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Federal Department of the Environment,
Transport, Energy and Communications DETEC

Federal Office for the Environment FOEN
Water Division

15.03.2024

Evaluating the outcome of restoration projects

Collaborative learning for the future

Table of content

Factsheets

Technical sheets

Further information

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Factsheet 0
Summary and content

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WA21: Rolf Gall, Stefan Vollenweider

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PDF download:
www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, Italian and German.

This factsheet summarises the purpose and procedure of the nationally standardised outcome evaluation for restoration projects. It also explains the structure and content of the practice documentation.

0.1 Summary

What is an outcome evaluation? An outcome evaluation is used to investigate whether a restoration project which has been implemented shows the desired effects, i.e. whether the defined objectives have been met and the resources have been effectively deployed.

What does the practice documentation offer? From 2020, a standard framework is specified for the outcome evaluation of river restoration projects throughout Switzerland, comprising two elements – the STANDARD and the EXTENDED outcome evaluation. This practice documentation explains the procedure in detail and provides 10 indicator sets for field surveys. For lakeshore restoration projects, a standardised procedure is planned for the future.

Why is a nationally standardised outcome evaluation needed? In the future, thanks to standardised surveys, it will be possible to compare experiences from different projects and contexts. Moving from project-specific individual observations to a cross-project overview permits an improved, more generalised understanding of the processes involved and of the factors inhibiting or promoting the effectiveness of restoration projects. Findings from the outcome evaluation are to be translated into specific recommendations for action. As a result, future restoration projects should be even more cost-effective and make a substantial contribution to the preservation and promotion of indigenous biodiversity.

What is the procedure for the STANDARD outcome evaluation? The STANDARD outcome evaluation is designed to assess typical goals of restoration measures on the basis of a large number of projects. The canton determines which projects from the forthcoming Programme Agreement (PA) are to be included in the outcome evaluation. For these projects – possibly in collaboration with the consultancies responsible for outcome evaluation and the FOEN – it selects the most appropriate indicator sets. Various indicator sets are available, depending on the size of the project. The consultancies responsible conduct the outcome evaluations in accordance with the practice documentation – once before and once or twice after the implementation of measures, depending on the project size.

What is the procedure for the EXTENDED outcome evaluation? In parallel with the STANDARD outcome evaluation, further projects are selected by the canton, in collaboration with the FOEN, for the EXTENDED outcome evaluation. This is designed to answer specific practice-related questions on the basis of a smaller number of projects. Between 2020 and 2024, six indicator sets from the STANDARD outcome evaluation are to be determined for a sufficiently large sample of small watercourses restored 4–12 years earlier. In comparison with channelised control reaches, it can be determined to what extent the observed effects depend on factors such as restored length, shading, or the availability of refugia (for recolonisation).

How is financing arranged? For each PA period, an outcome evaluation budget is calculated through negotiations between the federal and cantonal authorities. This consists of a STANDARD and an EXTENDED budget. The STANDARD budget is determined using a fixed calculation formula on the basis of federal contributions under the current and the forthcoming PA, with a federal subsidy rate of 60%. The EXTENDED budget is negotiated with each canton prior to the new PA period. Compared to the STANDARD budget, it relies more on cantons' readiness to participate; in return, federal subsidy rates are higher (80%).

What happens to the data collected? Data from the STANDARD and EXTENDED outcome evaluations is submitted to the FOEN by the individual restoration project managers, using standardised entry forms. Centralised data storage is currently under development. Cross-project data analysis is performed centrally. In addition to data from the outcome evaluation, information on project characteristics from the implementation evaluation is taken into consideration, as well as other explanatory variables from existing geodata (e.g. agricultural land use or number of barriers in the catchment). The results are widely disseminated, and recommendations for action are formulated for future projects. The findings from the STANDARD and EXTENDED outcome evaluations facilitate learning from experience and continuous optimisation of project planning and implementation, thus ensuring effective deployment of resources. The collaborative learning process provides good examples, motivation and arguments supporting the case for restoration.

0.2 Structure and content of the practice documentation

The practice documentation sets out the procedure for the STANDARD and EXTENDED outcome evaluations. This documentation is conceived as a collection – i.e. the various factsheets and indicator set technical sheets form independent units (Table 0.1). This structure means that factsheets and technical sheets can be individually updated in the course of the learning process on the basis of experience and methodological refinements. The factsheets are designed to be comprehensible as far as possible in an interdisciplinary context. The technical sheets contain disciplinary explanations so as to ensure the reproducibility of surveys conducted by specialised consultancies.

Table 0.1: Structure and main content of the practice documentation and target readership for individual parts. Ct = canton, Cs = consultancy for outcome evaluation.

Where	What (title, main content)	Who
FS 0	**Summary:** Purpose and procedure of the nationally standardised outcome evaluation, and an overview of the structure and content of the practice documentation.	Ct/Cs
FS 1	**Restoration outcome evaluation – the key points in brief:** Goals of standardisation of outcome evaluation across Switzerland. Profile of STANDARD/EXTENDED outcome evaluations.	Ct/Cs
FS 2	**STANDARD outcome evaluation – procedure and organisation:** 10 indicator sets for assessment of goals. From project selection to field survey in five steps.	Ct/Cs
FS 3	**EXTENDED outcome evaluation 2020-2024:** Focus on small watercourses. Determination of six indicator sets from the STANDARD outcome evaluation. Five-step procedure.	Ct/Cs
FS 4	**Learning for future projects:** Collaborative learning opportunities. From centralised data analysis to development of recommendations for action in three steps.	Ct/Cs
FS 5	**Data management:** Principles for the capture, quality control, submission and storage of data collected in the course of outcome evaluation.	Ct
FS 6	**Financing:** Calculation of the outcome evaluation budget with two components (STANDARD and EXTENDED). Financing rates.	Ct
FS 7	**Development of the framework:** Background information on the development of the framework in the research project at Eawag.	Ct/Cs
FS 8	**From framework to field survey:** General information on field surveys and explanation of the structure of the indicator set technical sheets.	Ct/Cs
Set 1	**Habitat diversity:** Six indicators used to describe habitat structure and diversity. Prescribed for all projects undertaking an outcome evaluation.	Cs
Set 2	**Dynamics:** Three indicators used to characterise temporal changes in river bank and bed structures. Optional for large projects and individual projects.	Cs
Set 3	**Connectivity:** Two indicators used to describe connectivity between river and surrounding area. Optional for large projects and individual projects.	Cs
Set 4	**Temperature:** An indicator used to describe the spatiotemporal variability of water temperature. Optional for medium-sized or larger projects.	Cs
Set 5	**Macrophytes:** An indicator used to describe the species composition, cover and diversity of aquatic plants. Optional for all project sizes.	Cs
Set 6	**Macroinvertebrates:** An indicator used to describe the composition and diversity of the macroinvertebrate community. Optional for all project sizes.	Cs
Set 7	**Fish:** Three indicators used to describe the composition of the fish community. Optional for all project sizes.	Cs
Set 8	**Riparian vegetation:** Three indicators used to assess the composition and dynamics of riparian vegetation. Optional for all project sizes.	Cs
Set 9	**Avifauna:** An indicator used to assess the number and abundance of selected bird species (target species). Optional for large projects and individual projects.	Cs
Set 10	**Society:** An indicator used to assess acceptance of the project by the stakeholders involved in the planning. Optional for all project sizes.	Cs
	Glossary: Definitions of a selection of key terms.	Ct/Cs
	References: List of all sources cited in the practice documentation. References are not provided for individual factsheets or technical sheets.	Ct/Cs

List of modifications

Relevant changes are marked in green.

Date (mm/yy)	Version	Change	Responsibility
4/2020	1.02	Correction of spelling errors, minor terminological modifications	Eawag

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Factsheet 1
Restoration outcome evaluation – the key points in brief

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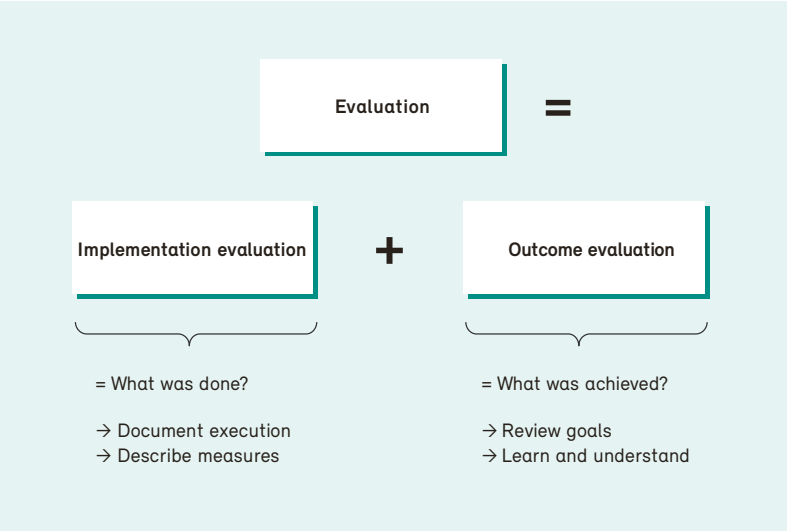
PDF download:
www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, Italian and German.

This factsheet explains the goals pursued by the FOEN through the standardisation of restoration outcome evaluation. It also provides a brief profile of the STANDARD and EXTENDED outcome evaluations, which are described in more detail in Factsheets 2 and 3.

1.1 Background

Under the revised Swiss waters protection legislation, watercourses and lakeshores are to be restored (Article 38a WPA). By 2090, around a quarter of the 16,000 km of degraded watercourses and lakeshores are to be restored. Each year, the federal government invests CHF 40 m in restoration measures. The financing is provided under four-year Programme Agreements (PAs) – the five-year period 2020–2024 being an exception – and via individual projects (BAFU 2018). The federal government covers 35–80% of the costs per project, depending on the quality indicators taken into account (e.g. increased space provided for waters). The remaining financing is provided by cantons, communes and third parties such as foundations, funds or environmental associations. By 2090, total expenditure will amount to approx. CHF 5 bn. These resources need to be deployed as effectively as possible. This can be verified by means of an evaluation.
An evaluation comprises two elements – the implementation evaluation and the outcome evaluation (BAFU 2012; Fig. 1.1). An implementation evaluation is used to review the number and type of projects initiated; it also provides information on the measures implemented (BAFU 2012). In contrast, an outcome evaluation is used to investigate whether a restoration project which has been implemented shows the desired effects, i.e. whether the defined objectives have been met and the resources have been effectively deployed (BAFU 2012).

Figure 1.1: The two components of an evaluation



1.2 Standardisation of implementation and outcome evaluation

Since 2017, the FOEN has requested the cantons to provide implementation evaluation data in a standard form: as well as general project data (e.g. name of waterbody, reach end coordinates), other characteristics of the measures implemented are recorded (e.g. types of measures implemented). With the third PA period starting in 2020, outcome evaluation for watercourse restoration measures has also been standardised across Switzerland. The goals pursued by the FOEN through the cross-project standardisation of implementation and outcome evaluation are threefold:

- **Reviewing implementation and outcomes:** implementation and outcome evaluations are carried out in order to demonstrate that the legal mandate is being fulfilled and the desired effects are being achieved. Nationally comparable implementation and outcome evaluation data from restoration projects is required in order to provide policymakers and the public with a convincing and detailed account of how resources have been invested and what changes and goals have been achieved with these investments.
- **Learning from experience:** The results of implementation and outcome evaluations facilitate learning from experience and continuous optimisation of project planning and implementation, thus ensuring effective deployment of resources. The collaborative learning process provides good

examples, motivation and arguments supporting the case for restoration. Moving from project-specific individual observations to a cross-project overview permits an improved, more generalised understanding of the processes involved and of the factors inhibiting or promoting the effectiveness of restoration projects.

- **Ensuring coordination:** Restoration implementation and outcome evaluations are coordinated to the greatest possible extent with related monitoring programmes, and with other implementation and outcome evaluations, so that synergies can be utilised and duplication avoided. This coordination encompasses the compatibility of methods or data formats, as well as synergies in data exchange and archiving.

1.3 STANDARD and EXTENDED outcome evaluation

From 2020, the restoration outcome evaluation comprises two elements – the STANDARD and EXTENDED outcome evaluations (Table 1.1). These are described in detail in Factsheets 2 and 3. The two elements complement each other: with the STANDARD outcome evaluation, developments are followed over a relatively long period through before-after comparisons. Here, as far as possible, the entire spectrum of restoration measures, types of watercourse and regions are covered. In contrast, with the EXTENDED outcome evaluation, specific questions, with particular project requirements, can be addressed in a timely manner. The FOEN is responsible for combining the results from STANDARD and EXTENDED and developing recommendations for action.

To sum up: with the **STANDARD outcome evaluation**, typical goals of restoration measures, derived from the legislation, are assessed on the basis of a large number of projects. For this purpose, the cantons select restoration projects implemented under the Programme Agreement or as individual projects. These are either restoration-only projects or flood protection projects with additional financing under the WPA (combined projects). The STANDARD outcome evaluation uses predefined indicator sets. These are determined once before and once or twice after implementation, depending on the project size. The PA period 2020–2024 is the first in which the STANDARD outcome evaluation is to be carried out. This period thus also represents a test phase in which experience is to be learned from and unresolved questions are to be addressed. From 2025, STANDARD is to shift to a 12-year cycle, similar to, but not coinciding with, the strategic planning for watercourse restoration.

The **EXTENDED outcome evaluation** is designed to answer specific questions relating to restoration practice. In the PA period 2020–2024, the focus is on the medium-term development of restoration projects in small watercourses, with six indicator sets from the STANDARD outcome evaluation being tested. The EXTENDED outcome evaluation will involve suitable small watercourse restoration projects dating back 4–12 years.

The framework for the STANDARD and EXTENDED outcome evaluation was developed at Eawag, on behalf of the FOEN, in close consultation with three advisory groups (internal, national, international) and through discussion at several Water Agenda 21 events (see Factsheet 7).

Table 1.1: Summary of the STANDARD and EXTENDED outcome evaluations

	STANDARD outcome evaluation	**EXTENDED outcome evaluation**
Why?	Assessment of typical restoration goals	Answering specific practice-related questions 2020–2024: medium-term development of small watercourse restoration projects; testing of indicators from STANDARD
Where?	As many PA restoration projects as possible, plus individual projects	PA restoration projects or individual projects 2020–2024: suitable small watercourse restoration projects dating back 4–12 years
What?	10 predefined indicator sets	Indicators selected according to questions studied 2020–2024: using six indicator sets from STANDARD
How?	Before-after survey	After survey, plus control reaches
How much?	60% financed by FOEN	80% financed by FOEN
How long?	2020–2024: test phase 2025 ff.: 12 years (1 cycle of strategic planning)	4-8 years (1-2 PA phases)

List of modifications

Relevant changes are marked in green.

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4/2020	1.02	Correction of spelling errors, minor terminological modifications	Eawag

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Fiche 2
Contrôle des effets STANDARD – Déroulement et organisation

Impressum

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Téléchargement au format PDF :
https://www.bafu.admin.ch/controle-des-effets-revit
(il n'est pas possible de commander une version imprimée)
Cette publication est également disponible en allemand.

Cette fiche présente le contrôle des effets STANDARD, qui se déroule en cinq étapes depuis la sélection du projet jusqu'au relevé de terrain. L'exploitation des données relevées est décrite dans la fiche 4.

2.1 Indicateurs

Le contrôle des effets STANDARD vérifie l'atteinte d'objectifs fréquents des revitalisations, en comparant les relevés avant et après une revitalisation d'un grand nombre de projets. Dans la mesure du possible, il couvre le spectre complet des mesures de revitalisation, des types de cours d'eau et des régions. Les 9 objectifs de revitalisation pris en considération sont vérifiés sur la base de 22 indicateurs prédéfinis, regroupés dans 10 jeux d'indicateurs (fig. 2.1 ; fiche 7). Chaque jeu d'indicateurs est décrit dans une fiche technique qui présente la méthode à employer pour garantir l'uniformité des relevés et des évaluations et qui fournit une estimation des coûts (fiches techniques 1 à 10). Le site web de l'Office fédéral de l'environnement (OFEV) met à disposition des formulaires prédéfinis pour la saisie et la transmission des données relevées (https://www.bafu.admin.ch/controle-des-effets-revit ; fiche 5). Les jeux d'indicateurs sont choisis en fonction des objectifs et de la taille du projet considéré (voir ci-dessous) et sont relevés intégralement sur le terrain. En concertation avec l'OFEV, il est possible de relever des indicateurs supplémentaires (regroupés dans le jeu d'indicateurs 11) pour vérifier d'autres objectifs spécifiques du projet.

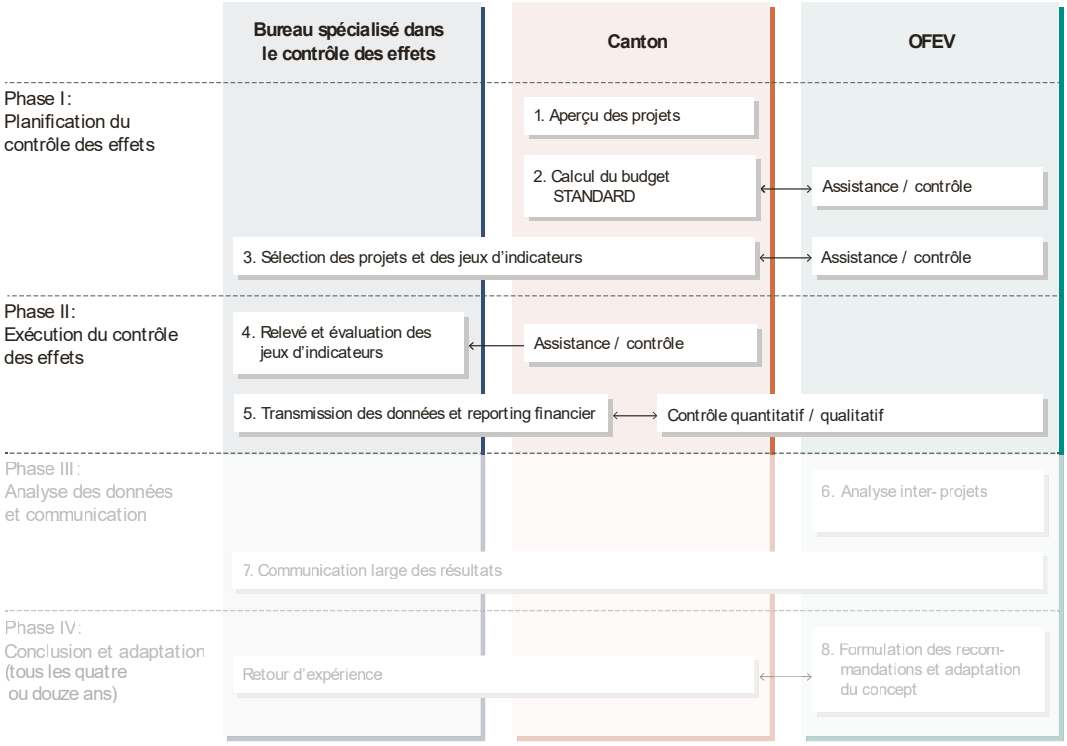
Figure 2.1 : Liste des objectifs fréquents des revitalisations à vérifier lors d'un contrôle des effets STANDARD, avec les indicateurs et les jeux d'indicateurs s'y rapportant. Les indicateurs proviennent de plusieurs sources (Woolsey et al. 2005, système modulaire gradué, etc.) et ont été partiellement actualisés pour cette documentation pratique (fiche 7). *Typique = typique au cours d'eau concerné

Objectifs	Jeux d'indicateurs	Indicateurs
Morphologie • Fond du lit : structure et diversité typiques* • Berges et rives : structure et diversité typiques* • Dynamique sédimentaire typique*	**1 Diversité des habitats**	1.1 Structure du fond du lit 1.2 Structure des rives 1.3 Profondeur d'eau 1.4 Vitesse d'écoulement 1.5 Offre en abris 1.6 Substrat
Hydrologie et hydraulique • Diversité hydraulique typique* • Connectivité latérale typique*	**2 Dynamique**	2.1 Dynamique de la structure du fond du lit 2.2 Dynamique de la structure des rives 2.3 Modification du niveau du fond du lit
	3 Connectivité	3.1 Dynamique d'inondation 3.2 Ligne de rive
Température Profil de température typique*	**4 Température**	4.1 Température
Communauté macrophytique Diversité et abondance typiques*	**5 Macrophytes**	5.1 Composition des macrophytes
Communauté macrozoobenthique Diversité et abondance typiques*	**6 Macroinvertébrés**	6.1 Composition du macrozoobenthos
Communauté piscicole Diversité et abondance typiques*	**7 Poissons**	7.1 Composition de la faune piscicole 7.2 Structure d'âges de la faune piscicole 7.3 Guildes écologiques de la faune piscicole
Végétation riveraine / alluviale Diversité et abondance typiques*	**8 Végétation riv. / all.**	8.1 Espèces végétales spécifiques 8.2 Composition des associations végétales 8.3 Évolution des communautés alluviales
Faune riveraine Diversité et abondance typiques*	**9 Avifaune**	9.1 Composition de l'avifaune
Société et économie Acceptation	**10 Socio-économie**	10.1 Acceptation du projet par les groupes d'intérêts
Objectif spécifique supplémentaire (p. ex. libellules, écrevisses, frayères, arthropodes)	**11 Objectif spécifique**	11.1 En concertation avec l'OFEV

2.2 Déroulement et organisation

Le contrôle des effets STANDARD se déroule en deux phases et cinq étapes, qui sont synchrones avec les négociations relatives à la convention-programme (CP) (fig. 2.2). Plusieurs services sont compétents : les cantons et les bureaux spécialisés mandatés pour le contrôle des effets se chargent de planifier et d'exécuter les contrôles propres à chaque projet sélectionné (phases I et II, regroupant les étapes 1 à 5) ; l'OFEV est le principal responsable de l'analyse inter-projets, de la communication des données et des adaptations à apporter au concept général (fiche 4). Les cinq étapes sont décrites en détail dans les paragraphes suivants et dans d'autres fiches. Les informations de base et le cadre conceptuel sont présentés dans la fiche 7.

Figure 2.2 : Les cinq étapes du contrôle des effets STANDARD. Les étapes ultérieures (6 à 8) sont expliquées dans la fiche 4.



Phase I : planification du contrôle des effets STANDARD

Étape 1 : vue d'ensemble des projets

Les cantons dressent la liste des projets de revitalisation de la prochaine période de programme pour lesquels un contrôle des effets est prévu. À partir de 2025, les cantons devront ajouter à cette liste les projets déjà réalisés pour lesquels il existe un relevé avant revitalisation effectué lors d'une précédente période de programme et pour lesquels un relevé après revitalisation sera effectué lors de la prochaine période.

Pour établir la vue d'ensemble des projets, il est possible d'utiliser un outil cantonal ou le tableau d'aide au calcul (liste des projets) qui a été créé pour l'établissement de la prochaine CP. Si le canton utilise une liste de projets existante, il doit la réexaminer avec soin afin de vérifier par exemple la probabilité de réalisation des différents projets mentionnés. La vue d'ensemble doit fournir des indications sur les coûts de construction attendus, afin que les projets puissent être classés dans les différentes catégories de taille décrites à l'étape 3 (petit, moyen, grand, projet individuel).

Étape 2 : calcul du budget STANDARD

Le budget dédié au contrôle des effets STANDARD est calculé avec l'aide de l'OFEV et arrêté conjointement lors de la négociation relative à la CP. Il finance d'une part les relevés avant

revitalisation de projets de la CP programmés pour la période de programme à venir et, d'autre part, les relevés après revitalisation de projets de la CP mais également des projets individuels réalisés lors de périodes passées. Le modèle de financement est détaillé dans la fiche 6.

Étape 3 : sélection des projets et des jeux d'indicateurs

Le canton définit de quelle manière il utilise le budget alloué au contrôle des effets STANDARD ; il choisit donc les projets dont il veut suivre les effets et détermine le contenu de chaque contrôle. Pour choisir les projets à contrôler, il tient compte des critères de sélection présentés ci-dessous (fig. 2.3). Les projets dont la probabilité de réalisation est élevée ou qui revêtent une grande importance au niveau cantonal sont particulièrement adaptés pour un contrôle des effets STANDARD, de même que les projets pour lesquels il existe déjà des données en lien avec certains jeux d'indicateurs (p. ex. données sur la population piscicole). La sélection des projets ne doit pas prendre en compte les effets attendus, ni la facilité d'accès pour les opérations de terrain. Un contrôle des effets est obligatoire pour tous les projets individuels.

En concertation avec les bureaux spécialisés mandatés pour le contrôle des effets, le canton se charge de définir le contenu du contrôle spécifique à chaque projet sélectionné. Il se réfère pour cela à la taille du projet considéré, c'est-à-dire à son coût (fig. 2.4). On distingue quatre tailles de projet : petit projet (moins de 250 000 francs), moyen projet (de 250 000 à 1 million de francs), grand projet (de 1 à 5 millions de francs) et projet individuel (cf. manuel sur les conventions-programmes dans le domaine de l'environnement). Les jeux d'indicateurs sélectionnables sont plus ou moins nombreux selon la taille du projet considéré (fig. 2.4). Le jeu d'indicateurs 1 « Diversité des habitats » est imposé : son relevé est obligatoire pour tous les contrôles des effets. Il doit être complété par d'autres jeux d'indicateurs au choix, dont le nombre augmente avec la taille du projet. Certains d'entre eux sont recommandés par l'OFEV. Dans tous les cas, les jeux d'indicateurs choisis doivent être en adéquation avec les objectifs du projet considéré ; choisir un jeu d'indicateurs sans signification pour le projet serait dénué d'intérêt. Il est à noter par ailleurs que le relevé de quelques jeux d'indicateurs est limité aux cours d'eau peu profonds. Si un projet poursuit des objectifs spécifiques qui ne sont pas pris en compte par les jeux d'indicateurs prédéfinis, il est possible – d'entente avec l'OFEV – de relever des indicateurs supplémentaires (p. ex. libellules, amphibiens, etc.) et de les regrouper dans le jeu d'indicateurs 11.

Le contenu minimal du contrôle des effets STANDARD est le même pour toutes les tailles de projet : il comprend le jeu d'indicateurs 1 « Diversité des habitats » et l'un des jeux d'indicateurs biologiques 5 à 9 au choix (le jeu d'indicateurs 11 n'est pas inclus dans le contrôle minimal). Le contenu maximal est plafonné et augmente avec la taille du projet (trois jeux d'indicateurs pour les petits projets et six pour les projets individuels). Le jeu d'indicateurs 10 « Socio-économie » peut être relevé en sus, indépendamment du nombre maximal de jeux d'indicateurs. Tel est également le cas pour le jeu d'indicateurs 11 « Objectif spécifique », utilisé en accord avec l'OFEV. Le tableau 2.1 donne une estimation grossière des coûts pour le relevé de chaque jeu d'indicateurs.

Figure 2.3 : Critères pour la sélection des projets éligibles à un contrôle des effets STANDARD, répartis par taille de projet.

Figure 2.4 : Jeux d'indicateurs imposés, sélectionnables et recommandés, par taille de projet (petit, moyen, grand, projet individuel). Le contenu maximal du contrôle des effets dépend de la taille du projet considéré. Le contenu minimal comprend le jeu d'indicateurs 1 et l'un des jeux d'indicateurs biologiques 5 à 9.

