al., 2010) Using birds as bioindicators of forest restoration progress: A preliminary study (Chowfin and Leslie, 2021)

Habitat and intervention type: Green infrastructure	
Rain Gardens, Bioretention Basins and Bioswales	**Insects** Streetscale bioretention basins in Melbourne and their effect on local biodiversity (Kazemi et al., 2009)
Stormwater Detention/ Retention Ponds	**Macroinvertebrates** The contribution of motorway stormwater retention ponds to the biodiversity of aquatic macroinvertebrates (Le Viol et al., 2009)
Constructed Wetland Treatment Systems	**General Biodiversity:** Effects of wetland construction on nitrogen transport and species richness in the agricultural landscape—Experiences from Sweden (Strand and Wesiner, 2013) Biodiversity of constructed wetlands for wastewater treatment (Hsu et al., 2013)

Following the collection of species richness and species abundance data, species diversity may also be evaluated, such as by using diversity indices. The two most common diversity indices are Shannon's diversity index and Simpson's diversity index. Practitioners can decide which diversity index or other evaluation method is the most appropriate for a project.

Table A4c-1 References

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The CEO Water Mandate's six core elements:

DIRECT OPERATIONS
Mandate endorsers measure and reduce their water use and wastewater discharge and develop strategies for eliminating their impacts on communities and ecosystems.

SUPPLY CHAIN AND WATERSHED MANAGEMENT
Mandate endorsers seek avenues through which to encourage improved water management among their suppliers and public water managers alike.

COLLECTIVE ACTION
Mandate endorsers look to participate in collective efforts with civil society, intergovernmental organizations, affected communities, and other businesses to advance water sustainability.

PUBLIC POLICY
Mandate endorsers seek ways to facilitate the development and implementation of sustainable, equitable, and coherent water policy and regulatory frameworks.

COMMUNITY ENGAGEMENT
Mandate endorsers seek ways to improve community water efficiency, protect watersheds, and increase access to water services as a way of promoting sustainable water management and reducing risks.

TRANSPARENCY
Mandate endorsers are committed to transparency and disclosure in order to hold themselves accountable and meet the expectations of their stakeholders.