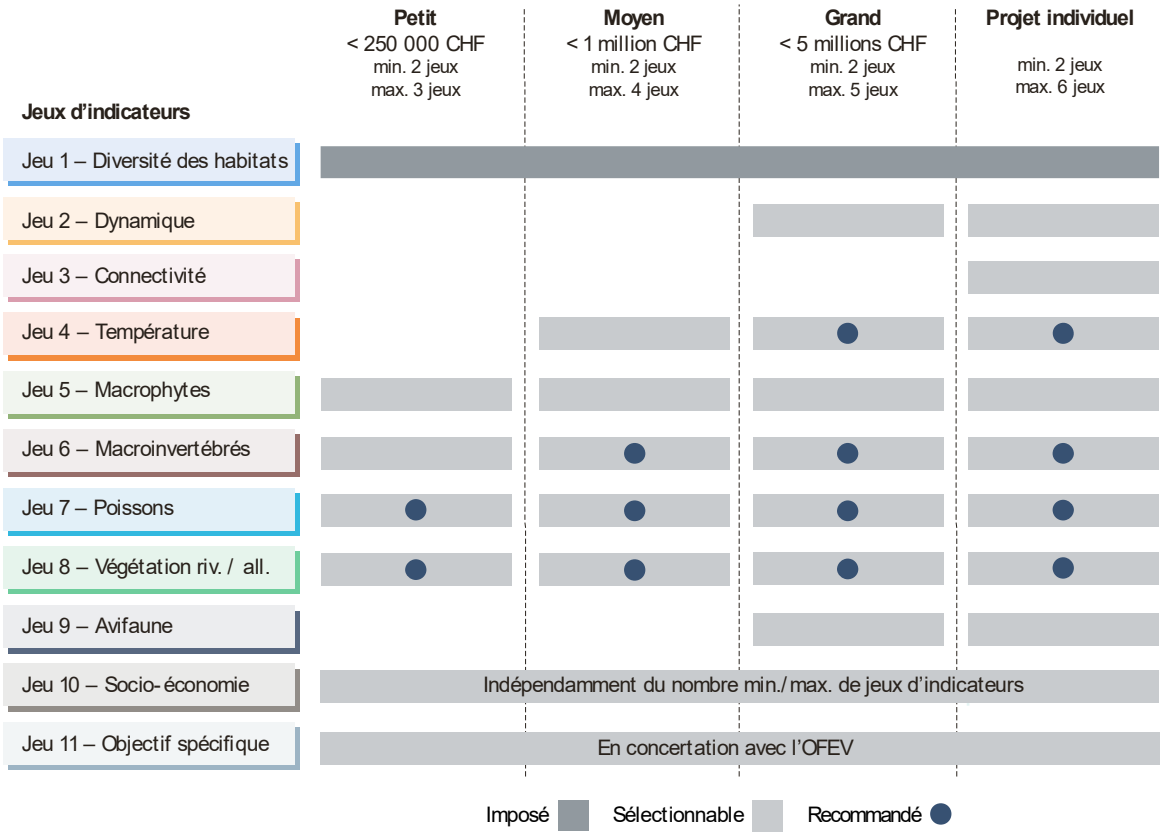


Tableau 2.1 : Estimation grossière des coûts pour le relevé de chaque jeu d'indicateurs (p. ex. pour un relevé avant ou un relevé après revitalisation). Les heures de travail sont ventilées de façon plus détaillée dans les fiches techniques. Les charges générales, par exemple pour le trajet jusqu'au lieu du relevé, ne sont pas comprises. Les calculs sont basés sur des tarifs horaires allant de 80 à 160 francs.

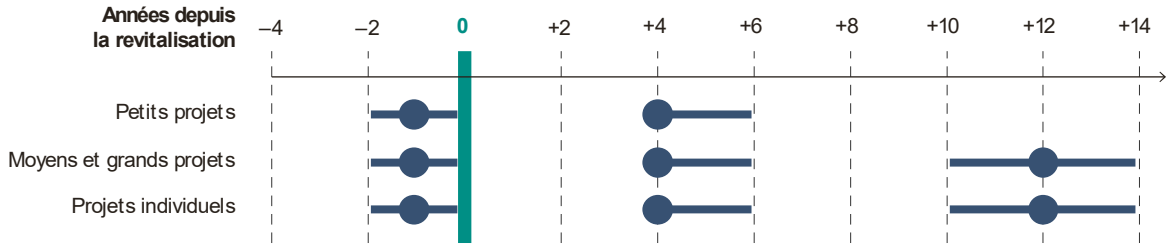
Jeu d'indicateurs	Charge de travail en heures-personne (selon fiches techniques)		Plage de coûts (en francs)	Remarques
	Spécialistes	Assistants		
1. Diversité des habitats	16-30	18-44	4000-9200	
2. Dynamique	12	18-20	6200-9500	y compris mensuration géodésique des profils en travers
3. Connectivité	32	32	7700-8300	
4. Température	14	8-32	2900-5400	hors achat des enregistreurs
5. Macrophytes	3	0-3	500-800	
6. Macroinvertébrés	20-40	1,5	2700-5700	y compris contrôle qualité détermination à l'espèce
7. Poissons	20-64	12-88	4200-19 000	
8. Végétation riv./all.	8-28	-	1300-4500	contrôle min. : indicateur 8.1 uniquement ; contrôle max. : indicateurs 8.1 + 8.2
9. Avifaune	13-18	-	2100-2900	
10. Socio-économie	11-14	-	1800-2200	

Phase II : exécution du contrôle des effets STANDARD

Étape 4 : relevé et évaluation des jeux d'indicateurs

Dans le cadre du contrôle des effets STANDARD, les indicateurs sont relevés avant et après la revitalisation. Font exception les tronçons de cours d'eau enterrés, qui ne peuvent pas être étudiés avant leur revitalisation (fiche 8). Le nombre de relevés dépend de la taille du projet (fig. 2.5). Un relevé avant revitalisation (0 à 2 ans avant le début des travaux de construction) et un relevé après revitalisation (4 à 6 ans après l'achèvement des travaux) sont prévus pour les petits projets. Un relevé avant revitalisation (0 à 2 ans avant le début des travaux) et deux relevés après revitalisation (4 à 6 ans et 10 à 14 ans après l'achèvement des travaux) sont prévus pour les moyens et grands projets. Fait exception le jeu d'indicateurs 10 « Socio-économie », dont le premier relevé après revitalisation doit avoir lieu seulement un an après l'achèvement des travaux. Le délai d'exécution des relevés de terrain peut être adapté en fonction de la situation, par exemple si l'absence d'une crue moyenne a empêché que des modifications morphologiques se produisent.
Le jeu d'indicateurs 1, obligatoire pour tous les projets, sert de base aux autres jeux d'indicateurs. À ce titre, il doit être relevé en premier. Tous les jeux d'indicateurs sont liés à des facteurs saisonniers spécifiques qui déterminent le moment de l'année où ils doivent être relevés (fiche 8).
Certains relevés couvrent l'intégralité du tronçon de revitalisation, comme par exemple certains indicateurs du jeu 1 (cartographie des structures du fond du lit et de la rive). D'autres se limitent à une partie du tronçon de revitalisation (fiche 8), en particulier les jeux d'indicateurs biologiques (en raison de leur complexité). Afin que les relevés puissent être comparés entre eux, le lieu choisi (totalité ou partie du tronçon de revitalisation) doit être exactement le même pour le relevé avant revitalisation et pour le(s) relevé(s) après revitalisation. Le prélèvement d'échantillons sur des sections de contrôle (canalisées) ou sur des sections de référence (proches de l'état naturel) n'est pas prévu dans le cadre d'un contrôle des effets STANDARD (fiche 7) ; il est toutefois envisageable avec l'accord de l'OFEV.

Figure 2.5 : Calendrier des relevés avant et après revitalisation.



Étape 5 : transmission des données et reporting financier

Une fois les travaux terminés, toutes les données issues du contrôle des effets STANDARD (mesures et évaluations) sont transférées vers la banque de données centralisée, soit directement par les bureaux spécialisés soit par le canton. Des formulaires prédéfinis sont à disposition pour la saisie des données. Le canton se charge ensuite de vérifier la qualité des données avant de les transmettre à l'OFEV (wiko_revit@bafu.admin.ch). Un reporting financier est établi à la fin de chaque période de programme. Des informations complémentaires sont fournies dans les fiches 5 et 6.

Répertoire des modifications

Les changements pertinents depuis la dernière version sont mis en évidence en vert.

Date (mm/yy)	Version	Modification	Responsabilité
4/2020	1.02	Correction d'erreurs typographiques, petits ajustements conceptuels	Eawag
4/2020	1.02	Petits ajustements graphiques (fig. 2.5)	Eawag
4/2020	1.02	Ajustement plage des coûts du jeu d'indicateurs 8	Eawag
7/2021	1.03	Ajustement plage des coûts du jeu d'indicateurs 6 (y compris contrôle qualité détermination à l'espèce)	Eawag
3/2024	1.04	Ajustement plage des coûts du jeu d'indicateurs 6 (y compris contrôle qualité détermination à l'espèce)	Eawag

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Factsheet 3
EXTENDED outcome evaluation 2020-2024

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www.bafu.admin.ch/outcome-evaluation-resto
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This publication is also available in French, Italian and German.

This factsheet describes the main themes and the procedure for the EXTENDED outcome evaluation for the Programme Agreement period 2020–2024: the effects of restoration measures in small watercourses are to be investigated using six of the ten indicator sets from the STANDARD outcome evaluation.

3.1 Main themes and indicators

In parallel with and supplementing the STANDARD outcome evaluation, the EXTENDED outcome evaluation makes it possible to answer specific questions relating to restoration practice (Factsheet 1). Between 2020 and 2024, the EXTENDED outcome evaluation will focus on two themes which were identified by the FOEN and Eawag over a number of workshops from 2016 to 2018 involving the three advisory groups participating in the development of the framework and other stakeholders (Box 3.1; Factsheet 7) – improving understanding of the effects of restoration measures in small watercourses and the development of effects over time, considering indicators used in the STANDARD outcome evaluation. A sufficiently large sample of suitable small watercourse restoration projects already implemented is to be investigated ("after" survey). Six indicator sets from the STANDARD outcome evaluation, for which sampling can be carried out on small watercourses, will be determined: Habitat diversity (Set 1), Temperature (Set 4), Macrophytes (Set 5), Macroinvertebrates (Set 6), Fish (Set 7) and Riparian vegetation (Set 8). The results from the restored reaches will be compared with control reaches.

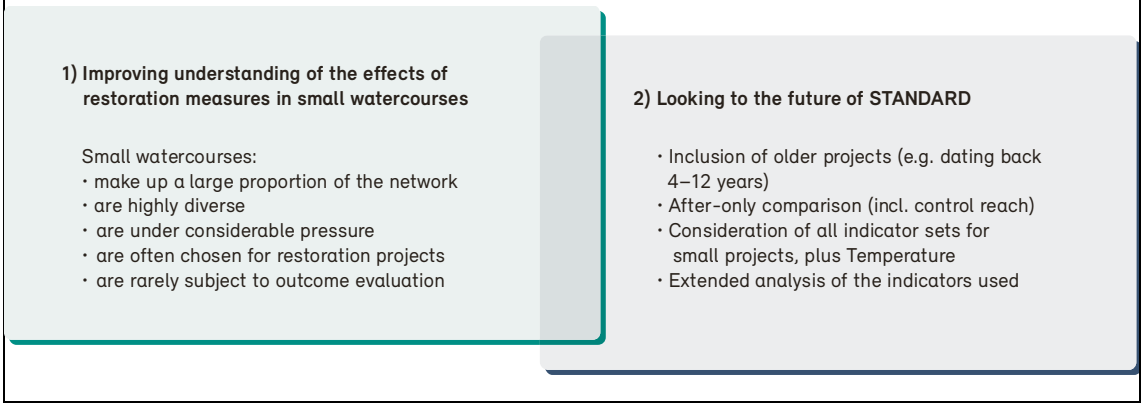
Box 3.1: The two main themes of the EXTENDED outcome evaluation 2020–2024

1. Improving understanding of the effects of restoration measures in small watercourses

Small streams make up a large proportion of Switzerland's river network and are highly diverse in terms of morphology and biology. They are under considerable pressure from human activities, and while they are often chosen for restoration projects, they are rarely subject to comprehensive outcome evaluation. The EXTENDED outcome evaluation will investigate to what extent observed effects depend on factors such as restored length, shading, fragmentation or project age.

2. Looking to the future of STANDARD

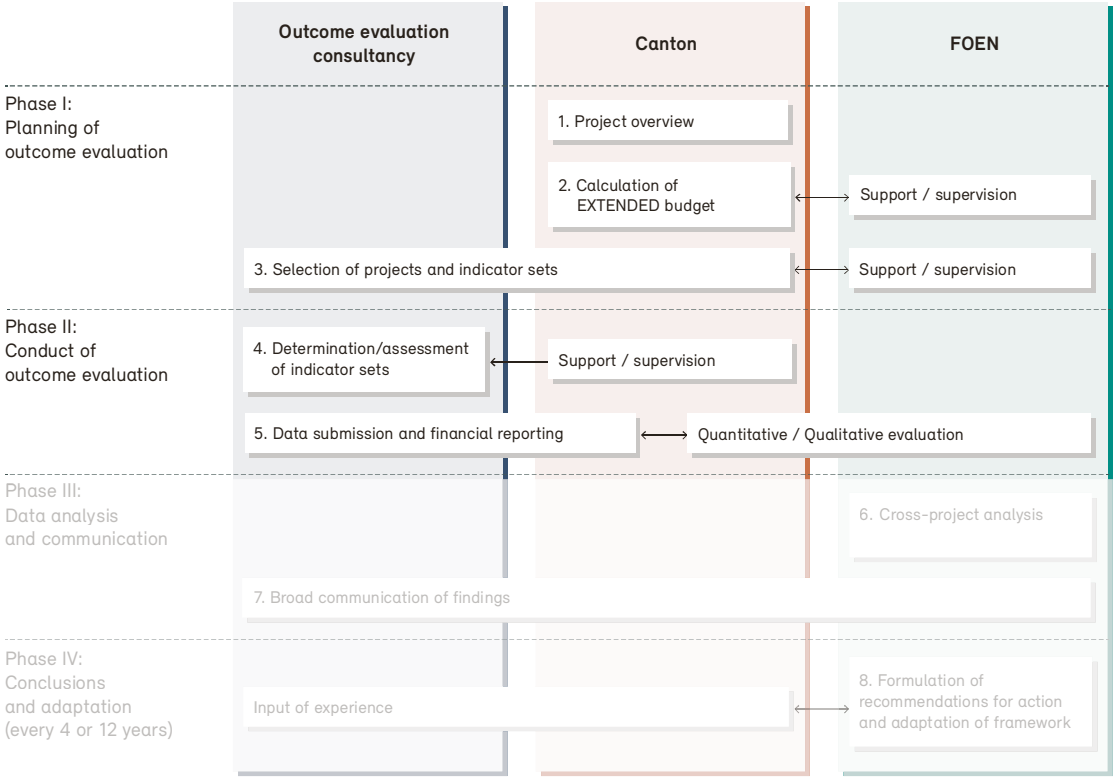
The EXTENDED outcome evaluation involving small watercourses is also to be used to learn as much as possible for the STANDARD outcome evaluation. This is to be achieved, firstly, by the use and detailed analysis of the same indicators. Secondly, the inclusion of older projects, completed some years ago, will provide a "time-lapse" view of how effects develop over time.



3.2 Procedure and organisation

Like the STANDARD outcome evaluation, the EXTENDED outcome evaluation also involves two phases and five steps (Fig. 3.1), the timing of which is linked to the Programme Agreement (PA) negotiations. Different entities are responsible: the cantons and the contracted consultancies are responsible for the planning and execution of the project-specific outcome evaluations (Phases I and II, or Steps 1–5). The FOEN has primary responsibility for cross-project data analysis and communication, and for modifications to the overall framework (Factsheet 4). The five steps are described in detail in the following sections and in other factsheets. Background information and conceptual foundations are presented in Factsheet 7.

Figure 3.1: The five steps of the EXTENDED outcome evaluation. The higher-level steps 6–8 are explained in Factsheet 4.



Phase I: Planning of the EXTENDED outcome evaluation 2020–2024

Step 1: Project overview

The FOEN sent the two main themes and the requirements for suitable projects to the cantons prior to the PA negotiations for 2020–2024, including information as to which indicators are to be determined.

Step 2: Calculation of the EXTENDED budget / Step 3: Selection of projects

During the PA negotiations, the FOEN discussed with the cantons whether there were suitable projects within the canton and for how many of the projects the canton was prepared to conduct an EXTENDED outcome evaluation. Possible project names were recorded in the minutes and corresponding funding (based on rough cost estimates) was reserved under the appropriate performance indicator.

Phase II: Conduct of the EXTENDED outcome evaluation 2020–2024

Step 4: Determination and assessment of indicator sets

The EXTENDED outcome evaluation is to be conducted on a sufficiently large sample of small watercourse restoration projects. The reaches are to have been restored 4–12 years earlier, which corresponds to the timing of the two “after” surveys from STANDARD (Factsheet 2). For each restored reach, a control reach is sought. With regard to structure and type of watercourse, this should have characteristics comparable to those of the restored reach prior to restoration, and it should ideally be situated in the same catchment as the restored reach.
In the restored and control reaches, all the indicator sets from the STANDARD outcome evaluation which are suitable for small watercourses are to be determined – i.e. Habitat diversity (Set 1), Temperature (Set 4), Macrophytes (Set 5; if present), Macroinvertebrates (Set 6), Fish (Set 7; if present) and Riparian vegetation (Set 8). Surveys are to be conducted at the appropriate times (Factsheet 8). The project-specific analysis and assessment of the indicator sets is to be carried out by the project managers in accordance with the requirements for the STANDARD outcome evaluation.

Step 5: Data submission and financial reporting

After quality control by the canton, the data is forwarded to the FOEN (wiko_revit@bafu.admin.ch). The relevant procedure is described in Factsheets 5 and 6.

3.3 EXTENDED outcome evaluation from 2025

Sufficiently in advance of the next PA period, the FOEN will discuss possible future questions with the cantons and researchers. These will be addressed on the basis of suitable projects already implemented or planned. The procedure is the same as that described above for the PA period 2020–2024.

List of modifications

Relevant changes are marked in green.

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4/2020	1.02	Correction of spelling errors, minor terminological modifications	Eawag

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Learning for future projects

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This factsheet discusses opportunities for collaborative, cross-project learning. The procedure and organisation of the learning process is presented in three steps.

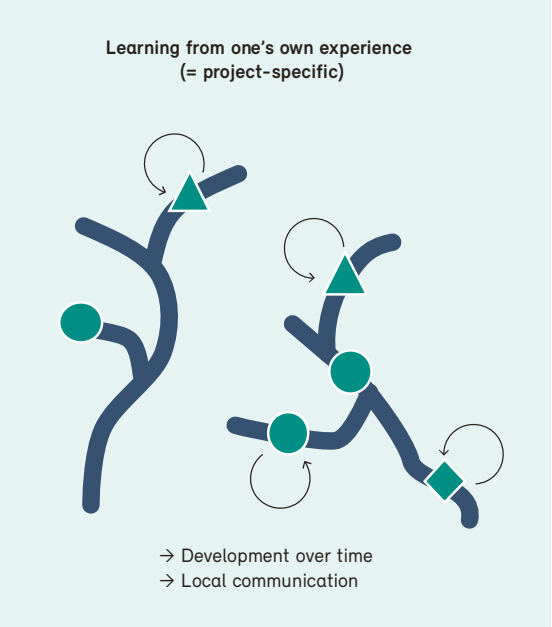
4.1 Opportunities for collaborative learning

The restoration of 4,000 km of Swiss watercourses and lakeshores by 2090 is a complex undertaking spanning several generations. At the same time, this lengthy time horizon also permits systematic learning from experience for future projects. Systematic, cross-project learning reduces uncertainties and makes it possible to continuously optimise the planning and implementation of projects and to make the most effective use of frequently limited resources (Roni & Beechie 2013).
With the standardisation of implementation and outcome evaluation, the FOEN is laying the foundations for a collaborative experience-sharing and learning process. Thanks to standardised surveys, cross-project assessment of the effects of different restoration measures will in future be possible, as project-specific experiences and findings become comparable (Box 4.1). This will result in an improved, more generalised understanding of the processes involved and of the factors inhibiting or promoting the effectiveness of restoration projects (cause-effect relationships). The comparability of experiences also provides the basis for transferring knowledge gained to future projects, e.g. in the form of recommendations for action for the strategic planning of watercourse restoration or the planning of measures.

Box 4.1: Two types of learning from implementation and outcome evaluation

1. Learning from one's own experience (project-specific)

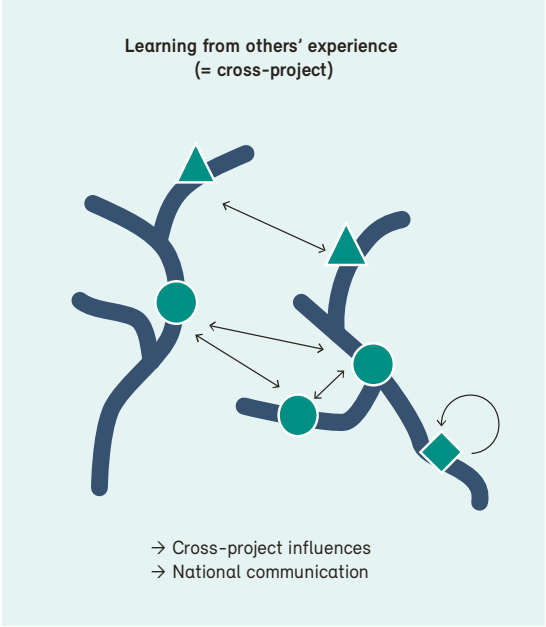
The managers of a restoration project accumulate specific experience in the course of the project and draw conclusions for future, similar projects. Development over time can be followed in detail on a project-specific basis.



A prerequisite for project-specific learning is the collection of and reflection on experiences within the project.

2. Learning from others' experience (cross-project)

The wealth of experience accumulated in other people's projects is utilised for one's own project planning and implementation. Through cross-project analysis, influences can be systematically explored, as a wide variety of contexts are covered (e.g. influence of restored length, watercourse size, fragmentation).



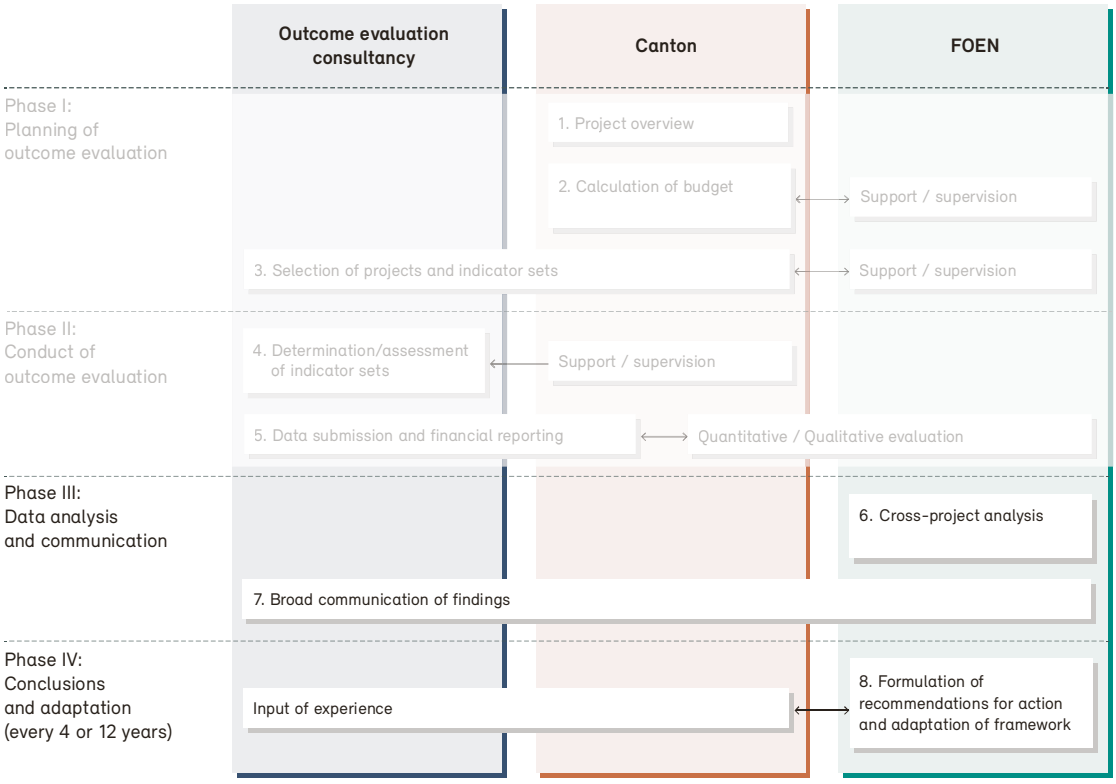
A prerequisite for cross-project learning is that data collected from numerous different projects in a standardised manner is centrally analysed, with the results being processed for direct use, e.g. in the form of recommendations for action.

4.2 Procedure and organisation of collaborative learning

A collaborative learning process is an ambitious goal. However, this does not take place automatically, but requires planning, mutual coordination and structure. The data obtained in the STANDARD and

EXTENDED outcome evaluations are further processed in two phases and three steps (Fig. 4.1); primary responsibility lies with the FOEN. The three steps are described in the following sections. Background information and conceptual foundations are presented in Factsheet 7.

Figure 4.1: The three steps for further processing of data from the STANDARD and EXTENDED outcome evaluations. These steps and phases build on Steps 1–5 of the STANDARD and EXTENDED outcome evaluations (Factsheets 2 and 3).



Phase III: Data analysis and communication

Step 6: Cross-project analysis

The FOEN is responsible for the centralised cross-project analysis of data from the STANDARD and EXTENDED outcome evaluations. As well as outcome evaluation data (indicator field surveys), project-specific information from implementation evaluation (project characteristics) is taken into consideration. In addition, for each project, other explanatory variables from existing geodata are considered, such as agricultural land use or the number of barriers in the catchment. Geodata collection is also undertaken in a centralised manner.
Centralised data analysis is commenced at an early stage, so that the initial phase of the STANDARD and EXTENDED outcome evaluation can be closely monitored and supported. Timely reporting of experience by project managers helps to optimise field surveys and the overall framework.

Step 7: Broad communication of findings

The findings of the outcome evaluation are widely communicated at regular intervals, as soon as consolidated results are available. Communication is to be targeted, using appropriate formats. The cantons are free to use their own data for communication.

Phase IV: Conclusions and adaptation (every 4 or 12 years)

Step 8: Formulation of recommendations for action and adaptation of framework

In a participatory process with stakeholder involvement, findings from the outcome evaluation are translated into recommendations for action. These are fed into the revision of the Handbook on Programme Agreements in the Environmental Sector and into decision-making aids, e.g. for the development of strategic planning for watercourse restoration.
Experience from practice is used for periodic evaluation and, if appropriate, optimisation of the STANDARD outcome evaluation and for the identification of future questions for the EXTENDED outcome evaluation.

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This factsheet explains the principles for the capture, quality control, submission and storage of data collected in the STANDARD and EXTENDED outcome evaluations. The use of data for cross-project analyses for the collaborative learning process is described in Factsheet 4.

5.1 Digital data capture

In addition to the determination of indicators in the field and assessment, digital data capture is also to be nationally standardised as far as possible. A standardised data base is essential for cross-project, centralised analysis, for the collaborative learning process and sharing of experience, and for secure long-term storage of all the data collected (data archive).

5.1.1 Data arising

For each of the ten predefined indicator sets, field protocols and data entry forms for standardised data capture are available on the FOEN website (www.bafu.admin.ch/outcome-evaluation-resto). These can be used for the STANDARD outcome evaluation. They are also to be used for the EXTENDED outcome evaluation (PA 2020–2024).

- *Field protocols:* These are available as pdf files, which can be printed out. They contain all the variables for the various indicators, as well as information on units and input ranges. The variables are assigned unique numbers. Field protocols can be completed by hand. Data recorded manually must subsequently be digitalised, i.e. input electronically into the entry form. Alternatively, data can be entered electronically directly in the field.
- *Data entry forms:* Depending on the indicator set, these comprise three or more worksheets. All the variables contained in the field protocol are to be entered, with the variable numbers permitting rapid matching of items between the field protocol and entry form. In the “DataDictionary” worksheet, all the variables are described, together with the corresponding unit, data type and value ranges; it thus serves as a reference resource. For data entry, wherever possible, drop-down lists are available, containing predefined entries and specified value ranges. As a result, data entry is facilitated, the risk of input errors (e.g. miskeying) is reduced, and data quality is improved. Missing values are indicated as NA.

In addition to the 10 predefined indicator sets, Indicator Set 11 allows project-specific characteristics to be taken into consideration, e.g. the determination of an indicator for dragonflies, amphibians or lichens. As no standardised methodological requirements exist, field protocols or data entry forms are not available. However, this data is also to be submitted to the FOEN (Fig. 5.1).
As well as the data entered in the entry form, additional data and information arises in certain indicator sets, e.g. photos or GIS files (see Table 5.1 below). This is indicated under the relevant variables in the entry form.

5.1.2 Responsibilities and requirements

Ideally, the data collected should be entered directly in the forms provided by the consultancy contracted to determine the indicator set in question. Data entry forms must not be individually adapted by users, since a standardised structure provides the basis for centralised data integration. Accordingly, certain cells in the entry forms are write-protected. Any difficulties arising with data entry should be reported immediately by e-mail to: wiko_revit@bafu.admin.ch. Prompt notification will ensure that the difficulty can be rapidly resolved and an updated version of the data entry form can be made available to users via the download page.
A data entry form is to be completed for each survey time point (before, after 1, after 2) and indicator set. The entry forms are assigned a specified name for storage and submission: KT_ProjektCode_ERHEBUNG_SetX_VersionsNr.xls; this file naming scheme (including use of upper- and lowercase characters) must be followed.

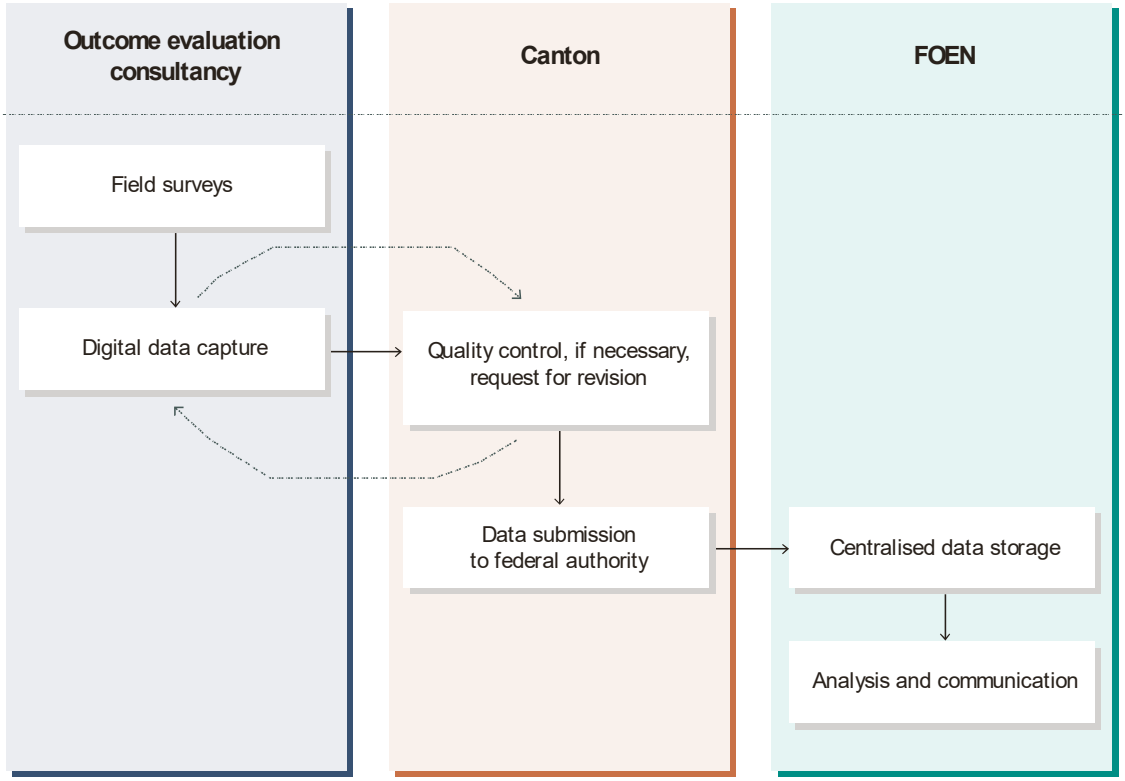
- “KT” stands for the two-capital-letter cantonal abbreviation (e.g. AI, BE, ZH).
- “ProCode” indicates the internal cantonal number/code assigned to the project. If a canton does not yet have a number of this kind, it is requested to create one. The project number is to be used consistently for the implementation and outcome evaluation.
- “ERHEBUNG” designates the survey time point and will read VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED).

Thus, an entry form could, for example, have the following name: BE_201903_VORHER_Set7_V1.xls. The same naming scheme is also to be used for other data (e.g. photos, GIS files).

5.2 Data flow

To ensure that outcome evaluation can promote cross-project learning, all the data collected must be integrated in a centralised archive and jointly analysed. Below, it is explained what steps are required for complete, standardised data collection, and who is responsible for each step (Fig. 5.1).

Figure 5.1: Steps required for data management from collection to analysis, and the entities responsible for each step.



5.2.1 Quality control

Data entry forms are to be checked for completeness and correctness by the canton (or the commune or third party). It is to be ensured that:

- all necessary values are included (header data, indicator-set-specific data on determination and assessment),
- the project code for the outcome evaluation is identical to the corresponding cantonal project number for the implementation evaluation (“Kenndaten”) and future field surveys associated with the outcome evaluation.

If any entries are missing or incorrect (e.g. wrong measurement unit, numbers in text fields, non-use of drop-down menus), the consultancy contracted for the outcome evaluation must be requested to make corrections if necessary. Only after this quality control is the data to be forwarded to the FOEN. On receipt of the data by the FOEN, an internal quality control is performed for completeness of entries.

5.2.2 Data submission

The various indicator sets for a single survey (e.g. “before” survey) may possibly be determined at different times. The data for all the indicator sets required for a single survey (e.g. “before” survey) should be collected by the canton and submitted to the FOEN en bloc, as soon as all the data is available and has undergone quality control. As well as the data entered in the entry form, a number of indicator set technical sheets call for additional information, e.g. photos or GIS files (Table 5.1). This information is to be submitted to the FOEN together with the entry forms. Project-specific survey data (e.g. Set 11 – Project-specific goal) is to be sent to the FOEN in the available format. Data submissions are to be made by e-mail to: wiko_revit@bafu.admin.ch.

Data collected using Modular Stepwise Procedure (MSP) methods (e.g. Indicator Sets 5 – Macrophytes, 6 – Macroinvertebrates, 7 – Fish) is also to be included in the macroinvertebrate database (MIDAT/MIDAT+) of the Swiss Centre for the Cartography of Fauna (CSCF/SZKF). Additional information will be provided in an updated version of this factsheet in 2020.

5.2.3 Centralised data storage

At the start of the STANDARD and EXTENDED outcome evaluation, data is transferred between the canton and the FOEN via entry forms. At the FOEN, the data is stored in a structured manner so that it can be used for centralised analysis.
Over the medium to long term, data from implementation and outcome evaluations is to be integrated into a “Restoration evaluation” data archive. This archive could be Web-based and thus accessible to authorised (federal, cantonal and, if appropriate, third-party) users. The data is to be used for cross-project analyses and should facilitate cross-project learning; additional project documentation (e.g. photos and maps) could optionally also be made accessible.

5.3 Data usage rights

The legal question of data usage rights is still under examination, and further information will be added to this factsheet in 2020. The cantons are free to pass on their own data to third parties and use it for communication purposes.

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Table 5.1: Data arising for each indicator set and specified file names. Templates can be found at: www.bafu.admin.ch/outcome-evaluation-resto
* For geodata please use coordinate system CH1903+ LV95.

Indicator set	Data arising and specified file names	Description
1. Habitat diversity	KT_ProCode_ERHEBUNG_Set1_V#.xls	Raw data and assessment of Set 1
	KT_ProCode_ERHEBUNG_Set1_Ind1_1.shp	River bed structures as polygon shapefile
	KT_ProCode_ERHEBUNG_Set1_Ind1_2.shp	River bank structures as line shapefile
	KT_ProCode_ERHEBUNG_Set1_Ind1_3_4.shp	Water depth and flow velocity along cross sections as point shapefile
	KT_ProCode_ERHEBUNG_Set1_Ind1_5.shp	Cover types as polygon shapefile
	KT_ProCode_ERHEBUNG_Set1_Ind1_6.shp	Substrate as polygon shapefile
	KT_ProCode_ERHEBUNG_Set1_1up jpeg KT_ProCode_ERHEBUNG_Set1_1down jpeg KT_ProCode_ERHEBUNG_Set1_2up jpeg KT_ProCode_ERHEBUNG_Set1_2down jpeg KT_ProCode_ERHEBUNG_Set1_3up jpeg KT_ProCode_ERHEBUNG_Set1_3down jpeg KT_ProCode_ERHEBUNG_Set1_4up jpeg KT_ProCode_ERHEBUNG_Set1_4down jpeg	Photos documenting restored section and subsection
	KT_ProCode_ERHEBUNG_Set1_air jpeg/ .tif/ .geotiff	If available, aerial/ drone-shot photograph (georeferenced) documenting the restored section
2. Dynamics	KT_ ProCode_ERHEBUNG_Set2_V#.xls	Raw data and assessment of Set 2
	KT_ProCode_ERHEBUNG_Set2_Ind2_1.shp	River bed structures at 5–10 years before restoration as polygon shapefile
	KT_ProCode_ERHEBUNG_Set2_Ind2_2.shp	River bank structures at 5–10 years before restoration as line shapefile
3. Connectivity	KT_ ProCode_ERHEBUNG_Set3_V#.xls	Raw data and assessment of Set 3
	KT_ProCode_ERHEBUNG_Set3_Ind3_1.shp	Floodable areas at HQ_2 as polygon shapefile
	KT_ProCode_ERHEBUNG_Set3_Ind3_2.shp	Shorelines at mid-flow as line shapefile
4. Temperature	KT_ ProCode_ERHEBUNG_Set4_V#.xls	Raw data and assessment of Set 4

Indicator set	Data arising and specified file names	Description
5. Macrophytes	KT_ProCode_ERHEBUNG_Set5_Output_Datastation.txt KT_ProCode_ERHEBUNG_Set5_Output_Taxa_used.txt KT_ProCode_ERHEBUNG_Set5_Output_Taxa_deleted.txt AND the station sheet in PDF	Output from the electronic tool of the MSK module
	KT_ProCode_ERHEBUNG_Set5_up.jpeg AND KT_ProCode_ERHEBUNG_Set5_down.jpeg OR KT_ProCode_ERHEBUNG_Set5_air.jpeg	Photos documenting Set 5
	KT_ProCode_ERHEBUNG_Set5_Stock*	List of any macrophytes planted, sowed or introduced with cuttings (to be submitted with “after” survey).
6. Macroinvertebrates	KT_ProCode_ERHEBUNG_Set6_V#.xls	Raw data of Set 6 If a spring and summer sample is made, name the documents as follows: KT_ProCode_ERHEBUNG_Set6_V#_Frühling.xls AND KT_ProCode_ERHEBUNG_Set6_V#_Sommer.xls
	KT_ProCode_ERHEBUNG_Set6_Probestelle1.jpeg KT_ProCode_ERHEBUNG_Set6_Probestelle2.jpeg KT_ProCode_ERHEBUNG_Set6_Probestelle3.jpeg KT_ProCode_ERHEBUNG_Set6_Probestelle4.jpeg KT_ProCode_ERHEBUNG_Set6_Probestelle5.jpeg KT_ProCode_ERHEBUNG_Set6_Probestelle6.jpeg KT_ProCode_ERHEBUNG_Set6_Probestelle7.jpeg KT_ProCode_ERHEBUNG_Set6_Probestelle8.jpeg	Photos documenting the sample sites
	KT_ProCode_ERHEBUNG_Set6_Probestellen.shp	Sample sites as point shapefile*
7. Fish	KT_ ProCode_ERHEBUNG_Set7_V#.xls	Raw data and assessment of Set 7
8. Riparian vegetation	KT_ProCode_ERHEBUNG_Set8_V#.xls»	Raw data and assessment of Set 8
	KT_ProCode_ERHEBUNG_Set8_Ind8_1_Fläche.shp AND/OR KT_ProCode_ERHEBUNG_Set8_Ind8_1_Punkte.shp KT_ProCode_ERHEBUNG_Set8_Ind8_2.shp KT_ProCode_ERHEBUNG_Set8_Ind8_3.shp	GIS files for individual indicators from Set 8

Indicator set	Data arising and specified file names	Description
9. Avifauna	KT_ ProCode_ERHEBUNG_Set9_V#.xls	Raw data and assessment of Set 9
	KT_ProCode_ERHEBUNG_Set9_TMOdata.zip	Export file (ZIP) from Terrimap Online (downloadable by clicking the save button in the Terrimap Online precinct view)
10. Society	KT_ ProCode_ERHEBUNG_Set10_V#.xls	Raw data and assessment of Set 10
Set 11	KT_ ProCode_ERHEBUNG_Set11_	No standardised methodological requirements exist for Set 11. However, this data is also to be submitted to the FOEN.

List of modifications

Relevant changes are marked in green.

Date (mm/yy)	Version	Change	Responsibility
4/2020	1.02	Correction of spelling errors, minor terminological modifications	Eawag
4/2020	1.02	Completion Table 5.1 (specification of coordinate system for geodata, addition of point shapefile for indicator Set 6)	Eawag
7/2021	1.03	Completion Table 5.1 (raw data and photos for-Set 6; if available, aerial/ drone-shot photograph (georeferenced) for Set 1)	Eawag
1/2022	1.04	Completion Table 5.1 (specification about the Output-files from the electronic tool that have to be handed in for Set 5)	Eawag
3/2024	1.05	Completion Table 5.1 (clarification of the naming of: Spring and summer sample in Set 6, area or point shapefile from indicator 8.1 in Set 8 and adjustment of the data to be submitted for Set 9)	Eawag

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Factsheet 6
Financing

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PDF download:
www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, Italian and German.

This factsheet explains the calculation of the budget for the STANDARD and EXTENDED outcome evaluations and defines the content of the financial reporting.

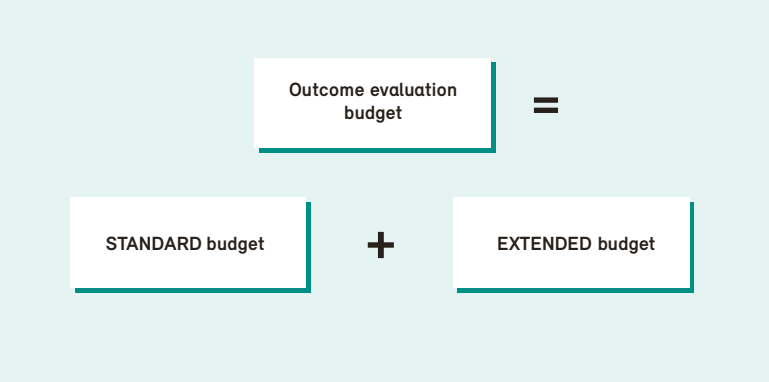
6.1 Introduction

With the Programme Agreement (PA) period 2020–2024, the financing of outcome evaluation has been reorganised. Before 2020, outcome evaluations received federal support as a component of a restoration project. This meant that an outcome evaluation was generally performed one to two years after the completion of construction, so that the costs could be included in the final accounts for the construction project. In addition, before 2020, an outcome evaluation was usually only undertaken in the case of larger, or more costly, projects where this appeared justifiable to the canton or commune concerned. There may possibly also have been a perverse incentive to conduct an outcome evaluation only in the case of projects where the proportion of federal subsidies was particularly high. For projects involving small watercourses or short reaches, the financial expenses of an outcome evaluation often seemed disproportionate, compared to the project costs.
The financial framework was thus not ideal for appropriately assessing the effects of restoration measures: firstly, biological indicators may only respond to the measures implemented over a much longer period than has previously been considered. Secondly, consideration of smaller projects is of major importance, as these make up a large proportion of all restoration projects across Switzerland. Accordingly, with the PA period 2020–2024, the financing of outcome evaluation has been separated from restoration projects (apart from the “before” survey for individual projects, see Section 6.3.2).
By defining financing and project requirements, the Handbook on Programme Agreements in the Environmental Sector provides the basis for federal-cantonal collaboration in the implementation of restoration projects. In the Handbook for the PA period 2020–2024, the two new performance goals/indicators “STANDARD outcome evaluation” and “EXTENDED outcome evaluation” were introduced under the Programme Goal “Restoration foundations”. With these performance indicators, fixed rates are set for federal subsidies for outcome evaluation. As these differ for STANDARD and EXTENDED, two performance indicators are required.

6.2 Financing model

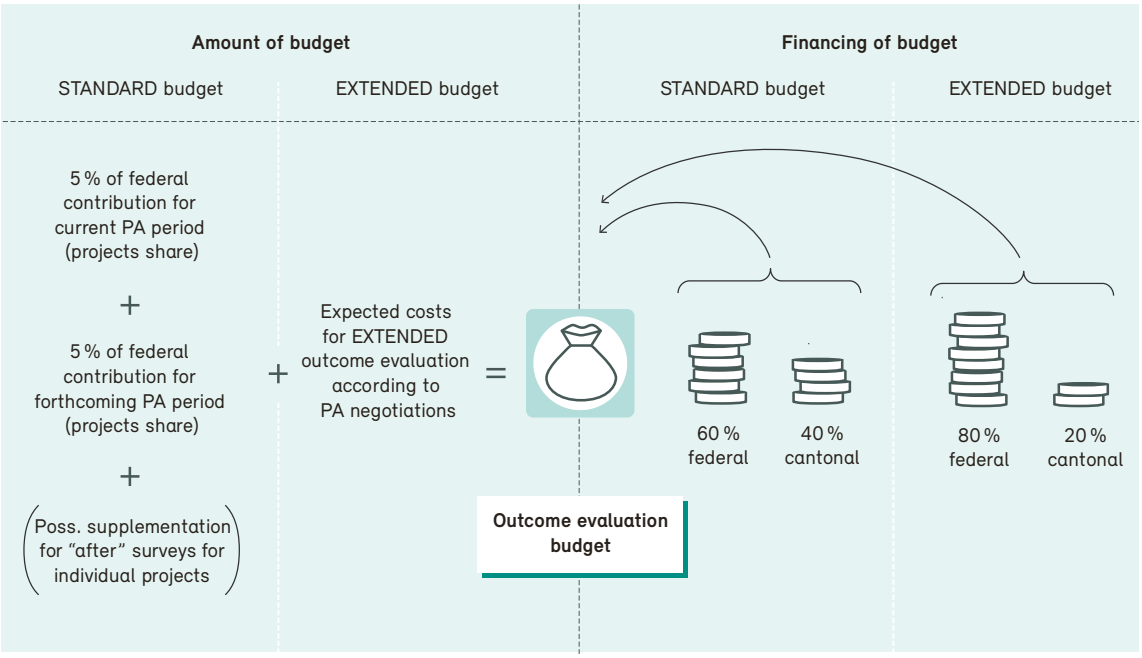
For each PA period, an outcome evaluation budget is calculated in the course of the PA negotiations between the federal and cantonal authorities. This comprises a STANDARD budget and an EXTENDED budget (Fig. 6.1).

Figure 6.1: The outcome evaluation budget, comprising the STANDARD and the EXTENDED budget.



The following sections (6.3 and 6.4) describe how the outcome evaluation budget is calculated and provide a breakdown of the financing (Fig. 6.2).

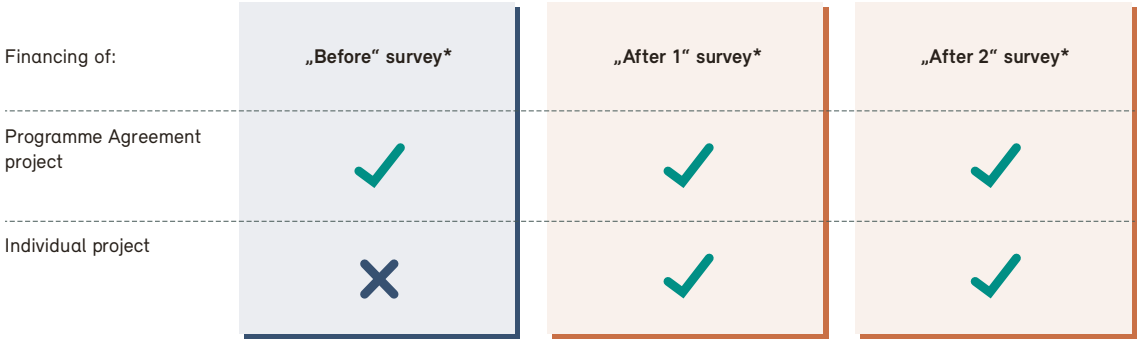
Figure 6.2: Amount and financing of the outcome evaluation budget comprising a STANDARD budget and an EXTENDED budget.



6.3 STANDARD budget

For the STANDARD outcome evaluation, a STANDARD budget is calculated, which is made up of federal and cantonal funds. Cantonal contributions may also be partly funded by communes or third parties. Federal subsidies for the STANDARD outcome evaluation amount to 60% of the costs arising. The amount of the STANDARD budget should be proportionate to the number and financial costs of a canton's restoration projects. It is therefore calculated on the basis of PA federal contributions. However, since the STANDARD budget is used to finance not only "before" surveys for new projects to be implemented under the forthcoming PA but also "after" surveys for projects already implemented during earlier PA periods (Fig. 6.3), and a canton's PA amount may vary widely from one period to another, the STANDARD budget is not calculated merely on the basis of a single PA period. Rather, the calculation is based on the amounts of the federal contributions for the forthcoming PA period (proportionate to the financial costs of new projects and "before" surveys) and for the current PA period (proportionate to the financial costs of implemented projects and "after 1" surveys).

Figure 6.3: Financing of "before" and "after" surveys by the STANDARD budget.



6.3.1 Calculation model

Taken as a basis for calculation are the federal contributions for Programme Goals (PG) 2 ("Restoration projects") and 3 ("Flood protection projects with additional financing under the WPA") of the current and the forthcoming Programme Agreement (the contribution for PG 1 "Restoration foundations" is not taken into account). The amount calculated is 5% of the federal contribution in each case. The sum of these two 5% values is the STANDARD budget (see the calculation example in Table 6.1). This is supplemented, if necessary, if "after" surveys for individual projects are planned for the forthcoming PA period (see Section 6.3.2).

Table 6.1: Example for calculation of the STANDARD budget excluding individual projects

		PG 1	PG 2	PG 3	Total
Current PA	Allowable costs (CHF)	13,500	1,300,000	150,000	
	Federal contribution (FC, in CHF)	0	780,000	30,000	
	Outcome evaluation sub-budget (5% of FC, in CHF)	0	39,000	1,500	40,500
Forthcoming PA	Allowable costs (CHF)	60,000	1,800,000	800,000	
	Federal contribution (FC, in CHF)	0	1,150,000	200,000	
	Outcome evaluation sub-budget (5% of FC, in CHF)	0	57,500	10,000	67,500
				STANDARD budget for forthcoming PA	**108,000**
				Federal share (60%)	64,800
				Cantonal share (40%)	43,200

This standardised model for calculation of the STANDARD budget ensures that all cantons invest comparable amounts in the STANDARD outcome evaluation. The STANDARD budget amounts to around 2–6% of the allowable project costs (empirical calculation based on real figures). This proportion resulted from exchanges between cantonal representatives and the FOEN at various events. While the funding reserved for outcome evaluation is not available for project implementation, lessons learned from outcome evaluation can be applied in future projects, helping to optimise the effects of restoration measures. The financing model adopted represents a compromise between the seemingly opposing interests of implementation and learning.
The FOEN supports the cantons in calculating the STANDARD budget, on the basis of the negotiation mandate defined for the forthcoming PA period and the federal contributions paid in the current PA period. The STANDARD budget calculated is communicated to the canton prior to the PA negotiations.

6.3.2 Individual projects: supplementation of the STANDARD budget

Not taken into account in the STANDARD budget thus calculated are individual projects. With regard to measures, system size and costs, individual projects vary widely, depending on whether they are implemented as restoration or as flood protection projects with additional financing under the WPA ("combined projects"). In addition, for purposes of outcome evaluation, the number of indicators recommended for individual projects is generally larger than for smaller projects (see Factsheet 2). The costs involved in outcome evaluation for individual projects therefore need to be estimated on a case-by-case basis, and such estimates are usually not yet available at the time of the PA negotiations.
For this reason, in contrast to PA projects, the "before" survey is, as in the past, financed through the project, with the same subsidy rate as the construction project. On the basis of experience with the "before" survey, a robust cost estimate can be prepared for the "after" surveys, which are then financed under the STANDARD outcome evaluation performance indicator. The calculated STANDARD budget (see Section 6.3.1) is supplemented by the amount of the cost estimate for the relevant PA periods in which the "after" surveys are to be conducted (see Table 6.2).

Table 6.2: Example for calculation of the STANDARD budget including individual projects

		PG 1	PG 2	PG 3	Total
Current PA	Allowable costs (CHF)	13,500	1,300,000	150,000	
	Federal contribution (FC, in CHF)	0	780,000	30,000	
	Outcome evaluation sub-budget (5% of FC, in CHF)	0	39,000	1,500	40,500
Forthcoming PA	Allowable costs (CHF)	60,000	1,800,000	800,000	
	Federal contribution (FC, in CHF)	0	1,150,000	200,000	
	Outcome evaluation sub-budget (5% of FC, in CHF)	0	57,500	10,000	67,500
				Subtotal: STANDARD budget for forthcoming PA	108,000
				Supplementation for individual-project "after" surveys	**62,000**
				STANDARD budget for forthcoming PA	**170,000**
				Federal share (60%)	102,000
				Cantonal share (40%)	68,000

6.4 EXTENDED budget

Financed from the EXTENDED budget is the EXTENDED outcome evaluation for new, specific questions arising periodically. Depending on the particular question, not every canton will necessarily have implemented a restoration project suitable for EXTENDED. These efforts rely on the voluntary participation of cantons which do have suitable projects. In return, federal support for the EXTENDED outcome evaluation is offered in the form of a higher subsidy rate of 80%; the remaining 20% is financed by the canton (or communes/third parties), as for the STANDARD outcome evaluation.
The relevant questions for EXTENDED are defined in each case by the FOEN in consultation with the cantons and discussed bilaterally with the cantons prior to the negotiations for the forthcoming PA period. At the latest during the PA negotiations, it is discussed whether suitable projects exist within the canton and to what extent the canton is prepared to participate in an EXTENDED outcome evaluation. The costs for the EXTENDED outcome evaluation in question are then determined on the basis of cost estimates and specified under the relevant performance indicator in PG 1 "Restoration foundations".
For the outcome evaluation budget, the expected costs for EXTENDED are added to the calculated STANDARD budget. An exception to this is the PA period 2020–2024, in which the funding not required for "after" surveys from STANDARD is used for EXTENDED.

6.5 Financial reporting

In the annual financial reporting on the Programme Agreement, the canton separately reports progress for each individual performance indicator, and thus also for the two performance indicators for outcome evaluation under PG 1 "Restoration foundations".

6.5.1 STANDARD outcome evaluation

Not infrequently in the course of a PA period, funds are shifted between programme goals ("alternative fulfilment") or contracts are modified (increase or reduction in federal subsidies). This may affect the defined STANDARD budget, which relates to the federal subsidies for PG 2 and 3. If there are major deviations (on the order of a six-figure sum) in the federal subsidies cumulatively agreed upon under PG 2 and 3, then the STANDARD budget is also to be adjusted.

At the end of each PA period, the STANDARD budget should have been used up; a minor deviation can be tolerated. In addition, at the end of each PA period (possibly including the rectification year), a list of the services performed is to be submitted to the FOEN, together with the implementation evaluation data. The following information should be included:

- Watercourse and project name according to implementation evaluation
- Survey time point/type (“before”, “after 1” or “after 2” condition)
- Indicator sets determined (numbers)
- Year of survey
- Costs of outcome evaluation according to this framework (or in consultation with the FOEN, if more extensive)

6.5.2 EXTENDED outcome evaluation

For the EXTENDED outcome evaluation, performance of the agreed service is demonstrated by the submission of data to the FOEN. Deviations from the sum defined in the Programme Agreement are certainly possible, as it can sometimes be difficult to estimate costs in advance. The costs are documented via the relevant performance indicator in the financial reporting for the PA.

6.6 Consultation with the FOEN

If a canton plans to conduct an outcome evaluation going beyond the framework or the defined indicators (e.g. inclusion of a control reach, an additional “before” or “after” survey, Indicator Set 11), this is possible in consultation with the FOEN. Conceivable reasons could be project-specific goals not covered by the defined indicators (Indicator Set 11), project-specific learning processes or different methods in the case of projects for which a “before” survey has already been conducted prior to 2020 (comparability of results). Because of limited resources, the inclusion of additional indicators or control reaches can only be supported to a limited extent through the STANDARD outcome evaluation. These primarily serve the purpose of project-specific learning, but are not essential for learning at the national level. Decisions on financial support are taken on a case-by-case basis.
Data additionally collected is also to be submitted to the FOEN, and the services performed are to be documented.

List of modifications
Relevant changes are marked in green.

Date (mm/yy)	Version	Change	Responsibility
4/2020	1.02	Correction of spelling errors, minor terminological modifications	Eawag

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This factsheet provides a variety of background information on the development of the framework for the STANDARD and EXTENDED outcome evaluations in the research project at Eawag.

7.1 Development of framework

The framework for the STANDARD and EXTENDED outcome evaluations was developed at Eawag, on behalf of the FOEN, between October 2015 and February 2018. In this process, a number of variants were outlined, strengths and weaknesses discussed, and cost estimates prepared. The framework was developed in close collaboration with three advisory groups (national, international and internal; see "Publication details"), comprising altogether over 30 representatives of various stakeholder groups (e.g. federal and cantonal authorities, consultancies, academia) and disciplines (e.g. ecology, river engineering, waters protection, geomorphology, social sciences and economics). After the completion of the initial development phase, the proposals were discussed with all the cantons represented at two Water Agenda 21 meetings (April and November 2018) and a workshop (September 2018). The concerns and criticisms expressed at these events were noted, and the framework was modified, e.g. with regard to the number of projects to be included in the STANDARD outcome evaluation. Approval and understanding were thus considerably enhanced as a result of these three events.

7.2 Typical goals of restoration projects

Restoration projects pursue a variety of goals – ecological, social or economic. With an outcome evaluation, the goals defined can be assessed. But which goals are most important for collaborative learning at the national level? During the development of the framework, typical goals of restoration projects were identified in several steps. First, possible restoration goals were collected with the aid of the three advisory groups and from the literature (e.g. Woolsey et al. 2005; Reichert et al. 2007, 2011). These can be grouped into an "objectives hierarchy" (see Fig. 7.2 below), which is a useful tool for providing a clear overview of goals with varying degrees of detail (Reichert et al. 2007, 2011). Next, four legal documents were systematically examined – the Waters Protection Act (WPA, SR 814.20), the Waters Protection Ordinance (WPO, SR 814.201), the Explanatory Report on the Amendment of the Waters Protection Ordinance (Explanatory Report on the Parliamentary Initiative on Protection and Use of Waters; BAFU 2011) and the Handbook on Programme Agreements (BAFU 2015) – and goals mentioned therein were inserted in the objectives hierarchy. Finally, in collaboration with the advisory groups, various filters were defined for the selection of priority goals – e.g. the number of mentions in the documents, the availability of indicators for goal assessment, or a goal's amenability to influence by a restoration project. The result was a list of 9 typical goals at Level 4 of the objectives hierarchy, further characterised by the various sub-goals at Level 5.

7.3 Indicators

Indicators are measurable quantities which provide valuable information on the condition of an ecosystem and its relevant processes (Lorenz et al. 1997). Determination of an indicator thus has two components – measurement in the field and subsequent assessment of the results (= rating). Indicators can be used to assess goal attainment – i.e. they represent the actual tools from the objectives hierarchy and are correspondingly closely linked to the objectives. The development of the framework for the STANDARD outcome evaluation relied on indicators already described for Switzerland for which a value function (= step from measurement to rating) is available. Initially, a list of over 80 indicators was compiled from various sources, such as the Handbook for evaluating rehabilitation projects in rivers and streams (Woolsey et al. 2005) or the Modular Stepwise Procedure (http://www.modul-stufen-konzept.ch). In several steps, the available indicators were assigned to the objectives in the hierarchy and their suitability for measurement and rating was critically discussed (e.g. direct association with goals, sensitivity for the aspects to be assessed). At the end of this process, 22 indicators remained for the nine typical goals. These 22 indicators focus on abiotic, biotic and social aspects.

Synergies exist between numerous indicators, i.e. the surveys are similar, are carried out at the same site, or can be readily combined. Accordingly, the 22 indicators were grouped into 10 synergistic indicator sets, directly linked to one of the nine typical goals of restoration projects. There are four abiotic indicator sets, five biotic and one social. An additional indicator set (Set 11) exists which, in consultation with the FOEN, can be adapted to project-specific goals and requirements.
The indicators were in some cases modified or updated for the practice documentation; an overview of the modifications is given in Table 7.3 below.

7.4 Control and reference reaches

7.4.1 What are control and reference reaches?

Control reaches are sections of watercourses which reflect the conditions in the restored reach prior to restoration – i.e. degraded conditions (e.g. channelisation; Chapman 1999). In contrast, reference reaches exhibit scarcely degraded, near-natural conditions, such as are to be attained through restoration. If, in the outcome evaluation, surveys are performed not only on the restored reaches but also at the same time on control or reference reaches, then various conclusions can be drawn as a result at the project level. Firstly, natural variation can be quantified – i.e. it can be estimated to what extent a parameter varies naturally over time, even without the implementation of restoration measures. This provides an indication of whether an observed change in the restored reach is in fact attributable to restoration (= effect) or is due to other factors (e.g. extreme winter). Secondly, the direction of developments can be assessed. However, only a reference reach can genuinely indicate whether a development towards more natural conditions is occurring – the mere finding of divergence from conditions in the control reach says little about the desired effect.

7.4.2 How are control or reference reaches selected?

The selection of appropriate control or reference reaches is a crucial, but often underestimated task, presenting not just numerous opportunities but also risks. Points to be considered in the selection of control or reference reaches are discussed in the literature (Roni et al. 2013):

- *Similar temporal variability*: If the restored section and the control or reference reach are subject to the same environmental changes (e.g. in precipitation) over time, then a difference in the development of indicators in the restored section can be interpreted as an effect of restoration. Often, however, it is far from easy to confirm or assume similar variability.
- *Stability*: In the outcome evaluation, several years may elapse before the next survey. Particularly for control reaches, there is a “risk” that they will themselves be enhanced during this period. They will then no longer reflect the conditions which would be shown by the restored reach without restoration and will thus lose their value as a control. For reference reaches, in contrast, there is a risk of deterioration in their condition.
- *Geographical proximity*: If control or reference reaches are located too close to restored sections, they may possibly be influenced by them. Sites upstream of restored sections are therefore often chosen as control reaches. Here too, however, there is a possibility of influence, e.g. due to the migration of mobile organisms. Excessive distance between control and restored reaches can also be problematic, as the environmental conditions are then too dissimilar.

7.4.3 Why is routine sampling of control reaches not included in the STANDARD outcome evaluation?

Various study designs are used internationally to evaluate the outcome of restoration measures or other interventions in the environment (Roni et al. 2013). The most common are the BACI (Before-After Control-Impact) and the EPT (Extensive Post-Treatment) design. With BACI, the restored reach (Impact) is sampled before and after restoration (Before-After) and compared with a channelised (Control) reach (see Section 7.4.1). With the EPT design, older projects are sampled only after restoration (e.g. 5–10 years later) and compared with a channelised control reach. For both BACI and EPT, reference reaches (i.e. near-natural reaches, cf. Section 7.4.1) are also included in some cases.

The various study designs differ according to the goals, effort or duration, and all have different strengths and challenges – i.e. no one approach can do everything (Roni et al. 2005, 2013). They are also carried out at different levels – either project-specific, involving a single project (e.g. BACI), or cross-project (e.g. multiple BACI, or mBACI; Roni et al. 2018; Factsheets 1 and 4). The project-specific level is, however, much more common (Weber et al. 2017).

The various study designs can be combined, thus combining the individual strengths of each approach. This is also the case for the nationally standardised outcome evaluation for Switzerland from 2020: for the STANDARD outcome evaluation, a multiple before-after (mBA) approach is to be used, i.e. a before-after comparison involving a large number of projects without control reaches. As a result, the development of restored reaches will be monitored over an extended period and as far as possible across the entire spectrum of restoration measures, types of watercourse and regions. In addition, with the EXTENDED outcome evaluation for 2020–2024, an extensive post-treatment/ multiple post-treatment (EPT/mPT) approach is being pursued – i.e. an “after” comparison involving a sufficiently large number of older projects in small watercourses, and including control reaches. This means that specific questions concerning the development of restored reaches of small watercourses can be addressed in good time – it is not necessary to wait for more than 5 years for results to be available for the learning process.

In the STANDARD outcome evaluation, control reaches are thus not routinely sampled; sampling of control reaches is, however, possible in consultation with the FOEN (Factsheet 1). This decision was taken during the development of the framework – after intensive discussions with the three advisory groups (see Publication details) – primarily for the following reasons:

- *Coverage of project diversity to enable causal understanding:* Restoration projects are highly diverse (measures, project context). In order to gain a better understanding of the factors inhibiting or promoting the effectiveness of restoration projects, a large number of projects with different contexts need to be covered in the outcome evaluation (Factsheet 4). Accordingly, the allocation of resources needs to be balanced in such a way that a sufficiently large number of projects undergo a sufficiently comprehensive outcome evaluation.
- *Learning about development over time:* Information on temporal variability and on long-term development can be obtained at the project level above all by means of high temporal resolution (frequently repeated measurements) and comparison with control reaches. Such surveys provide very interesting results, as strikingly shown by a German study of river restoration involving 21 consecutive years of electrofishing (Höckendorff et al. 2017). At the same time, these surveys are costly, i.e. the cost per project is increased and fewer projects can be covered by an outcome evaluation with the resources available for this purpose at the national level. However, the temporal aspect can also be addressed using a cross-project approach – by comparison of multiple projects from different contexts and different years (Roni et al. 2018).
- *Difficulty of selecting control reaches:* The challenges involved in selecting meaningful control reaches are often underestimated, as shown by international studies, e.g. by advisory group member Phil Roni from the US (Roni et al. 2013). They are described in Section 7.4.2.

7.5 Unresolved questions from Swiss restoration practice

In a workshop at the Water Agenda 21 meeting held on 28 October 2016, the following question was discussed: In your view, what are the most pressing questions that need to be answered by national analyses of the effects of restoration measures? Examples of the issues mentioned by participants are given in Table 7.1.

Table 7.1: Unresolved questions from restoration practice, as formulated by cantonal experts at a Water Agenda 21 workshop.

Ecological processes • *Degree of isolation of a reach:* How does this influence the effects of a restoration project? • *Restoration of connectivity:* Can this have adverse effects on aquatic communities?
Project goals • *Goal attainment:* What is a successful restoration? National consensus required with regard to goal attainment. • *Significance of goal definition:* To what extent does the definition of goals influence the results of the outcome evaluation?
Spatial scale • *Project size:* How does project size affect ecosystem recovery potential? • *Project perimeter vs effect perimeter:* How far do the effects of a restoration project extend?
Temporal scale/duration • *Duration of sampling:* How long does recovery take? How can one be sure of the results? • *Effectiveness:* How many years are required for conclusions on effectiveness to be drawn?
Recovery potential • *Morphology and water quality*: To what extent do successful restoration measures depend on these factors? • *Other pressures*: How do regional and social developments (e.g. huge increase in recreational pressures and litter) affect the development of a restoration project?
Tools/indicators • *Choice of indicators:* Which indicators are most suitable for assessing the effects of a restoration measure? • *Applicability:* Can outcome evaluation for restoration projects also be applied to flood protection projects?
Societal benefits • *Effectiveness from citizens' viewpoint:* How can the effectiveness of a restoration project be expressed (ecology per Swiss franc of taxpayers' money)? • *Public satisfaction:* How is this related to the ecological effects?
Success/effectiveness • *Intensity of restoration:* Where, and at what level of intensity, should restoration be performed? • *Effectiveness:* What measures ensure the greatest effectiveness?
Implementation • *Implementation:* How can one progress from strategic planning to specific projects? • *Risks:* Is there not a risk that an analysis of the effectiveness of measures will lead to formulaic recommendations?
Learning/knowledge transfer • *Exchanges among experts:* What degree of detail is required for fruitful exchanges? • *Learning process:* What can we learn from other disciplines (e.g. water quality)?

7.6 Explanatory variables

The outcome of a restoration project is influenced by numerous different factors – floods, catchment use, climate change, the measures adopted. One of the aims of nationally standardised outcome evaluation is to gain a better understanding of why a given restoration project has a certain effect while another does not. Such information on development potential is of major importance, e.g. for strategic planning (where are measures likely to be highly effective?). But cause-effect relationships can only be determined to a limited extent at the individual project level – rather, cross-project comparison is required.

In the scientific literature, a few examples can be found where explanatory variables are investigated in a meta-analysis (comparison of published studies). The findings of a study by Kail et al. (2015), for example, are shown in Figure 7.1: the authors analysed 91 European restoration projects to determine which variables best explained the observed effects. The results indicate that, among the eight variables considered, the biological effects measured were correlated in particular with project age, river width and agricultural area upstream. Reach land use and main measure were shown to be predictors of minor importance.

Relevant explanatory variables are to be integrated into the analysis of STANDARD and EXTENDED data. These are not determined in the field, but come from existing sources such as national geodata, other monitoring programmes, or the FOEN implementation evaluation of watercourse restoration projects. Examples of explanatory variables are given in Table 7.2.

Figure 7.1: Example of an extensive post-treatment analysis (Kail et al. 2015) synthesising the outcomes from 91 restoration projects in European rivers on fish, macroinvertebrate and macrophyte assemblages (richness/diversity and abundance/biomass). The relative importance (%) of eight variables (or predictors) on combined effects for all organism groups is shown. Box-plots indicate quartiles, range, and outliers of 10 replicate model runs (boosted regression tree model; total variance explained = 0.41; n = 353 response ratios).

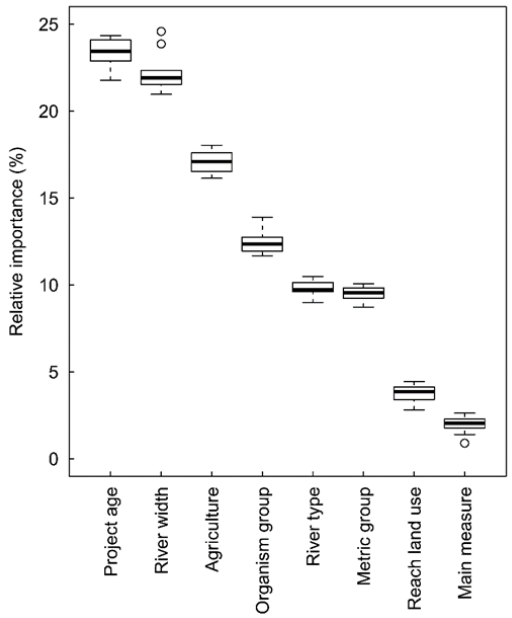

Table 7.2: Examples of explanatory variables which can be integrated into the centralised analysis of data from STANDARD and EXTENDED outcome evaluations.

Explanatory variable	**Data source**
Project characteristics • Project data (e.g. project setting, year construction completed) • Project classification (e.g. individual project, total costs) • General information (e.g. average bed width initially) • Set of measures (e.g. widening, deculverting) • Complicating factors (e.g. path relocation) • Financing (e.g. performance indicators, extended length)	*FOEN implementation evaluation*
Information on catchment • Catchment size • Elevation (project and average for catchment) • Geology	*Geodata* map.geo.admin.ch (catchment tool) map.geo.admin.ch (catchment tool) Typology (Schaffner et al. 2013)
Hydrology/morphology • River type • Stream order • Flow regime • Average flow (yearly, monthly)	*Geodata* Typology (Schaffner et al. 2013) Stream order (Pfaundler 2005) HYDMOD (Pfaundler et al. 2011) map.geo.admin.ch (catchment tool)/ average flows
Human influences • Hydropower (e.g. no. of plants up- or downstream; residual flow) • Land use (% forest, agriculture, settlement, etc.) • Water chemistry (e.g. nitrate, phosphate) • WWTPs in catchment • Degree of fragmentation • Population	*Geodata* Residual flow map FOEN; hydropower plant statistics (WASTA) Land use statistics Modelled values WWTP sites Ecomorphology Population_BFS_2014

Ecological status: • Data from nearby monitoring sites (surface water quality, biodiversity, habitat conservation) • Presence of protected areas	*Geodata/raw data* NAWA, BDM, WBS data Shapefiles of protected areas
Biological colonisation • Species distribution/abundance • River reaches with high level of biodiversity	*Geodata/raw data* Info from data centres (e.g. CSCF) ArtenV_NPA_Abs.shp (Schmidt & Fivaz 2013)

7.7 Framework for collaborative learning

According to US geomorphologist G. Mathias Kondolf (1995), “each restoration project constitutes an experiment, so that a failure can be just as valuable to the science as a success, provided we can learn from it”. Given the unique conditions and complexity of each local context, Kondolf stresses the importance of learning – i.e. long-term monitoring of the development of a restored watercourse and derivation of recommendations for future projects. Continuous learning reduces uncertainties and allows the most effective possible use to be made of often limited resources (Roni & Beechie 2013). According to Weber et al. (2017), collaborative learning is only possible within the following framework:

- *Standardised surveys:* Projects need to have a common denominator, i.e. monitoring and evaluation need to be sufficiently standardised (methods, sampling design) to enable cross-project comparison.
- *Decoupling of financing:* The financing of the outcome evaluation needs to be decoupled from that of the construction project, so that the effects of restoration can be observed over the long term (i.e. after completion of the construction phase).
- *Integration of explanatory variables:* Factors influencing the outcome of a restoration project need to be integrated into the analysis and interpretation as explanatory variables, including both local variables (e.g. length and width of restored reach) and factors operating over a wider area (e.g. bedload deficit, fragmentation). An overview of explanatory variables is given in Table 7.2.
- *Adaptability:* The limitations of existing approaches, methods or beliefs may need to be recognised and necessary adaptations made.
- *Stakeholder involvement:* A wide variety of stakeholders involved in the restoration of Swiss watercourses must be able to participate in collaborative learning.

Table 7.3: The most important modifications made when the indicators were updated (see also Section 7.3). References: [1] Woolsey et al. 2005; [2] Hunzinger et al. 2018; [3] Känel et al. 2017; [4] BAFU 2019.

Indicator (original source) and most important modifications
1.1 River bed structures[1] • Comprehensive survey conducted along the entire restored reach • Definition of the minimum area of a structure for the survey • Digitalisation of results and calculation of areas using GIS
1.2 River bank structures[1] • Replacement of structure types by separate determination of three attributes of bank structure – profile (3 qualities: linear, convex, concave), composition (5 qualities), slope (2 qualities) • Digitalisation of results and calculation of lengths and overlay/ comparison of shorelines by means of GIS • Longitudinal structures are no longer dealt with separately in the survey, but are characterised via the two attributes composition (permeable/impermeable structures) and profile (linear) • Modification of the evaluation functions owing to the larger number of possible structures
1.3 Water depth[1] **1.4 Flow velocity[1]** • Reduction in the number of cross sections to be measured (15–20 instead of 20–25) • No seasonal repetition of sampling
1.5 Presence of cover[1] • Modification of types of cover, harmonisation with the types of structures surveyed in the IAM method (Indice d'attractivité morphodynamique; Vonlanthen et al. 2018) • No field measurement, purely mapping • Evaluation based on expert assessment instead of sampling of reference reaches • Digitalisation of results and calculation of areas of cover using GIS
1.6 Substrate[1] • Alignment of evaluation methodology with that of the guidance on bedload regime restoration (Hunzinger et al. 2018) • Consideration of "substrate type" (as defined in Hunzinger et al. 2018) as one of two attributes of the substrate – mobilisability (plus composition -> not currently evaluable)
2.1 Temporal changes in diversity of geomorphic river bed structures[1] • See modifications under Indicator 1.1 "River bed structures"
2.2 Temporal changes in the quantity and spatial extent of morphological units[1] • See modifications under Indicator 1.2 "River bank structures"
2.3 Change in river bed elevation[2] • Translation of evaluation classes from the guidance on bedload regime restoration into standardised values between 0 and 1
3.1 Inundation dynamics[1] • Definition of the area referred to for the evaluation (-> minus water area at mid-flow)
3.2 Shoreline[1] • Modelling only, i.e. no field surveys, e.g. at different water levels
4.1 Temperature[1] Under discussion (autumn 2019): • Required duration (whole year vs 2 hot summer weeks) • Logger distribution: 1 logger per mesohabitat type (rather than logger distribution proportional to habitat distribution) • For evaluation: comparison with channelised reach upstream would be appropriate.
5.1 Macrophyte community[3] • The subreach for the survey should, if possible, be the same as the subsection selected for Indicator Set 1 "Habitat diversity". • Determination of the parameters of Ecomorphology Level R is not mandatory, but it is recommended if the subreach lies outside the subsection selected for Indicator Set 1. • The subreach must be documented by an aerial or eye-level photograph. • If any macrophytes were planted, sowed or introduced with cuttings, this must be documented. • With the new electronic template, there is no need for manual entry and read-in to the evaluation tool.

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6.1 Macroinvertebrate community[4]
- The subreach for the survey should be the same as the subsection selected for Indicator Set 1 "Habitat diversity".
- 8 samples are to be collected, according to the method defined in the module.
- All samples collected are separately sorted, identified and analysed.
- The second (optional) sampling campaign is conducted in August/September rather than September/October at altitudes of over 1400 m.
- Species-level identification of ephemeroptera, plecoptera and trichoptera (EPT, as in biodiversity monitoring)
- Abundance is measured for all taxa, i.e. also for each EPT species.
- A quality control of the EPT-taxa is required.
- An evaluation of EPT species is still under development.
- Calculation of the IBCH quality index is not mandatory.
- Archiving is recommended, but optional.

7.1 Fish community[1]
7.2 Age structure of fish population[1]
7.3 Ecological guilds of fish[1]
- Quantitative survey, including use of barriers (rather than semi-quantitative)
- Electrofishing in a characteristic subsection (rather than mesohabitat-based electrofishing), in accordance with detailed mapping in Set 1
- Weighing of fish and consideration of biomass (rather than merely abundance/density)
- No seasonal repetition of electrofishing
- Assessment: not only sensitive (sentinel) species to be considered, but all typical species.

8.1 Plant species[1]
- New name (previously "Plant species typical of floodplains")
- Increase in possible target species
- Guidance on selection of target species, with species list file (Ufervegetation_Ind.8.1_Empfehlung_Beispiele.xls)
- For at least three species, the number of individuals per unit area or the colonised area is determined for target species and/or neophytes.

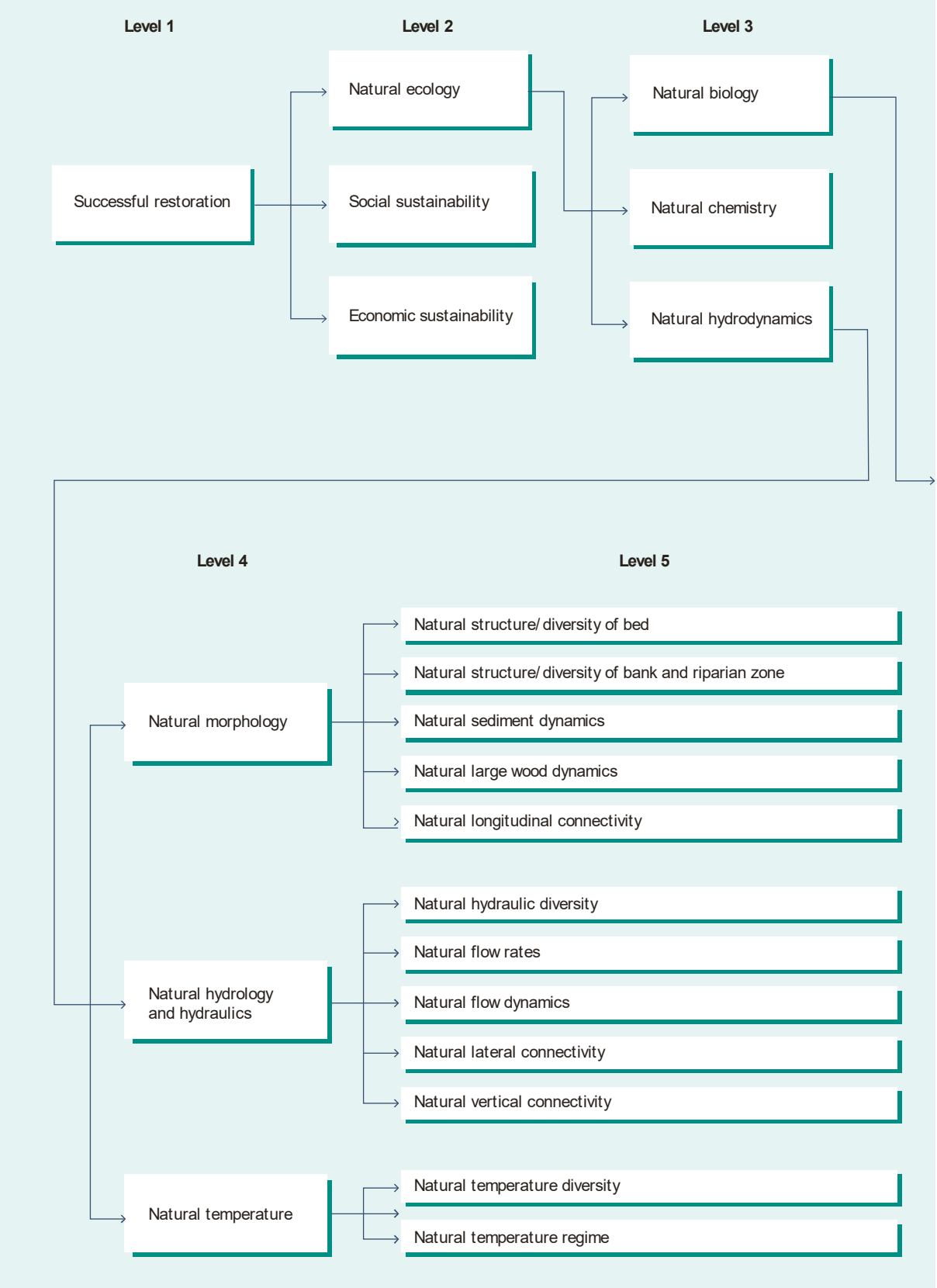
8.2 Plant communities[1]
- Survey based on the WBS (Monitoring the Effectiveness of Habitat Conservation in Switzerland) method, except that the permanently marked plots are not randomly distributed, but deliberately established
- A minimum of 5 permanently marked plots per (planned) plant community are set.
- Location and number of permanently marked plots remain the same before and after restoration
- The data from the phytosociological surveys can be used for two analyses, which are explained in more detail below - a comparison with the species lists of the Delarze habitats (analysis 1, mandatory) and the calculation of the score TypoCH of InfoFlora (analysis 2, optional).

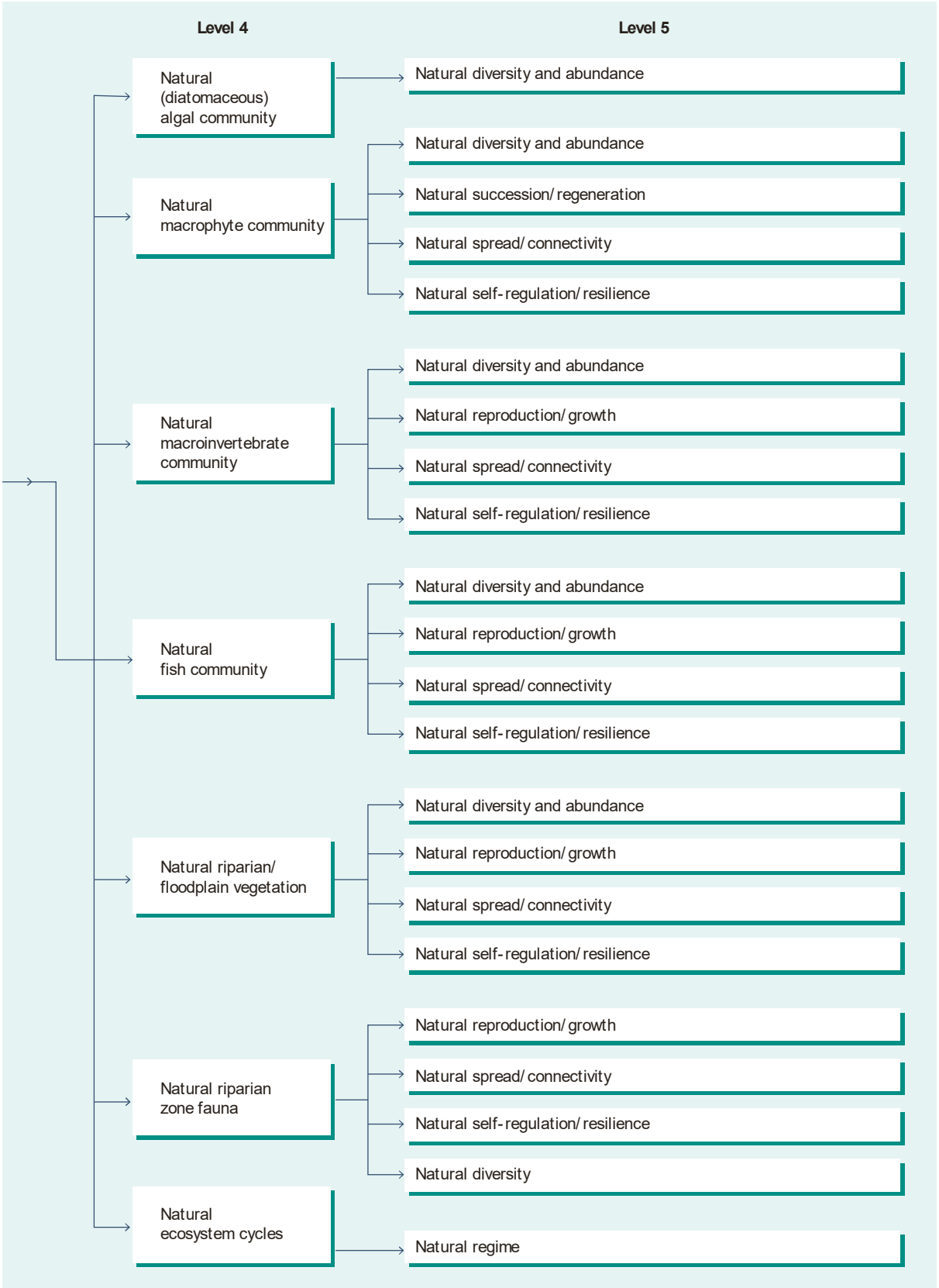
8.3 Temporal shift in the mosaic of floodplain vegetation categories[1]
- The step "Verification of the map of floodplain formations in the field" is now mandatory.

9.1 Bird species[1]
- The survey and mapping of avifauna is based on the standardised method for the Swiss Breeding Bird Atlas, the common breeding bird monitoring (MHB) programme and Indicator Z7 of Swiss Biodiversity Monitoring (BDM Coordination Office 2014); it is undertaken in collaboration with the Swiss Ornithological Institute.
- No assessment is to be carried out at present, until initial data from the restoration outcome evaluation is available.

10.1 Stakeholder acceptance[1]
- Modification of the time point of the second "after" survey (in year +1/+2 rather than +10/+12)
- Development of a questionnaire with 5 standardised questions to document the acceptance level.
- A value between 0 and 5 is assigned to each question, with 0 indicating very low and 5 very high approval.

Figure 7.2: Objectives hierarchy, with five levels




Level 4
Level 5
Natural (diatomaceous) algal community
Natural diversity and abundance
Natural macrophyte community
Natural diversity and abundance
Natural succession/ regeneration
Natural spread/ connectivity
Natural self-regulation/ resilience
Natural macroinvertebrate community
Natural diversity and abundance
Natural reproduction/ growth
Natural spread/ connectivity
Natural self-regulation/ resilience
Natural fish community
Natural diversity and abundance
Natural reproduction/ growth
Natural spread/ connectivity
Natural self-regulation/ resilience
Natural riparian/ floodplain vegetation
Natural diversity and abundance
Natural reproduction/ growth
Natural spread/ connectivity
Natural self-regulation/ resilience
Natural riparian zone fauna
Natural reproduction/ growth
Natural spread/ connectivity
Natural self-regulation/ resilience
Natural diversity
Natural ecosystem cycles
Natural regime

List of modifications

Relevant changes are marked in green.

Date (mm/yy)	Version	Change	Responsibility
4/2020	1.02	Correction of spelling errors, minor terminological modifications	Eawag
3/2024	1.03	Adaptation of table 7.3 in accordance with the updates in the technical sheets of sets 6 and 8	Eawag

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Factsheet 8
From framework to field survey

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This factsheet explains general aspects of the field survey and describes the structure of the indicator set technical sheets. Further details can be found in the technical sheets for Indicator Sets 1–10.

8.1 Survey principles

The following general principles are applicable for the planning and conduct of surveys:

- *Deployment of experienced professionals:* For each of the 10 indicator sets, the practice documentation contains a technical sheet, which provides instructions for conducting the survey and assessment. These technical sheets are addressed to professionals with specific experience in the area concerned and a sound knowledge of the material required and the relevant safety regulations. The use of personnel lacking appropriate experience is to be avoided for reasons of safety and quality.
- *Local knowledge:* Good local knowledge is crucial, particularly for the determination of the biological indicator sets (e.g. knowledge of local species) and in general for the assessment and interpretation of the data collected.
- *Coordination of all parties:* A variety of professionals are usually involved in outcome evaluation surveys. This makes consultation and coordination all the more important, e.g. with regard to the survey site (Section 8.3) or timing (see Section 8.4). A central coordination office, functioning as a hub for the various consultancies involved, is thus essential.
- *Personnel continuity:* Ideally, the “before” and “after” surveys will be carried out by the same individuals: personnel continuity reduces the risk of data being influenced by different survey personnel and facilitates data assessment and interpretation. In addition, familiarity with local conditions makes it possible to gain valuable time in the preparation and conduct of surveys.
- *Special procedure for deculverting:* For deculverting projects, a “before” survey cannot be conducted. For the assessment of the pre-project condition, values between 0 and 1 are therefore to be entered in the field protocol using professional discretion and subsequently compared with the values from the “after” survey conducted in the field.
- *Use of latest available forms for data collection and entry:* For data collection in the field and for subsequent data entry, the predefined field protocols and entry forms are to be used. These are available on the FOEN website at: www.bafu.admin.ch/outcome-evaluation-resto. Individual documents will be updated over time. Users must ensure that they always use the latest version for surveys and data entry. Further information on data entry can be found in Factsheet 5.
- *Reporting of difficulties or inconsistencies:* Any difficulties encountered in the use of the technical sheets or in data entry should be reported to the FOEN immediately, by sending an email to: wiko_revit@bafu.admin.ch. Rapid notification will ensure that problems are promptly addressed centrally, and that support can be provided for all users.

8.2 Structure of the indicator set technical sheets

The technical sheets for the ten indicator sets are all identically structured. The content shown in Table 8.1 is presented in the different sections.

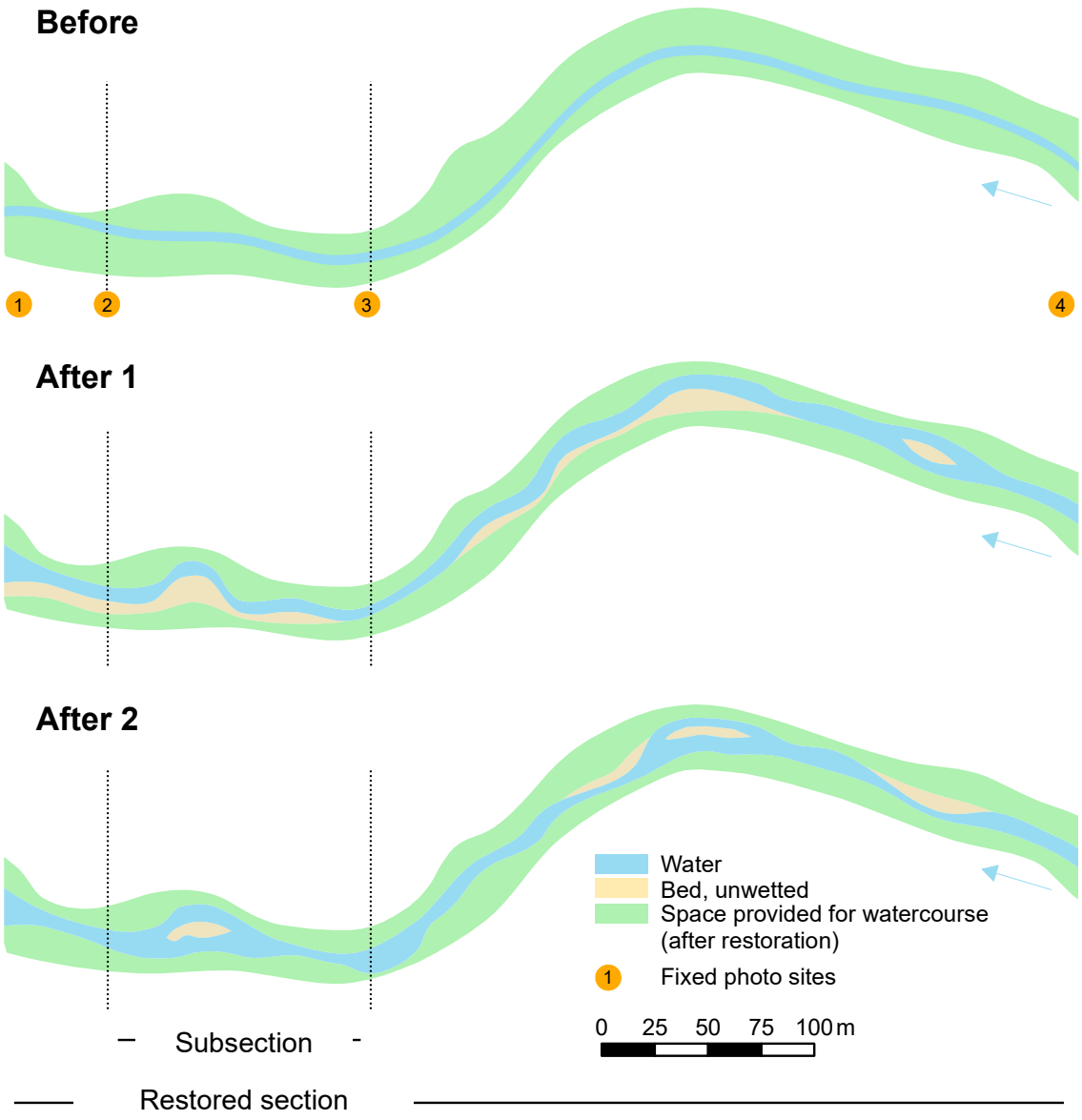
Table 8.1: Content presented in the technical sheets for the ten indicator sets

Section	Content
Title page	Overview of the scope and origins of the indicator set • *Name and symbol* of the indicator set • *List of the indicators contained*, including sources • *Status:* Date of the most recent updates to the technical sheet and version number • *Publication details* listing all contributors
Principle	Aim and purpose of the indicator set and fundamentals of the survey • *Background:* Explanation of the relevance of the indicators and relationship to the nine typical goals of restoration projects • *Parameters:* Brief definition of the key parameters determined • *Applicability:* Potential for, and limits to, application • *Special considerations:* Points to be specifically noted for the survey • *Survey site:* Site for determination of individual indicators (e.g. subsection, restored section) from a bird's-eye view • *Timing:* Seasonal time frame for determination of indicators. Need for replicate measurements. • *Material:* Special equipment required for the survey. The basic equipment for a field survey (writing materials, camera, suitable trousers, sunscreen, etc.) is taken for granted and not specifically listed.
Survey	Framework and procedure for the field survey • *Procedure:* Individual steps involved in the field survey and data analysis, in chronological order
Assessment of data for each indicator	Methods for the assessment of data collected in the field The assessment methods given derive in most cases from the original Indicator method sheets included in the "Handbook for evaluating rehabilitation projects in rivers and streams". These provide guidance and are to be revised in the coming years on the basis of experience accumulated in the STANDARD and EXTENDED outcome evaluation.
Time and personnel required	Estimated personnel and financial costs per survey (e.g. "before" survey) • *Estimated effort:* No. of persons, person-hours and level of expertise (specialists, assistants) required for the various steps. A rough cost estimate can be found in Table 2.1 of Factsheet 2.
Further information	Further information • *Data arising:* List of the data arising for the indicator set; see also Table 5.1 in Factsheet 5. • *Attachments:* Forms and other documents required for the survey. These are available on the FOEN website at: www.bafu.admin.ch/outcome-evaluation-resto • *List of modifications:* Details of changes made from one version to the next

8.3 Survey site

The "restored section" refers to the area in which a restoration measure is implemented. It comprises not only the aquatic habitat but also the surrounding area, i.e. at most the space provided for the watercourse after restoration. The location of the restored section is defined and surveyed (coordinates of lower and upper end) at the start of the outcome evaluation, i.e. prior to the "before" survey, and remains unchanged for the "before" and "after" surveys (Fig. 8.1). Certain surveys are performed along the entire restored section, e.g. parts of Indicator Set 1 (mapping of river bed and bank structures; Table 8.2). Other surveys, particularly for the resource-intensive biological indicator sets, but also more detailed investigations of habitat diversity (Indicator Set 1), are performed in a characteristic subsection of the restored section.

Figure 8.1: The restored section and subsection over the course of the “before” and “after” surveys. Direction of flow is from right to left.



The subsection is also defined at the start of the outcome evaluation. It should be situated in a part of the restored section which is particularly characteristic for the purposes of the project. As the project has yet to be implemented when the subsection is selected, the exact location must be determined on the basis of project plans, models or expected changes.
The subsection has a length of approx. 12 river bed widths (bank toe to bank toe, after restoration), but is at least 100 m and at most 200 m long. In the case of restorations shorter than 100 m, the subsection covers the entire restored section, and the width is that of the space provided for the watercourse after restoration. The location of the subsection does not change, i.e. it remains the same for the “before” and “after” surveys (Fig. 8.1). The site of the subsection is to be surveyed (coordinates of lower and upper end) and recorded in the field protocols for the indicator sets concerned. Likewise, the restored section and subsection are photographed from fixed locations in the course of the determination of Indicator Set 1 (photo sites 1–4 in Fig. 8.1). An aerial (drone-shot) photograph documenting the entire restored section is recommended.

Table 8.2: Survey site for indicators in the 10 indicator sets. *Plus possible extension (see technical sheet of the relevant indicator set)

Indicator set	Indicator	Survey site
1. Habitat diversity	1.1 River bed structures	Restored section
	1.2 River bank structures	Restored section
	1.3 Water depth	Subsection
	1.4 Flow velocity	Subsection
	1.5 Presence of cover	Subsection
	1.6 Substrate	Subsection
2. Dynamics	2.1 Temporal changes in diversity of geomorphic river bed structures	Restored section
	2.2 Temporal changes in quantity and spatial extent of morphological units	Restored section
	2.3 Change in river bed elevation	Restored section
3. Connectivity	3.1 Flood dynamics	Restored section
	3.2 Shoreline	Restored section
4. Temperature	4.1 Temperature	Subsection
5. Macrophytes	5.1 Macrophyte community	Subsection*
6. Macroinvertebrates	6.1 Macroinvertebrate community	Subsection
7. Fish	7.1 Fish community	Subsection
	7.2 Age structure of fish population	Subsection
	7.3 Ecological guilds of fish	Subsection
8. Riparian vegetation	8.1 Plant species	Restored section
	8.2 Plant communities	Restored section
	8.3 Temporal shift in the mosaic of floodplain vegetation categories	Restored section
9. Avifauna	9.1 Bird species	Restored section*
10. Society	10.1 Stakeholder acceptance	Restored section

8.4 Timing of surveys

All the indicator sets have specific seasonal time frames within which they have to be determined. In addition, for a survey to be meaningful, certain conditions need to be met, e.g. with regard to discharge. The time frames and conditions for surveys are shown in Table 8.3 and are specified in the technical sheets for all the indicator sets.

Table 8.3: Seasonal time frame for determination of indicator sets. LF = low flow, MF= mid-flow. Dark green = recommended time frame. Light blue = possible time frame.

	Month												Discharge		Notes/requirements
	1	2	3	4	5	6	7	8	9	10	11	12	LF	MF	
1. Habitat diversity							■	■	■	■			✓		Good transparency
2. Dynamics	■	■									■	■	✓		Vegetation-free, Set 1 determined in advance
3. Connectivity	■	■	■	■	■	■	■	■	■	■	■	■	✓	✓	Modelling
4. Temperature						■	■	■					✓		Assessment of fair-weather periods; Set 1 determined in advance
5. Macrophytes						■	■	■	■				✓	✓	Good transparency, Set 1 determined in advance
6. Macroinvertebrates			■	■	■	■							✓	✓	Campaign II (optional) from May to September, depending on altitude; Set 1 determined in advance
7. Fish							■	■	■				✓		Good transparency, Set 1 determined in advance
8. Riparian vegetation					■	■	■	■					✓	✓	
9. Avifauna					■	■	■						✓	✓	
10. Society	■	■	■	■	■	■	■	■	■	■	■	■			

List of modifications

Relevant changes are marked in green.

Date (mm/yy)	Version	Change	Responsibility
4/2020	1.02	Correction of spelling errors, minor terminological modifications	Eawag
4/2020	1.02	Minor graphical modifications	Eawag
4/2020	1.02	Modification Table 8.3: • Indicator set 1: Survey possible all year round under appropriate conditions. • Specification color code in the table caption.	Eawag

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Federal Department of the Environment,
Transport, Energy and Communications DETEC

Federal Office for the Environment FOEN
Water Division

Last revised: 15.3.2024; Version 1.06

Technical Sheet: Indicator Set 1 Habitat diversity

Indicators:

- 1.1 River bed structures (in accordance with Woolsey et al. 2005, no. 36)
- 1.2 River bank structures (in accordance with Woolsey et al. 2005, no. 45)
- 1.3 Water depth (in accordance with Woolsey et al. 2005, no. 17)
- 1.4 Flow velocity (in accordance with Woolsey et al. 2005, no. 16)
- 1.5 Presence of cover (in accordance with Woolsey et al. 2005, no. 11)
- 1.6 Substrate (in accordance with Woolsey et al. 2005, no. 35 and Hunzinger et al. 2018)

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PDF download:
http://www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, German and Italian.

This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

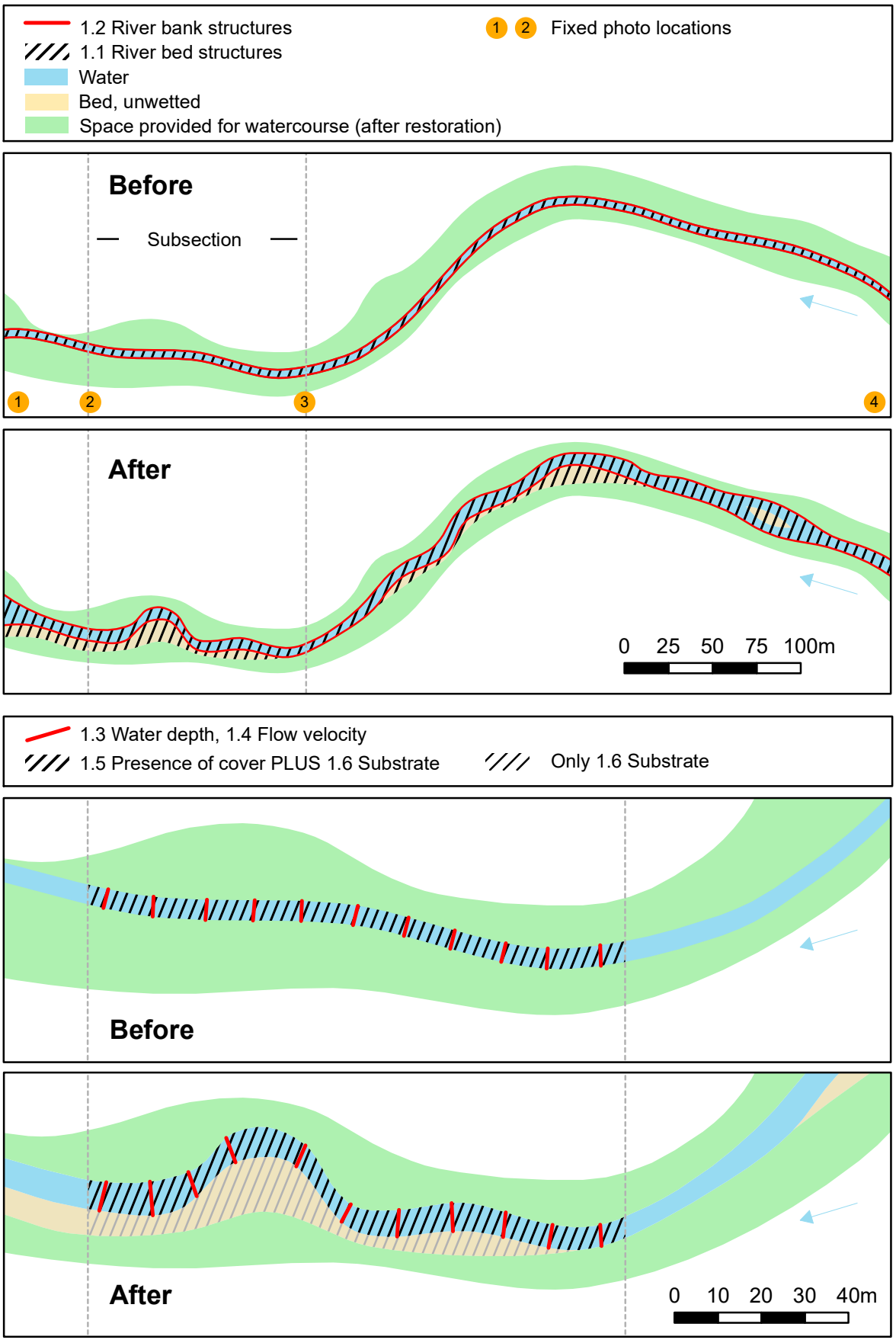
Principle

A river or stream section comprises a diverse mosaic of aquatic and terrestrial habitats. These habitats are shaped by abiotic processes, such as floods or bedload transport, but also by biological activity, such as plant growth or beaver operations. The habitats are used by different types of organisms, depending on the flow velocity, water depth or substrate composition. Indicator Set 1 is used to determine to what extent habitat diversity is altered by a restoration project; it thus provides the basis for the determination and interpretation of the biological indicator sets. Indicator Set 1 covers morphological bed and bank structures, the resultant hydraulic conditions (water depth, flow velocity), and substrate composition and mobility. Some of the indicators are determined along the entire restored section; the others are determined within a selected subsection (see also Factsheet 8 in the practice documentation).

This symbol is used to share tips and tricks from users.

Parameters	The following parameters are determined along the entire restored section: • River bed structures: occurrence and area of 9 types of structure • River bank structures: length of bank with different types of profile, composition and slope The following parameters are determined within a selected subsection, in which the biological indicator sets are also determined: • Flow velocity: distribution along at least 10 cross sections • Water depth: distribution and maximum along at least 10 cross sections • Presence of cover: occurrence and area [m^2] of 13 types of cover • Substrate: proportions of substrate area with different types of composition and mobilisability
Applicability	Indicator Set 1 is specified for all projects for which an outcome evaluation is conducted. It is particularly suitable for wadable watercourses, but it can also – with certain adjustments (e.g. measurements performed from a boat) – be used for large watercourses.
Special considerations	The timing of the determination of Set 1 should coincide as closely as possible with the biological surveys. This will permit the direct comparison of abiotic and biotic factors. Types of structure and cover cannot always be unequivocally classified; this task requires experience on the part of the observer. Different observers lacking experience can produce significantly different results. With the surveys described here, other indicators of habitat diversity can also be calculated – e.g. the IAM (Indice d'attractivité morphodynamique; Vonlanthen et al. 2018) or the HMID (Hydromorphologischer Index der Diversität; Gostner & Schleiss 2012).
Survey site	Restored section and subsection (see Fig. 1.1) The surveys extend across the entire width of the river bed, i.e., across the area between the left and right toe of the bank. This area is regularly mobilised during floods and is correspondingly free of perennial vegetation.
Timing	From a methodological perspective, the following points are to be noted: • Favourable discharge conditions, i.e. mean low flow as, for example, in late summer and autumn for low-lying watercourses (Q200–Q300), good transparency • The "before" and "after" surveys should be conducted under comparable discharge conditions. • No surveys directly after intense high flows, i.e. wait until representative structural-morphological conditions have re-established (e.g. macrophyte growth). • If macrophytes are present in the watercourse and they are mown for maintenance purposes, the survey should be conducted before mowing takes place.
Material	• General and detailed maps (e.g. high-resolution orthophoto), measuring tape, measuring rod, flow meter, waders. • Boat (for deeper rivers, to measure water depth and flow velocity)

Figure 1.1: Survey site for the indicators from Indicator Set 1.



Survey

The survey involves two stages: first, the entire restored section is mapped to provide a rough description of the river bed and bank structures; then, a selected subsection is surveyed in more detail (flow velocity, water depth, presence of cover, substrate). The location of the subsection remains unchanged before and after restoration, i.e. the “after” surveys are conducted in the same place (Factsheet 8).

Step	Description	Indicator
Preparation for mapping of the entire restored section	• Preparation of a general map (e.g. detailed site map, map, sketch, recent drone-shot aerial photo) which covers the entire restored section and on which the river bed and bank structures can be marked (minimum scale 1:1000). • For the “after” surveys, the general map may need to be thoroughly revised, or a new one prepared, depending on the extent of changes occurring in the course of the restoration project. For digital mapping, e.g. by means of QField, see tips on page 7	
Mapping of river bed structures (restored section)	• Inspection (on foot) of the entire restored section. Identification of river bed structures (Table 1.1) across the entire bed width (see survey site in the chapter "Principle"), i.e. including the unwetted areas such as open gravel or sand banks (Fig. 1.1). • Marking of the position and extent of river bed structures (area, shape) on the general map. Minimum area of a river bed structure: 3–5 m^2 for large, 1–3 m^2 for medium-sized and 0.5–1 m^2 for small watercourses (half to whole bed width). • For larger watercourses, mapping with the aid of a recent aerial photo will be most efficient. • Temporary structures established for recreational purposes (stone dams or piles, swimming areas) are not taken into account, i.e. what is mapped are the bed structures which would exist without them (generally shallows). • Block ramps are mapped differently depending on their construction type: - Closed block ramps = artificial bed (0). - Structured dissolved block ramp = sequence step (8) – plunge pool (9). Note: Only 1 step and 1 plunge pool are considered in the assessment for the entire restoration section so that the density of structures is not artificially increased. - Unstructured dissolved block ramp = run (5)	1.1
Mapping of river bank structures (restored section)	• In parallel with the mapping of river bed structures: mapping of the shoreline (= boundary between water and land). N.B. The shoreline does not necessarily run directly along the bank toe. The shoreline of side channels or backwaters is to be included. Water bodies that are disconnected from the main channel and are usually temporary are only considered if they are located in the regularly mobilised area of the bed (see survey location in the "Principle" chapter). • Characterisation of river bank structures based on the attributes of profile (= water-land interconnection), composition and slope (Table 1.2), and marking of their position and extent (length) on the general map. Minimum length of a river bank structure: at least 1 m in small, 3 m in medium-sized and 5 m in large watercourses.	1.2
Photo-documentation of the restored section	• Concurrently with the mapping of river bed and bank structures, up- and downstream photographs are taken at each of 4 fixed locations, from one of the two banks (Fig. 1.1). • For purposes of photo-documentation, a drone-shot aerial photograph (orthomosaic) is recommended, but is not a requirement.	

Preparation for mapping of subsection	• Based on the changes to be expected as a result of restoration, a subsection characteristic of the restoration project is selected (Factsheet 8). • The length of the subsection should be approx. 12 times the width of the river bed after restoration (from left bank toe to right bank toe, including unwetted areas) and should be at least 100 m and at most 200 m (Factsheet 8). • If the restored section is shorter than 100 m, then the entire restored section is studied. • For the subsection, a detailed map is prepared. Depending on the length of the restoration project, the map section or scale may need to be adjusted, compared to the general map.  For digital mapping, e.g. by means of QField, see tips on page 7	
Measurements along cross sections (subsection)	• Surveying of 10–15 cross sections at more or less regular intervals along the subsection, i.e. approx. every 10 m, at right angles to the river axis. Any notable features lying in between (e.g. local channel narrowing) are to be taken into account. The exact position of each cross section is recorded on the detailed map.  It is worth marking out the subsection and the location of the cross sections (e.g. using stakes) before starting the field surveys. The location of the cross sections can thus be recorded on the detailed map in advance. This will also facilitate recording of the available cover and the substrate (indicators 1.5 and 1.6). • Measurement of water depth and flow velocity at (at least) 10 points along the cross section, every 0.2 m to 1 m, at equal intervals. If fewer than 10 points can be measured – due to a low wetted width (< 2 m) – then a larger number of cross sections should be sampled. Overall, measurements should be made at approx. 150–200 points. • Water depth [m]: accurate to cm level, i.e. to 2 decimal places (x.xx m) • Flow velocity [m/s]: at 40% of water depth, i.e. 40% above the river bed. Accurate to cm level, i.e. to 2 decimal places (x.xx m/s). • Measurement of the wetted width. • Determination of the wetted area (= length of the study section x mean wetted width)	1.3, 1.4
Mapping of available cover (subsection)	• Mapping of all types of cover in accordance with Table 1.4. The area of each cover is recorded on the detailed map and assigned to a cover type. • Deciding whether to map or not: Ask yourself whether a fish of 25-30cm length can hide in/under it. If yes -> map. • If cover can be assigned to two or more types, the area is only assigned to the dominant type.	1.5
Mapping of substrate (subsection)	• Characterisation of the substrate, based on its composition and mobilisability (Table 1.3). Exception: Gravel is not naturally mobilized in lake outlets, bog streams and groundwater-fed streams. Accordingly, the survey and assessment of mobilisability can be dispensed with there. However, the composition of the substrate is still surveyed. • Recording of areas with uniform composition and mobilisability on the detailed map. Minimum area for substrate mapping: 3–5 m^2 for large, 1–3 m^2 for medium-sized and 0.5–1 m^2 for small watercourses. • Optionally (necessary for calculation of the IAM), the compactness of the river bed per area of uniform substrate can be qualitatively assessed using the boot test (Schälchli 2002): the effort and force required to loosen the top layer with the foot. Three categories – easy (no to little compaction), medium (moderately packed), high (tightly packed). • In case of sintering: - Composition: If there is no interstitial/pore space, then map as rock (7). If it has interstitial spaces, then as boulders (6).	1.6

- Mobilisability: The bed is no longer mobilisable in the case of sintering, i.e. similar to a cover layer -> no mobilisation (5), regardless of whether texture indicated as rock or blocks.

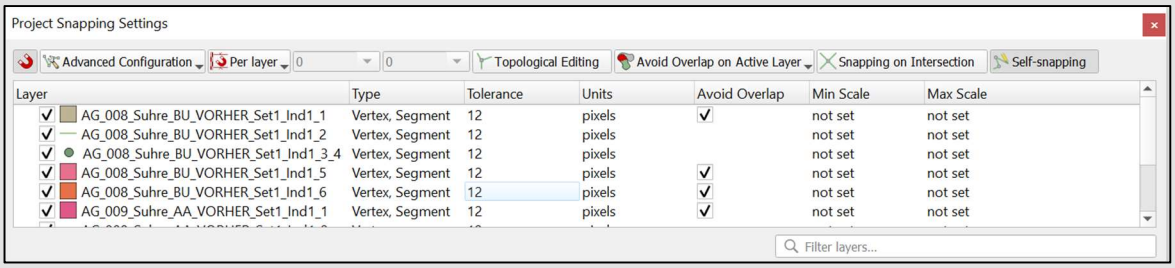
Digitalisation of general and detailed maps (data mapped in the field)	• Digitalisation of the survey data, using GIS, under consideration of the requirements defined in the data model (download under “Hilfsmittel” on the FOEN webpage; there you can also find a GIS sample dataset) • Creation of 2 shapefiles for the restored section (for the file naming scheme, see “Data arising” below): 1. Polygon shapefile for the 9 river bed structures 2. Line shapefile for the river bank structures, with profile, composition and slope • Creation of 3 shapefiles for the subsection 1. Point shapefile for water depth and flow velocity along cross sections 2. Polygon shapefile for the 13 cover types 3. Polygon shapefile for substrate based on composition and mobilisability The following procedure is recommended for digitizing the data mapped in the field: 1. optional: georeferencing drone image. Use of Swisstopo aerial images -> available free of charge since 1.3.21: https://www.swisstopo.admin.ch/de/geodata/images/ortho/swissimage10.html 2. placing of the cross sections. 3. reading in the data for the cross sections (instructions under "Hilfsmittel" on the FOEN website). 4. Draw the shoreline and divide it into sections according to the shoreline structure. In the subsection, orient to cross sections and pay attention to precision. 5. draw the bed surface and divide it into subsections according to the bed structure. The bed area extends beyond the shoreline if benches are present, otherwise shoreline as boundary. 6. drawing the valley path. The length of the valley path is used to determine the average width of the stream bottom (= bed area / length of valley path) and from this the unit length. 7. drawing of shelter offer (subsection). Can project above the shoreline (ex. stone groynes, undercut banks). 8. drawing from substrate (subsection). Extends beyond shoreline if gravel bars are present, otherwise shoreline as boundary. • Requirements for quality of GIS data to be submitted: - All lines must be coupled except at the beginning and end of the section. - There must be no self-intersections or duplicate nodes. - Polygons must contain at least three nodes. - Polygons of the same shapefile must not overlap each other. - Polygons of the bed structure or the substrate must not have any gaps between them. A topology check/ geometry check allows to identify these error sources. In QGIS the *Geometry Checker* plugin can be used for this purpose. https://docs.qgis.org/3.34/en/docs/user_manual/plugins/core_plugins/plugins_geometry_checker.html The following principles and settings are recommended: • Carry out separate geometry checks for each layer • Geometry check rules: - Points: • Topology checks –> Check for Duplicates - Lines: • Geometry validity –> Self-intersections • Geometry validity –> Duplicate nodes • Geometry validity –> Self contacts	

- For polygons:
  - Geometry validity –> Self-intersections
  - Geometry validity –> Duplicate nodes
  - Geometry validity –> Self contacts
  - Geometry validity –> Polygon with less than 3 nodes
  - Geometry properties –> Polygons and multipolygons may not contain any holes
  - Geometry conditions –> Minimal polygon area *0.2 map units squared based on small watercourses*
  - Geometry conditions –> No sliver polygons *maximum thinness 20*
  - Topology checks –> Check for features within other features
  - Topology checks –> Check for overlaps smaller *than 10 map units squared*
  - Topology checks –> Check for gaps smaller than *10 map units squared*

Digital mapping in the field

Prior to fieldwork

- Set snapping settings in the QGIS project
  - Project –> *Snapping Options –> Advanced Configuration*
  - Select the following settings:
    - Enable Snapping
    - Enable Topological Editing
    - Select Avoid Overlap on Active Layer
    - Enable Snapping on Intersection
    - Layers: Check all
    - Type: Vertex and Segment for all layers
    - Tolerance: 12 (default)
    - Units: pixels
    - Check Avoid Overlap for polygons



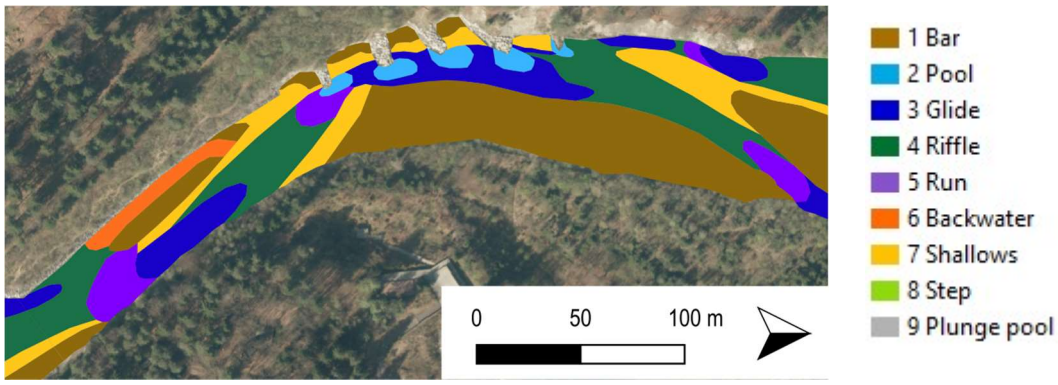
During Fieldwork

- Do NOT use the freehand digitizing feature in QField
- Do not zoom in past the scale 1:100 for drawing
- Note: with the snapping sections selected, it will be possible to draw over existing polygon features in the active layer without creating overlapping features

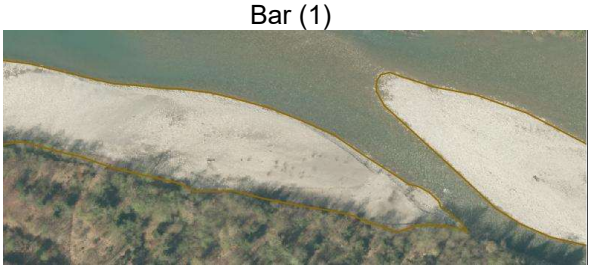
Table 1.1: River bed structures mapped along the restored section for Indicator 1.1, including, by way of example, photos of the Kander (canton of Bern) and of a step-pool sequence (Photos: Flussbau AG).

No.	Structure	Description
1	Bar	Local sediment deposit, not submerged during low-flow conditions, in the middle of the river or along the bank
2	Pool	Local deepening of river bed due to erosion by secondary currents and/or eddies
3	Glide*	Elongated, deep channel section with slow current. Wetted width/depth ratio low (<10–12).
4	Riffle*	Broad, elevated portion of river bed with slow current, with a low gradient. Wetted width/depth ratio higher (>10–12).
5	Run*	Steep channel section with swift current, with a high gradient
6	Backwater	Wetted area with no current during low-flow conditions (“dead end”)
7	Shallows	Low-current zone along the bank or along a gravel bar
8	Step**	Natural or artificial drop followed by a pool. The step begins at the point in the upper waters where flow is accelerated towards the drop and ends where the jet enters the lower waters; here the pool begins.
9	Plunge pool**	Larger depression following a step
0	Artificial bed	Local artificial stabilisation of the river bed, which is not mapped as a step

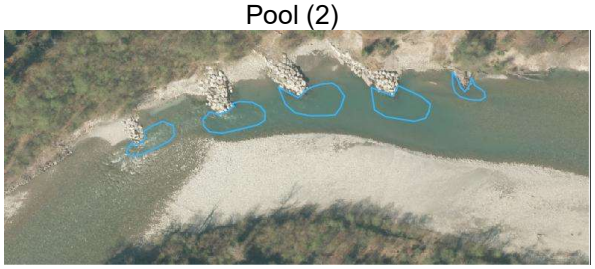
* Glide, riffle and run together form a sequence typical of low-gradient rivers (gradient <3%).
** Step-pool sequences are natural features of steep waters (gradient >1%), which appear as a result of artificial sills, but also in more gently sloping rivers.



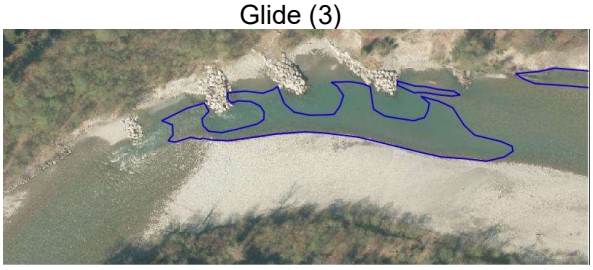
Bar (1)



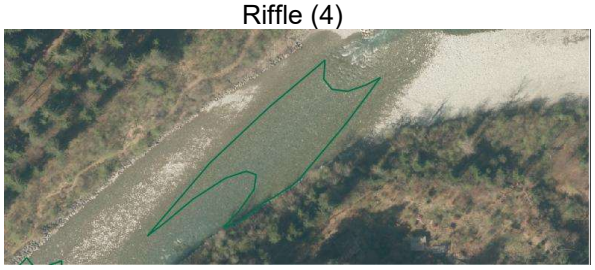
Pool (2)



Glide (3)

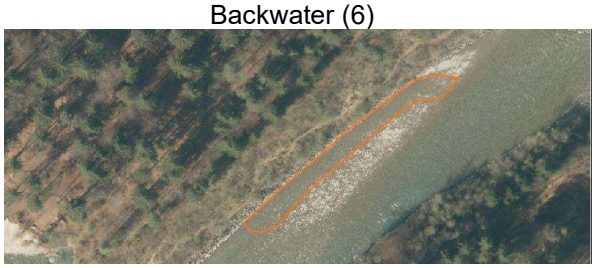


Riffle (4)

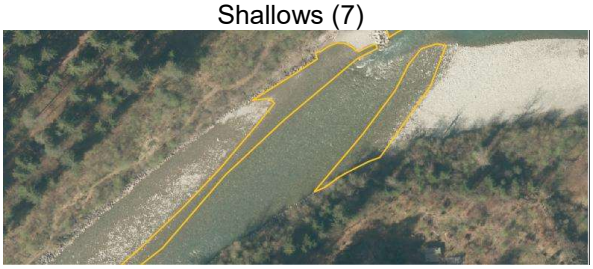


Run (5)

Backwater (6)



Shallows (7)



Step (8) – Plunge pool (9)

Table 1.2: Three attributes of river bank structures which are mapped for Indicator 1.2 along the restored section. The photos illustrate the various qualities for profile, composition and slope (Photos: Flussbau AG).

Attribute	No.	Quality
Profile	1	Linear
	2	Convex: cape, the bank projects into the water
	3	Concave: bay, the water extends into the bank
Composition	1	Permeable embankment (rough banks), e.g. bioengineering, loosely packed natural stones, wood
	2	Impermeable embankment (smooth banks), e.g. tightly packed natural stones, wall, concrete grid
	3	Unconsolidated material (including grass)
	4	Root systems
	5	Rock
Slope	1	Gentle (≤ 1:2)
	2	Steep (> 1:2)

Permeable embankment, steep

Impermeable embankment, steep

Rock, steep

Impermeable embankment, steep, linear

Convex

Concave

Unconsolidated material, gentle

Unconsolidated material, steep

Root systems, steep

Unconsolidated material, steep

Table 1.3: The two attributes of the substrate (Indicator 1.6). The attribute “mobilisability” corresponds to the parameter “substrate type” in the enforcement aid for reactivation of bedload transport (Hunzinger et al. 2018; photos Flussbau AG).

Attribute	No.	Quality	
Composition	1	Silt/fine sediment	<0.2 mm
	2	Sand	0.2–2 mm
	3	Gravel	2–16 mm
	4	Stones	16–64 mm
	5	Large stones	64–250 mm
	6	Boulders	>250 mm
	7	Rock	impermeable
	8	Organic material	e.g. grasses, reeds, roots, branches, woody debris
	9	Artificial substrate	e.g. engineered bed
Mobilisability	1	Deposits of suspended particles	Sand, silt
	2	Fine bedload	Finer-grained portions of regularly transported bedload (*)
	3	Coarse bedload	Coarser portions of regularly transported bedload (*)
	4	Bed material mixed with bedload	Bedload grains are deposited between the large grains of bed material (*)
	5	Coarse bed material	Large grains of bed material predominate, often arranged in an imbricated structure (*)

(*) Do not be deceived by the grain sizes in the photos below - the grain sizes for mobilisability vary depending on the water body and must be determined accordingly on a water body-specific basis.

Suspended particle deposits

Fine bedload

Coarse bedload

Bed material mixed with bedload

Coarse bed material

Table 1.4: Types of cover mapped in the subsection for Indicator 1.5.

No.	Cover type
1	Submerged stones or boulders
2	Non-submerged stones or boulders (also areas behind rocks)
3	Small organic particles (mobile, e.g. small branches, collections of leaves, grass)
4	Medium-sized organic particles (relatively immobile, e.g. fine roots, bryophytes 5–20 cm in diameter)
5	Large branches in the water, large roots (from trees standing along the waterside)
6	Tree trunks (lying)
7	Tree stumps or intact root plates (lying)
8	Overhanging vegetation (dead or living, up to a maximum of 50 cm above the water surface)
9	Undercut banks
10	Submerged plants, floating plants
11	Overhanging grass / reeds
12	Turbulent water zones
13	Pools (various pool types are combined)

Evaluation

The evaluation approaches given below are based on those found in the original publications for the indicators (Woolsey et al. 2005; Hunzinger et al. 2018). They serve as a guide and will be revised in the coming years on the basis of the experience accumulated in the STANDARD and EXTENDED outcome evaluations. An evaluation file can be found on the FOEN website under "Hilfsmittel". In it, various steps of the evaluation and assessment of the data are explained and automated.

Indicator	Description
1.1 River bed structures	To be determined are the number of structures per structure type and the total number of structures per unit length (e.g. 2 pools, 1 bar, 1 glide). To do so, the restored section is divided into subreaches, each one a unit length long (= unit length section). If the restoration section is longer than an integer multiple of the unit length, a residual section remains that is also evaluated. A structure is counted if it does not adjoin another structure of the same type within a unit length section. Structure type 0 (artificial bed) is excluded from the calculations, i.e. not counted. If a structure extends across the boundary between two unit length sections, it must be decided on a case-by-case basis whether the structure is counted in both sections or only in the section in which the larger part of the structure is located. Criteria to be considered for the decision are, for example, the size of the smaller part of the structure or the influence on the evaluation (representativeness of the evaluation for the unit length section). Defined as “unit length” is a length 12 times the width of the river bed (from left bank toe to right bank toe, including unwetted areas). This corresponds to the mean wavelength of alternate bars or meanders. The evaluation classes and the conversion to dimensionless normalised values are as follows for each unit length section and for the remaining section:

Evaluation classes	Normalised values
Only one structure type present	0
The structure type glide dominates. Other structure types occur with isolated, spatially isolated structures.	0.25
4 or more structure types are present with a density of 4-8 structures per unit length. If the structure type glide dominates, the structures of the remaining structure types locally form a diverse pattern.	0.5
All structure types of a glide-riffle-run or a natural or near-natural step-pool sequence present with a density of 8-11 structures of this sequence per unit length.	0.75
All structure types of a glide-riffle-run or a natural or near-natural step-pool sequence present with a density of 12 structures or more of this sequence per unit length	1

For the evaluation at the level of the restored section, the evaluations from the unit length sections are averaged weighted according to their length. This results in a value between 0 and 1.

1.2 River bank structures	For the evaluation, two parameters are calculated – one for the proportion of the shoreline with linear embankment (linear embankment parameter A_{Emb}) and one for the proportion of the shoreline lacking linear embankment (structural elements parameter $A_{Structure}$). Analogous to the procedure in indicator 1.1, the evaluation for both parameters is carried out at the level of the unit length sections and subsequent formation of the weighted average (see description of the evaluation of indicator 1.1):

- **Linear embankment parameter (A_{Emb}):**
  Shoreline linear, with embankment (structure types 111, 112, 121, 122)
  -> Profile = linear
  -> Composition = permeable or impermeable embankment

$$A_{Emb} = \frac{1}{2}\left(1 - \frac{L_{Impermeable\ embankment\ linear} + 0.5\ L_{Permeable\ embankment\ linear}}{L_{Bank}}\right)$$

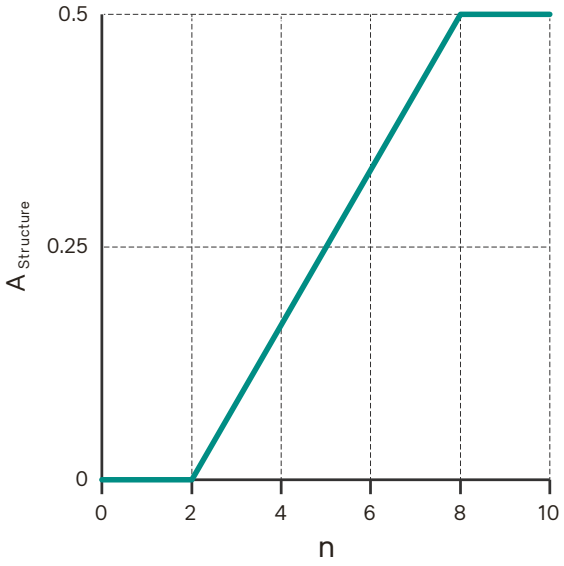
  Normalised values resulting for A_{Emb} are between 0 (smooth/ impermeable embankment on both sides) and 0.5 (no linear embankments).

- **Structural elements parameter ($A_{Structure}$):**
  Shoreline lacking embankments -> Composition = unconsolidated material, root systems, rock
  AND shoreline convex or concave with embankment -> Composition = permeable or impermeable embankment

  For the shoreline lacking linear embankment (i.e. for all structure types EXCEPT 111, 112, 121 and 122), the number of structure types present per unit length is determined (n). The structure types arise from the combination of the three attributes of river bank structures. The definition of “unit length” is given in the section on the evaluation of Indicator 1.1. The values n are normalised as shown in Figure 1.2.

n	$A_{Structure}$
< 2	0
2 ≤ n ≤ 8	$(n-2) * (\frac{1}{12})$
> 8	0.5

Figure 1.2: Calculation of the structural elements parameter ($A_{Structure}$) based on the number of structure types per unit length (n).



1.3 Water depth	To evaluate the distribution of maximum flow depth, the coefficient of variation of maximum water depth is calculated:

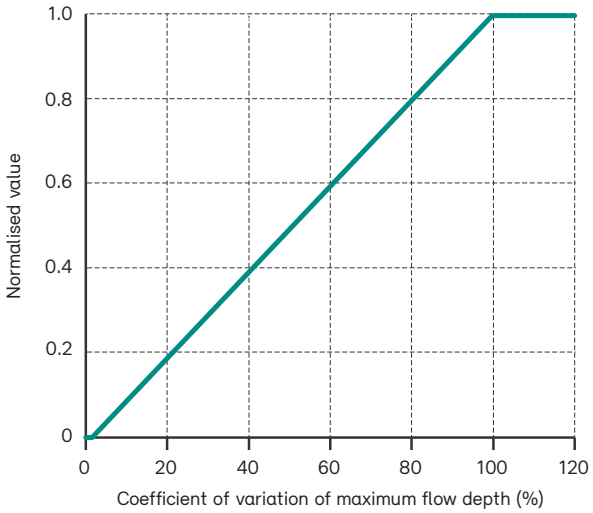
$$VC_{max.\ water\ depth} = \frac{\sigma_{max.\ water\ depth}}{\mu_{max.\ water\ dept}} x\ 100\ [\%]$$

$\sigma_{max.\ water\ dept}$ = Standard deviation of maximum water depths measured

$\mu_{max.\ water\ depth}$ = Mean of maximum water depths measured

For normalisation, a coefficient of variation of 0% corresponds to a value of 0, and a coefficient of variation of ≥100% corresponds to a value of 1, with the value function being linear in between (Figure 1.3).

Figure 1.3: Normalisation of results for Indicator 1.3 Water depth



1.4 Flow velocity	To evaluate the distribution of flow velocity, the coefficient of variation is calculated; in the formula, equal account is taken of all the flow velocities measured:

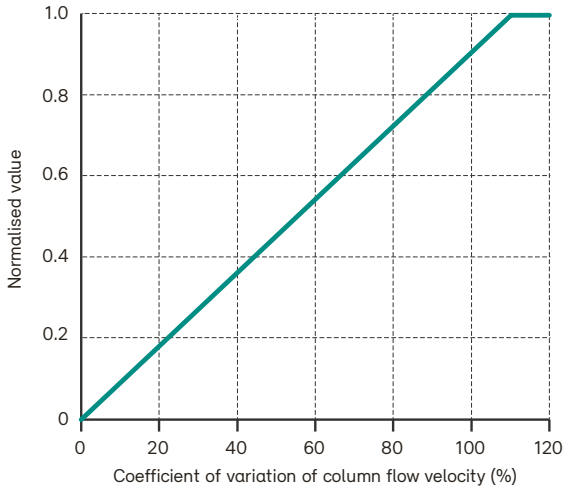
$$VC_{Flow\ velocity} = \frac{\sigma_{Flow\ velocity}}{\mu_{Flow\ velocity}} x\ 100\ [\%]$$

$\sigma_{Flow\ velocity}$ = Standard deviation of flow velocities measured

$\mu_{Flow\ velocity}$ = Mean of flow velocities measured

For normalisation, a coefficient of variation of 0% corresponds to a value of 0, and a coefficient of variation of ≥110% corresponds to a value of 1, with the value function being linear in between (Figure 1.4).

Figure 1.4: Normalisation of results for Indicator 1.4 Flow velocity



1.5 Presence of cover	The total area is calculated for each of the 13 cover types. Available cover is then determined for the entire wetted area (= “currently available cover” for the time point Before or After1 or After2).

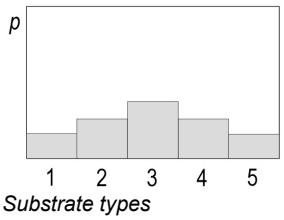
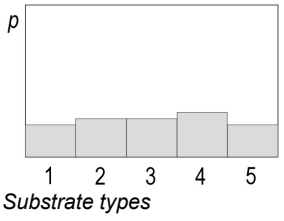
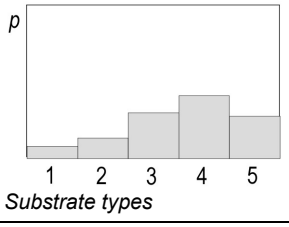
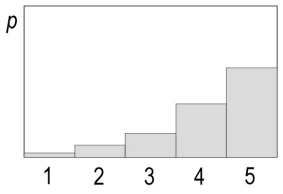
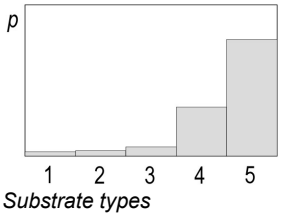
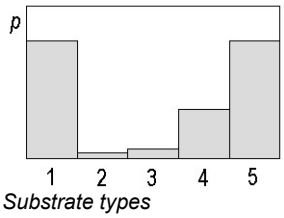
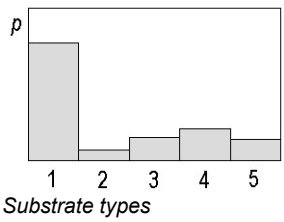
An estimation is then made of watercourse type-specific cover availability (reference condition). This step is currently based on expert knowledge (consideration of river type, knowledge of reference watercourses, possibly with the aid of known reference reaches of the watercourse).
Lastly, currently available cover is compared with watercourse type-specific cover availability.

$$\text{Proportion of reference condition [\%]} = \frac{\text{Currently available cover [\%]}}{\text{River type} - \text{specific cover availability [\%]}}\ x\ 100$$

This proportion describes closeness to the reference condition and can be evaluated or normalised using the following matrix. Here, deviation from reference conditions is evaluated (i.e. 100% minus proportion of reference condition [%]). Accordingly, not every increase in available cover automatically counts as an improvement.

	Evaluation scores				
	0	**0.25**	**0.5**	**0.75**	**1**
Deviation from reference condition (%)	Very strong deviation (>80%)	Strong deviation (50–80%)	Marked deviation (30–50%)	Slight deviation (10–30%)	No deviation (<10%)

1.6 Substrate	The attribute “mobilisability” is evaluated using the method described for the parameter “substrate type” in the enforcement aid for reactivation of bedload transport. The normalised value for the outcome evaluation (between 0 and 1) is apparent from the following list. “Substrate type” corresponds to the attribute of mobilisability defined in Indicator Set 1. For the attribute “Composition”, no evaluation method is currently available. It does, however, represent an important variable for the sampling and interpretation of the biological indicators.

1	Bedload deposits predominate. No or limited areas of coarse, armored bed material. Rather limited fine sediments.	
0.75	Balanced distribution of all classes.	
0.5	Mostly coarse substrate mixed with bedload. Some areas with bedload deposits.	
0.25	Mainly coarse and armored bed material, partly mixed with bedload. No areas with bedload deposits.	
0	Mainly coarse and armored bed material, locally also mixed with bedload.	
0	Predominantly coarse and armored bed material, with vaste fine sediment deposits. (-> This distribution is found, for example, in residual flow reaches where the flood discharge recedes unnaturally fast or which are influenced by reservoir flushing).	
0	Gravel bed covered with fine sediment deposits. (-> This distribution is found, for example, in shallow reaches of small streams with intensively farmed catchment areas or at the root of a dam).	

Time required

Table 1.5: Summary of time required in person-hours for the determination and evaluation of Indicator Set 1. General items (e.g. travel time) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation of field surveys (excl. drone flights)	1	2		
Field mapping of river bed and bank structures, per km	1	5–10		
Digitalisation of river bed and bank structures, per km			1	5–8
Survey of subsection	1	5–10	1–2	5–10
Data processing for subsection			1	8–16
Evaluation	1	4–8		
Total person-hours	16–30		18–44	

Notes: -

Further information

Data arising	• Data entry form Indicator Set 1: KT_ProCode_ERHEBUNG_Set1_V#.xls • Shapefiles, under consideration of the requirements defined in the data model (download under “Hilfsmittel” on the FOEN webpage) • River bed structures as polygon shapefile: KT_ProCode_ERHEBUNG_Set1_Ind1_1.shp • River bank structures as line shapefile: KT_ProCode_ERHEBUNG_Set1_Ind1_2.shp • Water depth and flow velocity along cross sections as point shapefile: KT_ProCode_ERHEBUNG_Set1_Ind1_3_4.shp • Cover types as polygon shapefile: KT_ProCode_ERHEBUNG_Set1_Ind1_5.shp • Substrate as polygon shapefile: KT_ProCode_ERHEBUNG_Set1_Ind1_6.shp • Photos from 4 fixed photo locations: KT_ProCode_ERHEBUNG_Set1_1up.jpeg; KT_ProCode_ERHEBUNG_Set1_1down jpeg; KT_ProCode_ERHEBUNG_Set1_2up.jpeg; KT_ProCode_ERHEBUNG_Set1_2down jpeg; KT_ProCode_ERHEBUNG_Set1_3up.jpeg; KT_ProCode_ERHEBUNG_Set1_3down jpeg; KT_ProCode_ERHEBUNG_Set1_4up.jpeg; KT_ProCode_ERHEBUNG_Set1_4down.jpeg» • If available, aerial (drone-shot) photograph documenting the restored section: KT_ProCode_ERHEBUNG_Set1_air.jpeg Elements of the file naming scheme (see Factsheet 5): • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	The field protocol, data entry form and other tools (e.g. evaluation file, geodata model, GIS example dataset) can be downloaded at: https://www.bafu.admin.ch/wirkungskontrolle-revit

List of modifications

Relevant changes are marked in green.

Date (mm/yy)	Version	Change	Responsibility
1/2023	1.05	Digitalisation of the data: Description of the step-by-step procedure	Eawag
1/2023	1.05	Addition of tips and tricks for the survey (marked with the symbol)	Eawag
1/2023	1.05	Various minor details (e.g. clarity of wording adjusted, mention of evaluation file and GIS sample data set)	Eawag
1/2023	1.05	Survey location: specification of the term ‘river bed’	Eawag
1/2023	1.05	Indicator 1.1: • Survey/evaluation: specification of handling of block ramps.	Eawag
1/2023	1.05	Indicator 1.2: • Survey: specify handling of disconnected water bodies.	Eawag
1/2023	1.05	Indicator 1.6: • Survey: specification of handling of sintering • Survey/evaluation of mobilisability: specification of procedure in bog streams, lake outlets and groundwater-fed streams • Evaluation of mobilisability: addition of two more distributions of substrate types to the listing.	Eawag
3/2024	1.06	Tips for geometry checks in QGIS	Eawag
3/2024	1.06	Tips for digital mapping in QField	Eawag

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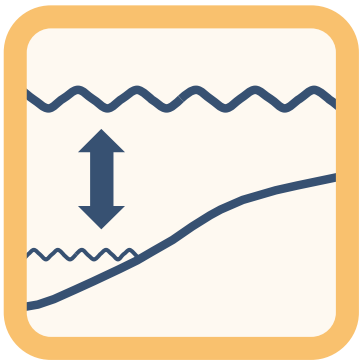
Federal Department of the Environment,
Transport, Energy and Communications DETEC

Federal Office for the Environment FOEN
Water Division

Last revised: 1.5.2020; Version 1.02

Technical Sheet: Indicator Set 2 Dynamics



Indicators:

- 2.1 River bed structure dynamics (Woolsey et al. 2005, no. 33)
- 2.2 River bank structure dynamics (Woolsey et al. 2005, no. 43)
- 2.3 Change in river bed elevation (in accordance with Hunzinger et al. 2018)

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PDF download:
http://www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, German and Italian.

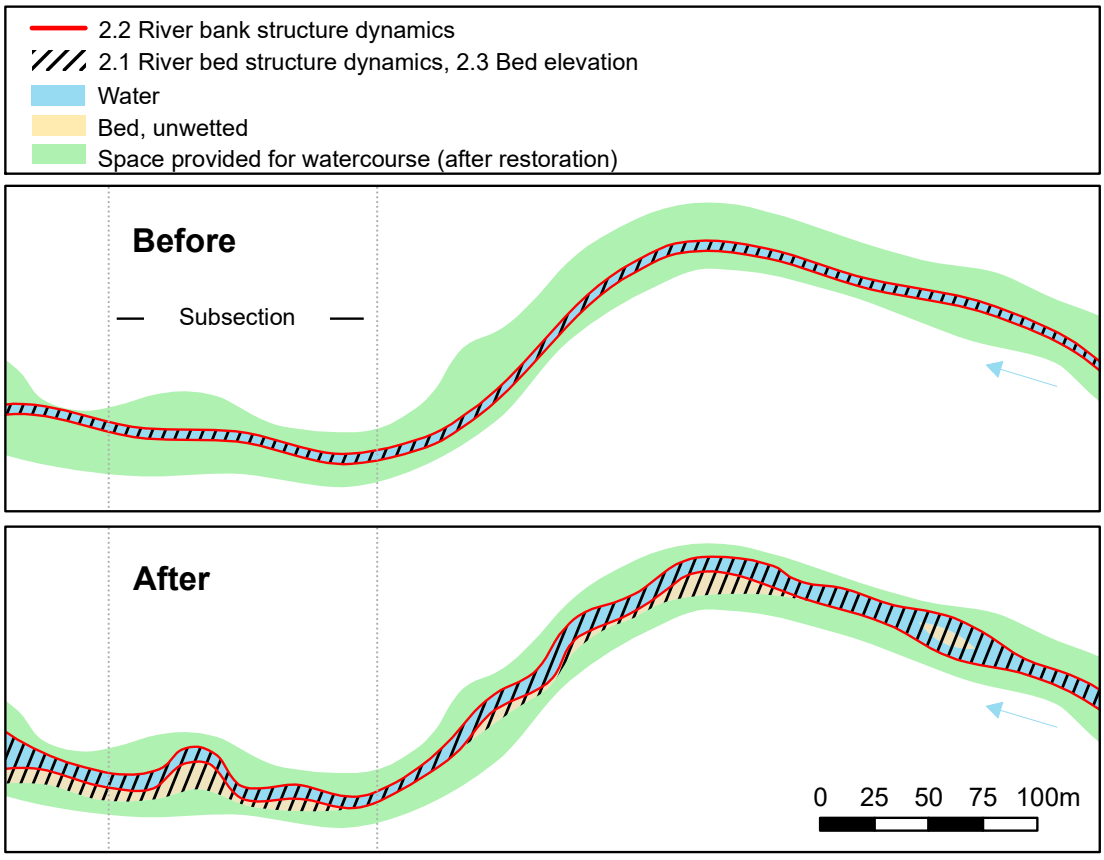
This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

In natural watercourses, the morphological bed and bank structures are continuously reshaped by floods, as solids are stirred up and gravel or wood is washed away or deposited. Structural changes over time are an indicator of the morphological dynamics of the watercourse and of the regenerative capacity of the ecosystem. Indicator Set 2 is based on the data collected in Indicator Set 1. It is determined how and to what extent the morphological bed and bank structures have changed, as well as the river bed elevation.

Parameters	Proportion of the bed area with altered bed structures (%) Proportion of the non-human-modified shoreline length with altered bank structures (%) Mean bed elevation (m asl)
Applicability	For the project sizes large and individual project.
Special considerations	In connection with Indicator Set 1, bed and bank structures are surveyed once before and twice after restoration; for Indicator Set 2, an additional “before” survey is conducted with the aid of aerial photography/cross-section surveying. The magnitude of flood discharges between two data collection points must be taken into account in the evaluation.
Survey site	Restored section (see Fig. 2.1)
Timing	One “before” survey and two “after” surveys of bed and bank structures are already conducted in connection with Indicator Set 1. For Indicator Set, 2 an additional “before” survey using aerial photography or cross-section surveying is required in order to determine the dynamics prior to restoration. Aerial photography or cross-section surveying should take place 5–10 years earlier – an interval corresponding to that between the two “after” surveys. Data is to be collected during low-water conditions. Between two data collection points, a discharge of at least HQ_2 must have occurred.
Material	Field map from Indicator Set 1. Aerial photographs or cross-section data from 5–10 years prior to restoration. Indicator 2.3 – Change in river bed elevation: equipment for geodetic survey.

Figure 2.1: Survey site for indicators from Indicator Set 2.



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Survey of structures	• Identification of bed structures (Table 1.1, Set 1) and bank structures (Table 1.2, Set 1) based on a large-scale aerial photograph and/or cross-section data collected 5–10 years prior to restoration. • Mapping of the position and size of structures	2.1, 2.2
Evaluation of structures	• Overlay/comparison of the bed structures and bank structures from two sets of data collected at different times. The choice of methodology is left to the user. • Determination of the areas where different bed structures were observed at the two time points. • Determination of the sections where different bank structures were observed at the two time points or where the shoreline has shifted. The extent of shoreline shifting is determined.	2.1, 2.2
Measurement of cross sections	• Geodetic survey of 12 cross sections along the entire restored section. The distance between two cross sections should be >1 bed width. • Cross sections are measured from the upper limit of one riparian zone to the upper limit of the other. The shape of the bed is recorded using at least 5 points. • In addition, 2 cross sections are surveyed upstream and 2 downstream of the restored section, at the same distance apart as in the restored section.	2.3
Determination of longitudinal profile	• For each cross section, the mean bed elevation is determined. • Representation of the longitudinal profile of the mean bed elevation. • Comparison of the longitudinal profile with the longitudinal profile in the reference condition. This is determined in accordance with Hunzinger et al. (2018), Section 3.2.3.	2.3

Evaluation

The evaluation approaches given below are taken from the original indicator method sheets in the "Handbook for evaluating rehabilitation projects in rivers and streams" (Woolsey et al. 2005). They serve as a guide and will be revised in the coming years on the basis of the experience accumulated in the STANDARD and EXTENDED outcome evaluations.

Indicator	Description
2.1 Bed structure dynamics	The sum of the areas with altered bed structures is divided by the total bed area: $$p = \frac{Area\ with\ altered\ bed\ structures\ (m^2)}{Total\ bed\ area\ (m^2)}$$ This value (p) is normalised as shown in Figure 2.2.
2.2 Bank structure dynamics	The sum of the shoreline length with altered bank structures or shoreline shifting is divided by the total length of the non-human-modified shoreline, and this value (p) is normalised as shown in Figure 2.3.

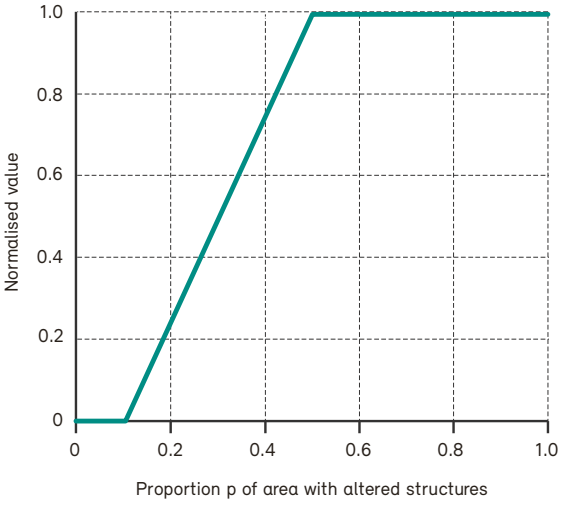
$$p = \frac{Shoreline\ length\ with\ altered\ bank\ structures\ (m) + \sum k_i \times shoreline\ length_i\ with\ shifting\ (m)}{Total\ length\ of\ shoreline\ without\ embankment\ \ (m)}$$

Extent of shoreline shifting:	k = 1	limited shoreline shifting	$\Delta Y \leq h$
	k = 2	moderate shoreline shifting	$h < \Delta Y \leq 10\ h$
	k = 3	channel displacement	$10\ h < \Delta Y$

ΔY = amount of shoreline shifting [m] along the cross-section axis, i.e. perpendicular to the river axis.
h = mean water depth across cross-sections at HQ_2 [m]

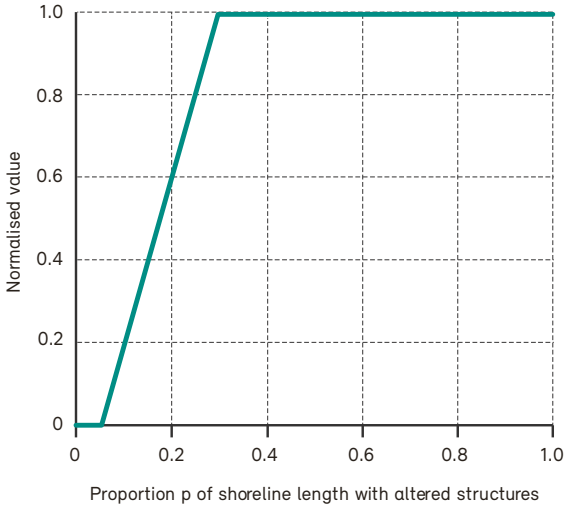
2.3 Change in bed elevation	Indicator 2.3 is normalised as follows:	
	Normalised value	*Longitudinal profile of mean bed elevation in restored section*
	1	≈ Longitudinal gradient in reference condition
	0.5	< Longitudinal gradient in reference condition
	0	<< Longitudinal gradient in reference condition

Figure 2.2: Normalisation of the bed structure dynamics indicator (2.1).



p	*normalised value*
≤ 0.1 (within measurement accuracy)	0
0.1 < p < 0.50	2.5 p – 0.25
> 0.50	1

Figure 2.3: Normalisation of the bank structure dynamics indicator (2.2).



p	*normalised value*
≤ 0.05 (within measurement accuracy)	0
0.05 < p < 0.30	4 p – 0.2
> 0.30	1.0

Time required

Table 2.1: Summary of time required in person-hours for the determination and evaluation of Indicator Set 2. General items (e.g. travel time) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	**Specialists**		**Assistants**	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation (acquisition of aerial photographs, earlier cross-section data)			1	2–4
Determination of bank and bed structures from aerial photographs/cross-section data	1	8		
Overlay of site maps			1	8
Determination of mean bed elevation, evaluation of cross-section survey			1	8
Determination of reference bed elevation, evaluation	1	4		
Total person-hours	12		18–20	
Notes: The costs for a geodetic cross-section survey amount to approx. CHF 200/cross section in a stream up to 5 m wide, and approx. CHF 400/cross section in a larger watercourse. The periodic FOEN cross-section surveys may also be used.				

Further information

Data arising	• Data entry form for Indicator Set 2: KT_ProCode_ERHEBUNG_Set2_V#.xls • River bed structures at 5–10 years before restoration as polygon shapefile: KT_ProCode_ERHEBUNG_Set2_Ind2_1.shp • River bank structures at 5–10 years before restoration as line shapefile: KT_ProCode_ERHEBUNG_Set2_Ind2_2.shp Elements of the file naming scheme (see Factsheet 5) • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	The field protocol, data entry form and other useful documents are available at: https://www.bafu.admin.ch/wirkungskontrolle-revit

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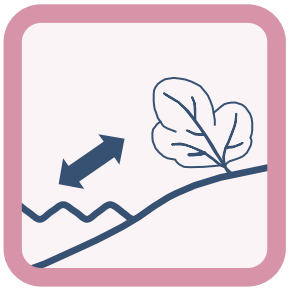
Technical Sheet: Indicator Set 3 Connectivity



Indicators:
- 3.1 Inundation dynamics (Woolsey et al. 2005, no. 13)
- 3.2 Shoreline length (Woolsey et al. 2005, no. 44)

Publication details

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Scientific advice for update (2019):
Experts consulted: Lukas Hunzinger (Flussbau AG), Lorenz Moosmann (Öko-Institut e.V.), Klement Tockner (Österreichischer Wissenschaftsfonds FWF), Volker Weitbrecht (VAW)
National advisory group: Ulrika Åberg (Eawag), Marco Baumann (TG), Simone Baumgartner (BAFU), Anna Belser (BAFU), Nanina Blank (AG), Arielle Cordonier (GE), Roger Dürrenmatt (SO), Claudia Eisenring (TG), Martin Huber-Gysi (BAFU), Lukas Hunzinger (Flussbau AG), Manuela Krähenbühl (ZH), Vinzenz Maurer (BE), Nathalie Menetrey (VD), Erik Olbrecht (GR), Eva Schager (NW), Lucie Sprecher (Eawag), Gregor Thomas (BAFU), Pascal Vonlanthen (Aquabios), Heiko Wehse (Hunziker Betatech), Christine Weber (Eawag), Hansjürg Wüthrich (BE)

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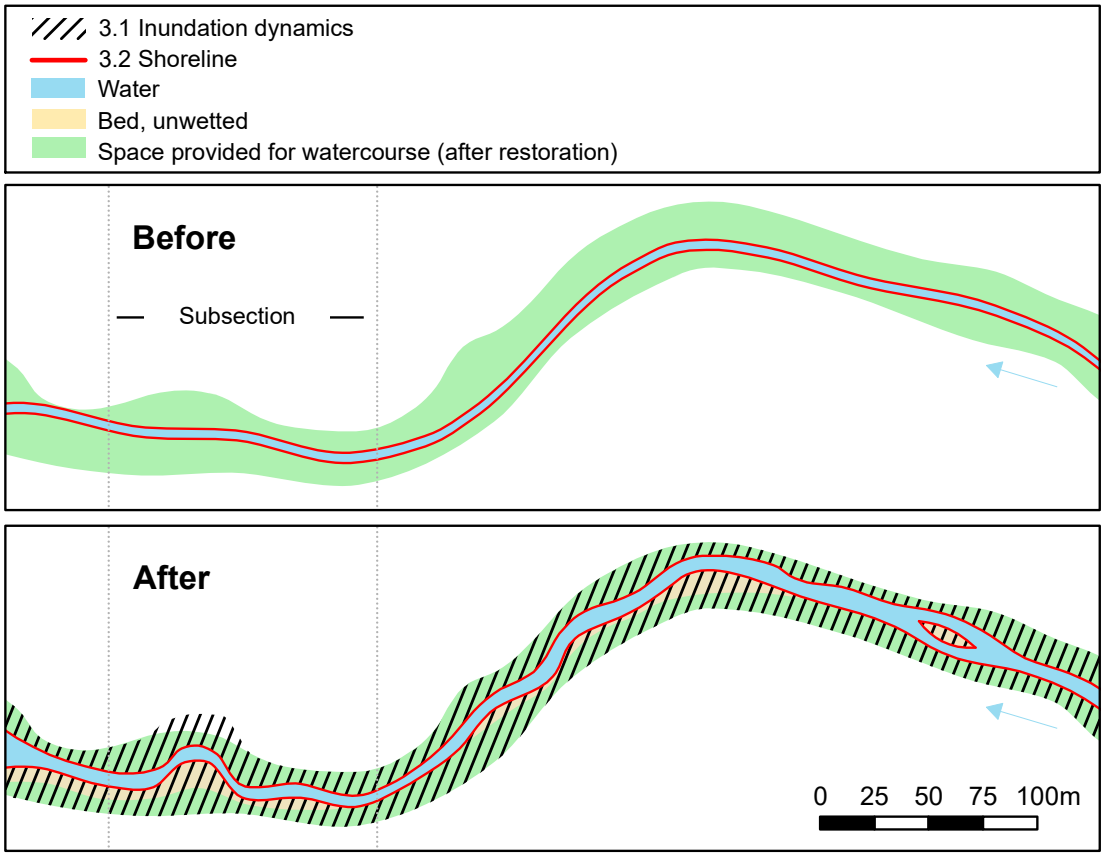
This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

Natural watercourses are closely connected with the surrounding area – longitudinally, laterally and below the river bed. During flood events, surface waters overflow and inundate the adjacent floodplains; nutrients, organisms, wood and gravel are transported from water to land and vice versa. However, key ecological processes also occur along the shoreline when water levels are lower. Indicator Set 3 is used to quantify the degree of lateral connectivity, firstly via the shoreline length and secondly on the basis of the inundation area.

Parameters	Area inundated (m^2) under flood discharge conditions expected to occur once every two years (HQ_2) Shoreline length per river length (along the thalweg; km/km)
Applicability	This Indicator Set can only be selected for individual projects.
Special considerations	For individual projects, detailed digital elevation models or hydraulic models are generally available. These provide an ideal basis for modelling of the inundation area and the shoreline. A field survey is thus not required. Afforestation of (parts of) the area within the project perimeter may complicate the drone-assisted production of a digital elevation model.
Survey site	Restored section (see Fig. 3.1)
Timing	Indicator 3.1 (inundation dynamics): Modelling is performed for HQ_2. Indicator 3.2 (shoreline length): Modelling is performed for medium-flow conditions.
Material	Digital elevation model. Software for hydraulic modelling (e.g. BASEMENT) and geographical information system (GIS). Historical maps.

Figure 3.1: Survey site for indicators from Indicator Set 3 before and after restoration. The dotted line shows the location of the subsection.



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Determination of the current inundation area	• Modelling of inundation (HQ_2) based on a current digital elevation model. Modelling can be in 1D or 2D, depending on the topographic material; 2D modelling requires more detailed topographic images, in both the wetted and unwetted parts of the bed. For large watercourses where the topography of the unwetted part of the bed can be identified using aerial photographs (readily visible), 2D modelling is probably more efficient. • Determination of the current inundation area (m^2) at HQ_2 before and after restoration. The inundation area is defined as the area wetted at HQ_2 minus the area wetted under mean-flow conditions.	3.1
Determination of the current shoreline length	• Modelling of the current shoreline length under mean-flow conditions, using the digital elevation model. • Determination of the current shoreline length under medium-flow conditions as the shoreline length per river length (along the thalweg; km/km).	3.2
Determination of the potential inundation area	• Estimation of the potential inundation area (m^2). This comprises the part of the surrounding area which is inundated at HQ_2 in the near-natural reference condition. The estimation is made with the aid of historical maps (e.g. based on gravel areas, contours, etc.), historical cross sections and records (e.g. photos, newspaper articles, description of typical flooded areas).	3.1
Determination of the historical shoreline length	• Determination of the historical shoreline length (km/km) based on historical records [e.g. the Topographic Atlas of Switzerland (Siegfried Map)].	3.2

Evaluation

The evaluation approaches given below are taken from the original indicator method sheets in the "Handbook for evaluating rehabilitation projects in rivers and streams" (Woolsey et al. 2005). They serve as a guide and will be revised in the coming years on the basis of the experience accumulated in the STANDARD and EXTENDED outcome evaluations.

Indicator	Description
3.1 Inundation dynamics	The normalised value is derived from the proportion of the potential inundation area which is currently inundated at HQ_2 (see Fig. 3.2). A value of 1 is attained if the potential inundation area is entirely inundated at HQ_2, and a value of 0 if no additional area is inundated at HQ_2 (e.g. in a channelised section). Between these two extremes, the value function describes a parabola.
3.2 Shoreline length	For the evaluation, the current shoreline length is compared with that under historical conditions: Current shoreline length as a proportion of the reference shoreline length $$\frac{Current\ shoreline\ length\ (km/km) - 2}{Historical\ shoreline\ length\ (km/km) - 2}$$ This proportion corresponds to the normalised value between 0 and 1 (Fig. 3.3).

Figure 3.2: Normalisation of the inundation dynamics indicator (3.1).

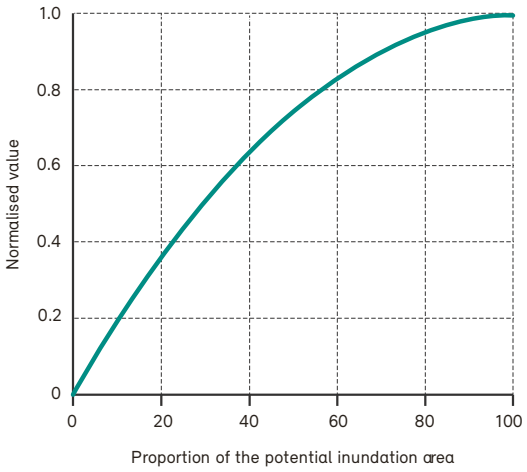
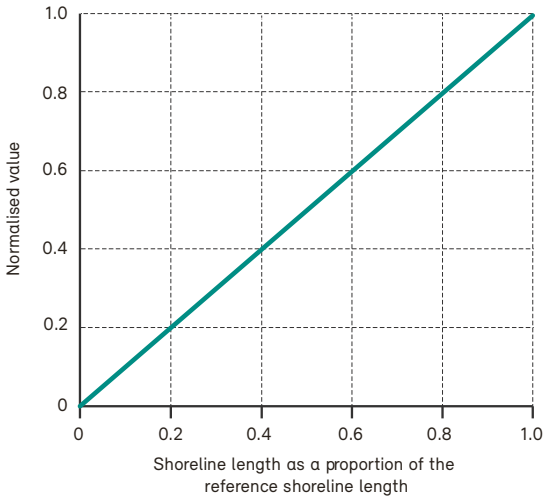


Figure 3.3: Normalisation of the shoreline length indicator (3.2).



Time required

Table 3.1: Estimated time required in person-hours for the determination and evaluation of Indicator Set 3. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation (importing elevation model, obtaining historical maps and aerial photographs)			1	8
Hydraulic modelling (1D/2D)	1	12	1	12
Data processing, site map	1	12	1	12
Evaluation	1	8		
Total person-hours	32		32	

Notes: -

Further information

Data arising	• Data entry form for Indicator Set 3: KT_ProCode_ERHEBUNG_Set3_V#.xls • Inundation areas as polygon shapefile: KT_ProCode_ERHEBUNG_Set3_Ind3_1 • Shorelines as line shapefile: KT_ProCode_ERHEBUNG_Set3_Ind3_2.shp Elements of the file naming scheme (see Factsheet 5) • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	The field protocol, data entry form and other useful documents are available at: https://www.bafu.admin.ch/wirkungskontrolle-revit

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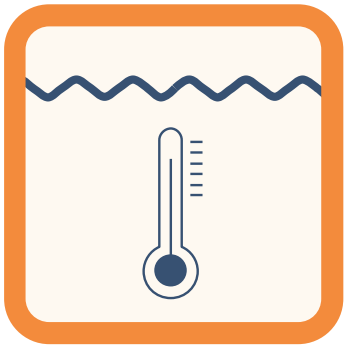
Technical Sheet: Indicator Set 4 Temperature



Indicators:
- 4.1 Temperature (Woolsey et al. 2005, no. 38)

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National advisory group: Ulrika Åberg (Eawag), Marco Baumann (TG), Simone Baumgartner (BAFU), Anna Belser (BAFU), Nanina Blank (AG), Arielle Cordonier (GE), Roger Dürrenmatt (SO), Claudia Eisenring (TG), Martin Huber-Gysi (BAFU), Lukas Hunzinger (Flussbau AG), Manuela Krähenbühl (ZH), Vinzenz Maurer (BE), Nathalie Menetrey (VD), Erik Olbrecht (GR), Eva Schager (NW), Lucie Sprecher (Eawag), Gregor Thomas (BAFU), Pascal Vonlanthen (Aquabios), Heiko Wehse (Hunziker Betatech), Christine Weber (Eawag), Hansjürg Wüthrich (BE)

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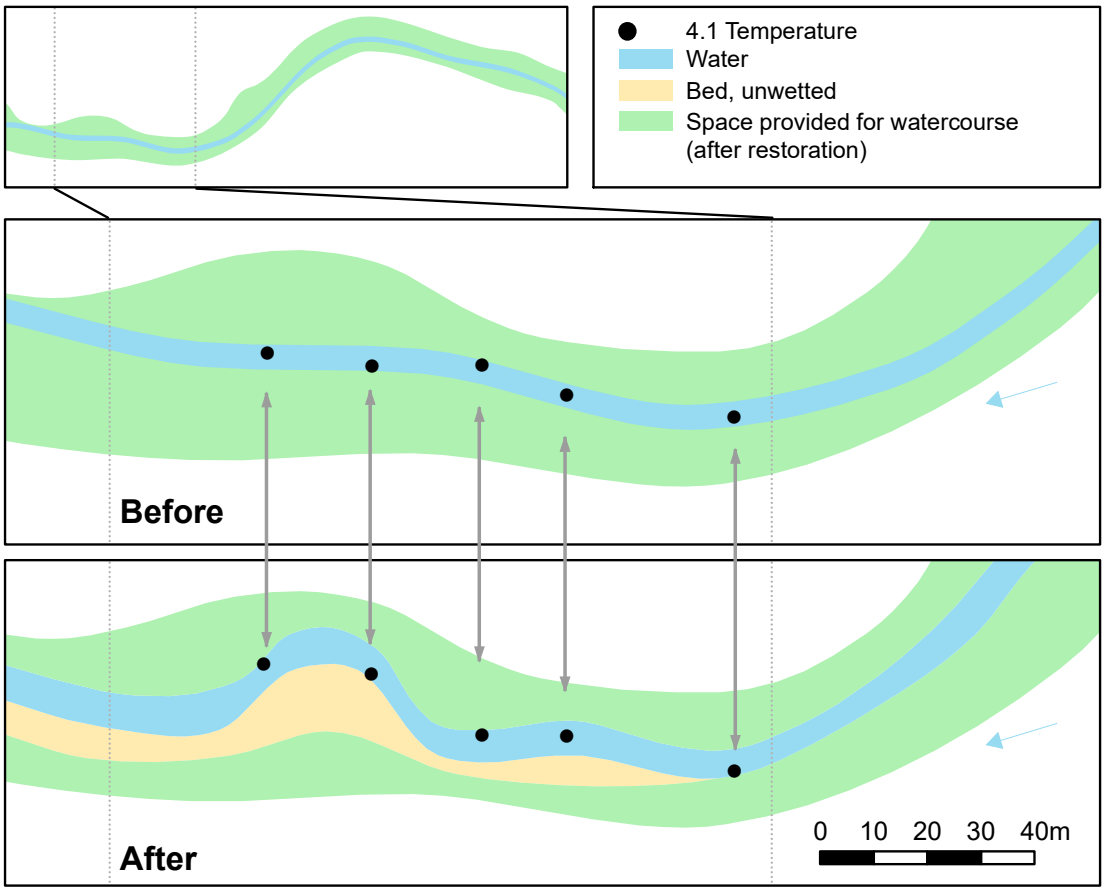
Principle

Water temperature is one of the key variables for aquatic ecosystems, determining the rate at which such fundamental processes occur as, for example, photosynthesis in aquatic and riparian plants; decomposition of leaf litter by invertebrates, fungi or microbes; or the metabolism of cold-blooded animals such as fish (e.g. respiration, digestion, growth). Many natural waters show spatial and temporal variation in water temperature, e.g. due to influx of groundwater, afforestation in the upper reaches, or meltwater. Indicator Set 4 describes the spatial and temporal distribution of surface temperature in watercourses, focusing on the summertime fair-weather, low-flow period.

Parameters	Five loggers are deployed along the subsection designated in Set 1, and 1–2 additional loggers in the upstream channelised section. To be determined is the variation in daily maxima between measurements in different habitats during a summertime fair-weather, low-flow period (2–3 weeks to 2 months).
Applicability	The Indicator Set can be used for all watercourse sizes (wadable/non-wadable). For the STANDARD outcome evaluation, it can be selected for medium-sized and large or for individual projects.
Special considerations	There is a risk of weather-related temperature changes being incorrectly attributed to restoration. Accordingly, caution is to be exercised in choosing the temperature data to be taken into consideration, e.g. for the before/after comparison. Essentially, only days which are similar in terms of key factors for water temperature are to be compared. These key factors are air temperature, solar radiation and discharge.
Survey site	Subsection, upstream channelised section
Timing	In this Indicator Set, water temperature is measured in summertime fair-weather, low-flow periods. If a project-specific interest exists, measurements may also be carried out in other seasons. Depending on the recording interval (hourly) and storage capacity of the loggers, data may need to be retrieved several times. The additional effort required should be taken into account when loggers are purchased. In channels with high bedload transport, monthly data retrieval is recommended so as to minimise potential data losses.
Material	Temperature loggers: a wide variety are available, ranging from low-cost loggers with limited memory and measurement accuracy (e.g. iButtons) to highly precise and rugged (e.g. Vemco) loggers. Ideally, accuracy should be 0.1°C and resolution 0.01°C. Protective cover for loggers, anchoring system.

Figure 4.1: Survey site for indicator 4.1 from Indicator Set 4.



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Deployment of loggers before restoration	• Restored section: 5 loggers to be deployed, based on the subsection mapping performed in Indicator Set 1: each permanently wetted bed structure type to be equipped with 1 logger. Loggers to be located on the bed or in the lower half of the water column. • Upstream channelised section: 1–2 additional loggers to be deployed at the bank and midstream. • Loggers to be securely anchored, so that they can remain in place and provide reliable measurements even under harsh conditions (e.g. high flows with bedload transport). Wherever possible, loggers should be attached to existing infrastructure (e.g. bridges, pipes, etc.). • Loggers should be positioned in such a way as to be readily recoverable, but also protected, so as to minimise any risks of vandalism, tampering or theft. • Logger locations are to be precisely recorded (e.g. GPS positioning, photos) • Measurements are to be made at hourly intervals. • Depending on the type of restoration measure, loggers may need to be removed before construction work begins.	4.1
Deployment of loggers after restoration	• The same number of loggers are to be deployed as far as possible in the same position as before the implementation of measures (position within the longitudinal profile and relative to the banks).	4.1
Read-out	• See “Timing”	4.1

Alternative data source: drone-based thermal infrared remote sensing. This method is still labour-intensive, but it enables precise characterisation of spatiotemporal thermal heterogeneity in the upper centimetres of the water column (Tonolla et al. 2019).

Evaluation

The method for evaluation of temperature data has not yet been finalised. Various evaluation approaches can be found in the original indicator method sheets in the "Handbook for evaluating rehabilitation projects in rivers and streams" (Woolsey et al. 2005). These serve as a guide and will be discussed and revised in the coming months on the basis of the experience accumulated in the STANDARD and EXTENDED outcome evaluations.

Time required

Table 4.1: Estimated time required in person-hours for the determination and evaluation of Indicator Set 4. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation (deciding on logger sites)	1	2		
Deployment of loggers, recovery, data retrieval			1–2	8–16
Evaluation	1	12		
Total person-hours	14		8–32	

Notes: Depending on the logger type and watercourse characteristics, more time may be required for data retrieval.

Further information

Data arising	• Data entry form for Indicator Set 4: KT_ProCode_ERHEBUNG_Set4_V#.xls Elements of the file naming scheme (see Factsheet 5) • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
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Technical Sheet: Indicator Set 5 Macrophytes

Indicator(s):
- 5.1 Macrophyte community (Känel et al. 2017)

Publication details

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Authors of original publication (2017): Barbara Känel (ZH), Christian Michel (Eawag), Peter Reichert (Eawag)

Scientific advice for update (2019):
Expert consulted: Barbara Känel (ZH)
National advisory group: Ulrika Åberg (Eawag), Marco Baumann (TG), Simone Baumgartner (BAFU), Anna Belser (BAFU), Nanina Blank (AG), Arielle Cordonier (GE), Roger Dürrenmatt (SO), Claudia Eisenring (TG), Martin Huber-Gysi (BAFU), Lukas Hunzinger (Flussbau AG), Manuela Krähenbühl (ZH), Vinzenz Maurer (BE), Nathalie Menetrey (VD), Erik Olbrecht (GR), Eva Schager (NW), Lucie Sprecher (Eawag), Gregor Thomas (BAFU), Pascal Vonlanthen (Aquabios), Heiko Wehse (Hunziker Betatech), Christine Weber (Eawag), Hansjürg Wüthrich (BE)

Experts consulted for update (2022):
Barbara Känel (ZH), Pascal Mulattieri (Biol'Eau), Daniel Küry (Life Science), Niklaus Müller (FUB)

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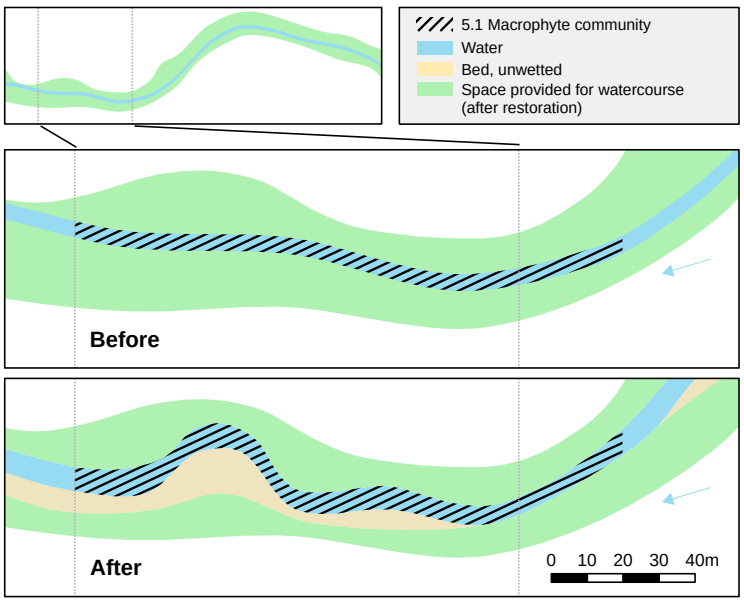
Principle

Macrophytes – i.e. vascular plants, bryophytes and macroscopic algae – are an important component of many river and streams. They provide habitats for fish and macroinvertebrates and – as primary producers – represent an important food source, as well as playing a significant role in the oxygen balance and nutrient cycle. As macrophytes are generally sessile and perennial, they reflect the totality of environmental impacts over prolonged periods. Indicator Set 5 is used to determine macrophytes and abiotic site parameters, which can subsequently be automatically evaluated with an electronic tool.

Parameters	All vascular plants, bryophytes, charophyceae, green-colored filamentous algae and mat-forming algae are recorded according to the taxa list (MSK module, Appendix DA1, chap. 4.4 - 4.5). All taxa are determined to the lowest possible level. This level is defined in the taxalist in the column "determinability". For each taxon, the absolute cover is recorded. Exceptions are the bryophytes and the filamentous green algae. For these, the cover only has to be recorded in total for the taxon "Bryophyta" or "filamentous green algae", an estimation of the absolute cover at a lower determination level is not necessary. Site conditions: determination of gradient, discharge, shading, depth and substrate is obligatory, as these are required to classify the type of study section. Unlike in the MSP module, the determination of Ecomorphology Level R and Physical Appearance is optional.
Applicability	Can be selected for all project sizes (small, medium-sized, large and individual projects). In accordance with Section 3.3 of the MSP Module, mainly wadable watercourses with small gradients (< 1.5%) and moderate discharge fluctuations. The method is also suitable for watercourses where no macrophytes can be observed before restoration, but where they are expected to develop after restoration.
Special considerations	If macrophytes were introduced in the course of restoration, e.g. through planting or cuttings, this must be taken into account in the plausibility check for the evaluation and in the interpretation of results. In addition, the list of introduced macrophyte species must be provided, at the latest, with the “after” survey.
Survey site	Subreach, if possible within the subsection (see Fig. 5.1)
Timing	June to September Medium to low water levels and good visibility
Frequency	A single survey is sufficient, unless a common species cannot be identified to species level. In this case, it is recommended (i) to carry out a second site visit at a time when the species has developed further characteristics relevant for identification and/or (ii) to call in an additional expert. Such efforts are not required in the case of individual finds, since the evaluation and final results will scarcely be influenced.
Material	A detailed list of the materials required can be found in Annex A2 (p. 92) of the MSP module.

Figure 5.1: Survey site for the indicator from Indicator Set 5.



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Definition of the study section	• A representative, uniform subreach is identified (see Section 4.3 of the MSP module). • To exploit synergies and reduce the effort required, the subreach should ideally be the same as the subsection selected for Indicator Set 1 “Habitat diversity”. • If the subsection of Set 1 is selected for the survey, a macrophyte expert (e.g., designated surveyor) must verify that it is suitable for macrophyte development after restoration as part of the impact monitoring planning process. If the subsection is not suitable for macrophyte development, e.g., due to a desired shading of the watercourse by continuous stocking of the banks, the subsection must be moved. If relocation is not possible, macrophyte survey shall be waived. • If the subsection from Set 1 is suitable for the development of macrophytes, it must be assessed whether it is sufficiently long for species diversity to be determined (requirements specified in the methodology). If the length is insufficient, the subreach must be extended in accordance with the MSP module to a total length of approx. 20 times the mean wetted width. • The start and end point of the subreach should not change before and after restoration, so that the subreaches remain comparable.	5.1
Photographing the subreach	• For the documentation, an aerial photograph must be made during the vegetation period, or the start and end point of the subreach must be photographed.	5.1
Determination of abiotic site parameters	• The abiotic site parameters relevant for type classification (shading, water depth, discharge, gradient and substrate composition) are determined in the field. For this purpose, the field protocol of the MSP module is used. • Other abiotic site parameters may optionally be additionally determined, using the same field protocol (e.g. Ecomorphology Level R, Physical Appearance).	5.1
Identification of macrophyte vegetation	• In the field, the macrophytes are mapped and determined to the lowest possible level according to the taxalist (Appendix DA1, Chapters 4.4 - 4.6 in the MSP module).	5.1
Digitalisation of raw data using electronic data entry form	• For further analysis, the raw data from the field protocols is digitalised using an electronic data entry form. The data is now prepared for the type classification and evaluation by the electronic tool (see MSP website).	5.1

Evaluation

The raw data compiled is automatically analysed by means of an electronic tool (typology and type-specific evaluation).

Indicator	Description
5.1 Macrophyte community	The electronic tool evaluates the following: The vegetation is evaluated type-specifically, by comparing the current survey with a near-natural (as far as possible) reference for the vegetation-river type in question (p. 56 of MSP module, DA5). The evaluation is performed with the aid of type-specific goal hierarchies and value functions in five classes. It is based on the ecological goals specified in Annex 1 of the Waters Protection Ordinance (WPO). It covers the following areas: • composition (proportions of type-appropriate growth forms and neophytes, and dominance structure) • diversity (number of type-appropriate species and growth forms) • biomass (absolute cover of higher macrophytes and algae). In addition to this aquatic ecology evaluation, an evaluation is performed from a conservation perspective, based on the national priority rating of the species present and their contribution to biodiversity in terms of target values (see section 6.5 of the MSP module).

The typology and evaluation by the electronic tool must subsequently be checked for plausibility by a macrophyte expert (e.g. surveyor) (chap. 7 MSP module).
Restoration changes the site conditions in the watercourse. Under certain circumstances, this can result in the tool applying different typologies to the study section before and after restoration, i.e. assigning it to different vegetation flow types. This results in the section before and after restoration being evaluated based on different criteria. To prevent this, the macrophyte expert must assign the study section to the same vegetation flow type as part of the plausibility check. To determine the vegetation flow type, the macrophyte expert is guided by a near-natural condition in the given cultural landscape (according to chap. 6.2 and chap. 5.5, MSP module).
Based on the expected characteristics of the typology parameters gradient, discharge, shading, water depth and substrate under reference conditions and the typology scheme (Fig. 13, p. 53, MSP module), the expert can estimate the near-natural vegetation flow type.

Time required

Table 5.1: Estimated time required in person-hours for the determination and evaluation of Indicator Set 5. General items (e.g. travel time for fieldwork) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Mapping of vegetation and site conditions	1	1.5		
Digitalisation of raw data using electronic data entry form	1	1		
Evaluation using electronic tool	1	0.25		
Plausibility check by processor	1	0.25		
Post-determination of difficult taxa in the laboratory, without archiving (e.g. bryophytes*)	1	0.5		
Total person-hours	3.5			

Notes: The time required for mapping depends on the accessibility of the reach, species diversity and the experience of mapping personnel. It may vary between 20 minutes and an hour per subreach. The safety measures specified in the MSP module are to be complied with. * In case of difficulties in species identification of bryophytes, a current list of experts can be consulted at swissbryophytes.ch

Further information

Data arising	• End products of the electronic tool: KT_ProCode_ERHEBUNG_Set5_Output_Standortdaten.txt, KT_ProCode_ERHEBUNG_Set5_Output_TaxaVerwendet.txt, KT_ProCode_ERHEBUNG_Set5_Output_TaxaVerworfen.txt AND Site documentation as pdf • Photos: KT_ProCode_ERHEBUNG_Set5_up.jpeg AND KT_ProCode_ERHEBUNG_Set5_down.jpeg OR KT_ProCode_ERHEBUNG_Set5_air.jpeg • List of any macrophytes planted, sowed or introduced with cuttings (to be submitted with “after” survey; data format not specified): KT_ProCode_ERHEBUNG_Set5_Stock Elements of the file naming scheme (see Factsheet 5) • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	For data entry and evaluation, it is essential that the latest versions of the electronic form and tools are used (see below). These are available on the Modular Stepwise Procedure website Relevant for the determination and evaluation of Indicator Set 5: • Field protocol: Modular Stepwise Procedure website • Electronic data entry form: Modular Stepwise Procedure website • Electronic tool for evaluation of raw data: Modular Stepwise Procedure website

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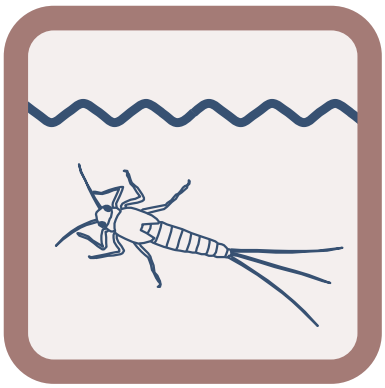
Technical Sheet: Indicator Set 6 Macroinvertebrates



Indicator(s):

- 6.1 Macroinvertebrate community (in accordance with the MSP module, FOEN 2019)

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This publication is also available in French, German and Italian.

This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

The term “benthic macroinvertebrates” (MI) refers to bottom-dwelling invertebrates visible to the naked eye. By analysing their diversity and abundance, it is possible to assess the overall ecological quality of a watercourse, since benthic macroinvertebrates respond to any changes in habitat conditions. They thus indicate not only the morphological and hydrological conditions and the dynamics of the watercourse, but also chemical water quality. Indicator Set 6 is based on the new Modular Stepwise Procedure (MSP) module for assessment of the quality and diversity of benthic macroinvertebrates (FOEN 2019), but it has been adapted for the STANDARD outcome evaluation. This Technical Sheet only describes the differences compared to the methodology specified in the relevant MSP module.

Parameters	Collection of at least 8 samples from 8 different substrate-flow velocity combinations in the study section; the surface-area percentage is indicated for each of the 8 habitats; the 8 samples are separately sorted, identified and analysed; species-level identification of ephemeroptera, plecoptera and trichoptera (EPT) taxa; abundance is determined for all taxa, i.e. also for each EPT species (see also «Erläuterungen zu den Laborarbeiten» in the attachments).
Applicability	The area of application and methodology are identical to the MSP module (see Section 2.3, MSP module). Application of the indicator is not restricted by project size (small, medium-sized, large or individual project).
Special considerations	Application of this method must never be entrusted to inexperienced personnel. Consequently, the volume of work indicated here represents the time required by a specialist. In addition, the same person should be responsible for carrying out the surveys before and after restoration, so as to minimise the influence of the operator. The final results are to be submitted to the MIDAT database.
Survey site	Subsection (see Fig. 6.1)
Timing and frequency	Sampling must take place outside high-flow or particularly dry periods (see Section 2.3 of the MSP module). At least one survey is required, to be carried out if possible in spring, within the same sampling window as in the MSP module. A second campaign is not mandatory, but is highly recommended. This will permit the identification of larvae which in spring are too small for species-level identification, as well as the addition of new species to the list. Alternatively, adult specimens could be collected during the first campaign. This rapid and straightforward technique would provide added value for species-level identification of EPT taxa, especially plecoptera (Knispel, 2020). Unlike in the MSP module, the second campaign must be carried out in August/September instead of September/October, at elevations over 1400 m asl.
Material and equipment	All the field and laboratory equipment required is listed in Annex A5 of the MSP module. The safety measures to be observed are described in Section 3.2.3 of the MSP module.

Table 6.1: Recommended priority sampling window according to elevation. Z = sampling window, P = buffer for hydrological special cases. First campaign shown in turquoise; second (optional) campaign in dark blue.

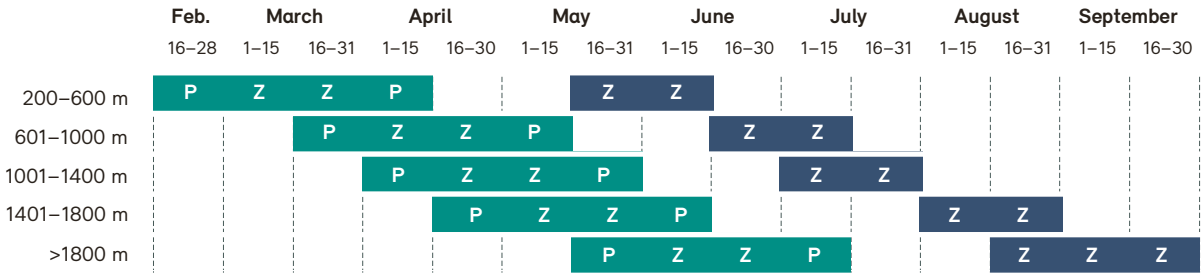
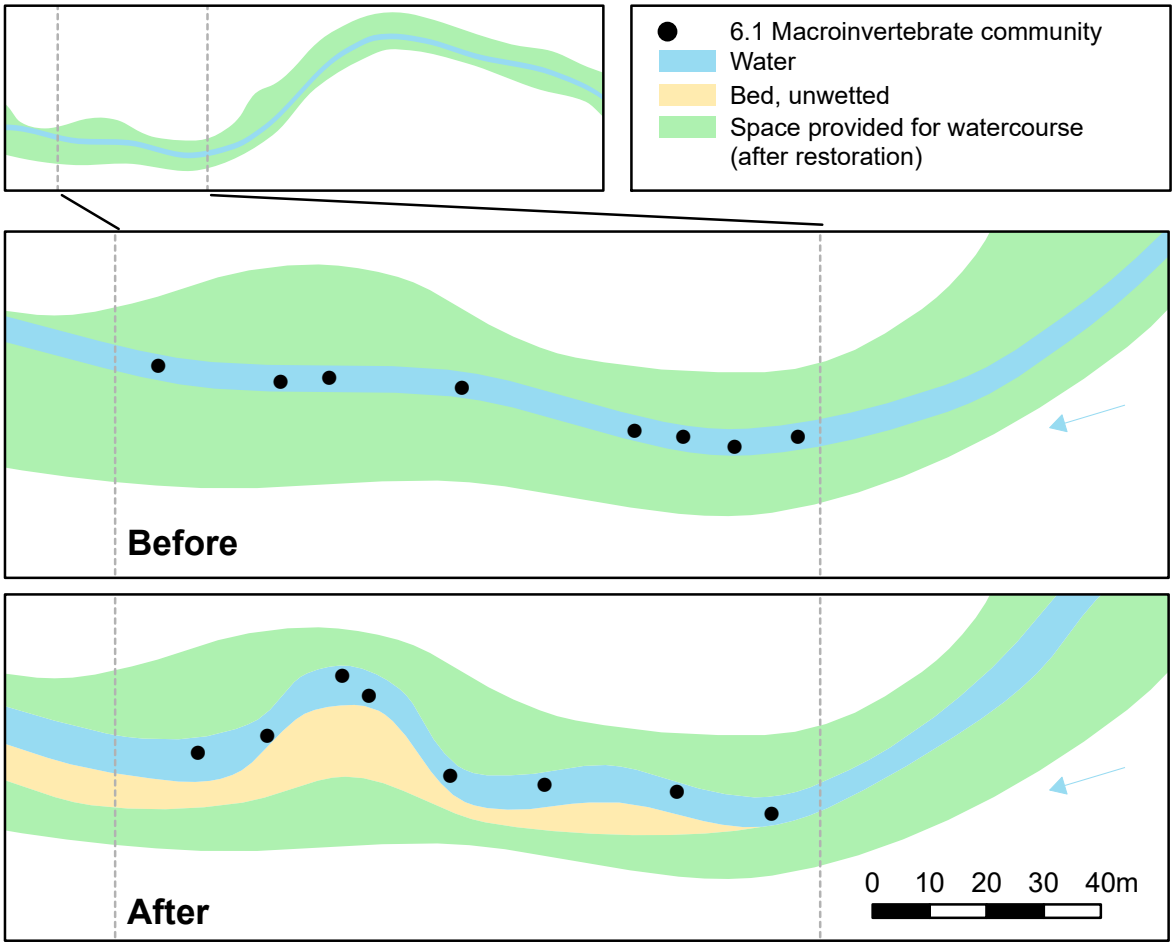


Figure 6.1: Survey site for indicator 6.1 from Indicator Set 6. The black marks indicate the sampling points. At each sampling point, 1 sample is collected (= 1 individual sample, as specified in the MSP module), i.e. 8 samples are collected across the 8 sampling points (not 8x8 samples).



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Selection of a representative watercourse section	• A section representative of the watercourse has already been defined and mapped for Indicator Set 1 "Habitat diversity". For sampling of benthic macroinvertebrates, the same section or subsection must be chosen.	6.1
Completion of survey grid (taken from Annex A1-2, IBCH_2019 module)	• The survey grid is completed according to the instructions given in the MSP module. However, some adjustments have been made to improve the transfer of data to the database. It is therefore necessary to use the data entry form for Indicator Set 6 (see appendices). • At least 8 sampling points are selected on the basis of the survey grid (only in substrates with ≥ 1 % coverage). They are to be numbered from 1 to 8. • As a supplement to the survey grid, one photo per substrate-flow velocity combination must be created.	6.1
Sample collection	• Samples are collected at each point by means of kick sampling (method described in Section 3.3.4 of the IBCH_2019 module). • Unlike the method specified in the MSP module, each (kick) sample must be separately labelled and stored in the field (the 8 samples are not to be combined in a single container). Accordingly, the habitat type (i.e. substrate-flow velocity combination) must always be indicated on the label (see «Erläuterungen zu den Laborarbeiten», standard labels).	6.1

Sorting method:	The sorting method is the same as that described in the MSP module (Section 3.4.2). It is imperative that all EPT material is stored separately by area for the examination of EPT species.	
Identification	Unlike in the MSP module, the 8 samples are analysed separately (see modified laboratory protocol), and the EPT taxa must be identified to species level (see the form for the EPT species list). Caution: Identification to species level is difficult and requires a lot of experience. If the identifier is not confident, it is perfectly possible to leave the determination of the EPT taxa at species level to a more experienced person. The results are transferred to the laboratory protocols of Indicator Set 6 (appendices).	
Enumeration of sorted individuals	Sorted individuals are enumerated as described in the MSP module (Section 3.4.4). Subsampling (estimation by counting the individuals of a randomly selected part of the sample) is not permitted. However, if more than 200-300 individuals of the same taxon are estimated, it is permissible to carry out a partial count with multiplication only for this taxon according to the procedure described in the "Erläuterungen zu den Laborarbeiten" in the appendices. In this case, a balance is kept for the area concerned.	
Expert quality control (QC), archiving and storage of the specific material	Once the EPT samples have been determined, quality control by experts is mandatory. The aim is to check the EPT samples determined at species level with the purpose of learning process and quality assurance in the determination at species level. The following is a step-by-step overview of the quality control process (QC, see also Fig. 6.2 below): 1. **Dispatch of EPT to experts for QC**: The scope of the material to be reviewed must be determined in consultation with the expert depending on the project. The specialist office then sends the EPT taxa it has determined to the QC experts (see «Erläuterungen zu den Laborarbeiten» in the attachments for a recommendation). At this stage, a non-exhaustive list of experts for quality control can be requested from Info fauna. A different expert will be appointed for each EPT order. The names of the selected experts should be noted on the laboratory protocol. 2. **Implementing QC**: The QC experts carry out the QC as agreed with the specialised office. A maximum of CHF 250 (incl. VAT) per order (E, P, T) can be claimed for the quality control, i.e. a maximum of CHF 750 (incl. VAT) per survey on programme objective 1 of the programme agreement. 3. **Completing the anonymised QC form**: The experts carrying out the quality control must complete the QC form for the outcome evaluation separately for each order and each project. The QC form can be downloaded from the FOEN website (see attachments). The experts send the completed form to wiko_revit@bafu.admin.ch. Accordingly, three QC forms are required for a project in which species of all three EPT orders were found. 4. **Feedback on the QC to the MI specialist office**: This form also serves as the basis for the feedback to the assessors. The experts are free to provide their feedback in order to achieve more complete reporting for the assessors (e.g. via the laboratory protocol, where the column "X" is available for this purpose). Unless otherwise agreed between the MI specialist office and the expert, all sample material will be returned to the MI specialist office by the expert. 5. **Correction of the MI data**: After the quality control has been sent back to the assessor, the assessor makes the necessary corrections. 6. **Archiving of the material (recommended):** To allow for possible later verification of observations or more detailed taxonomic analysis by Info fauna (see steps 13 and 14), it is strongly recommended to keep all material identified per station (i.e. EPT and IBCH taxa), ideally for a period of 10 years. For this purpose, all designated taxa should be stored in separate tubes, but without separation by subsample. The appropriate	

	equipment and method for archiving is described in the document «Erläuterungen zu den Laborarbeiten» in the attachments. 7. **Sending the corrected MI data to the canton**: The assessor is instructed to send the corrected and complete data of Indicator Set 6 (data entry form, area photos and shapefile) to their client. 8. **Check MI data and send to Wiko team with data from other sets**: The canton sends the checked data to the FOEN via the address wiko_revit@bafu.admin.ch, together with all other sets of the project. 9. **Checking the MI data**: The MI data is checked for completeness by the Wiko team. If necessary, the Wiko team will enquire with the canton. 10. **Integration of MI data into the Wiko database**: The Wiko team integrates the MI data into the Wiko database. 11. **Centralised dispatch of MI data to Info fauna**: The Wiko team sends newly received MI data to Info fauna at regular intervals. 12. **Standardised plausibility check of MI data for Info fauna database**: Info fauna carries out a standardised plausibility check of the MI data. 13. **Possible selective verification of material**: If necessary, Info fauna will request material from the MI specialist offices for verification. If the material is not available for verification by Info fauna, the corresponding MI data will not be included in the Info fauna database. 14. **Cross-project evaluation of anonymised QC forms**: The Wiko team collates the information from the QC forms and creates overviews of common problems in the species identification of EPT. 15. **Organisation of courses based on QC results for the further training of MI specialist offices and cantons:** Regular further training courses for MI specialist offices and cantons are organised based on the QC results. The problems identified in the QC are addressed in the courses.	

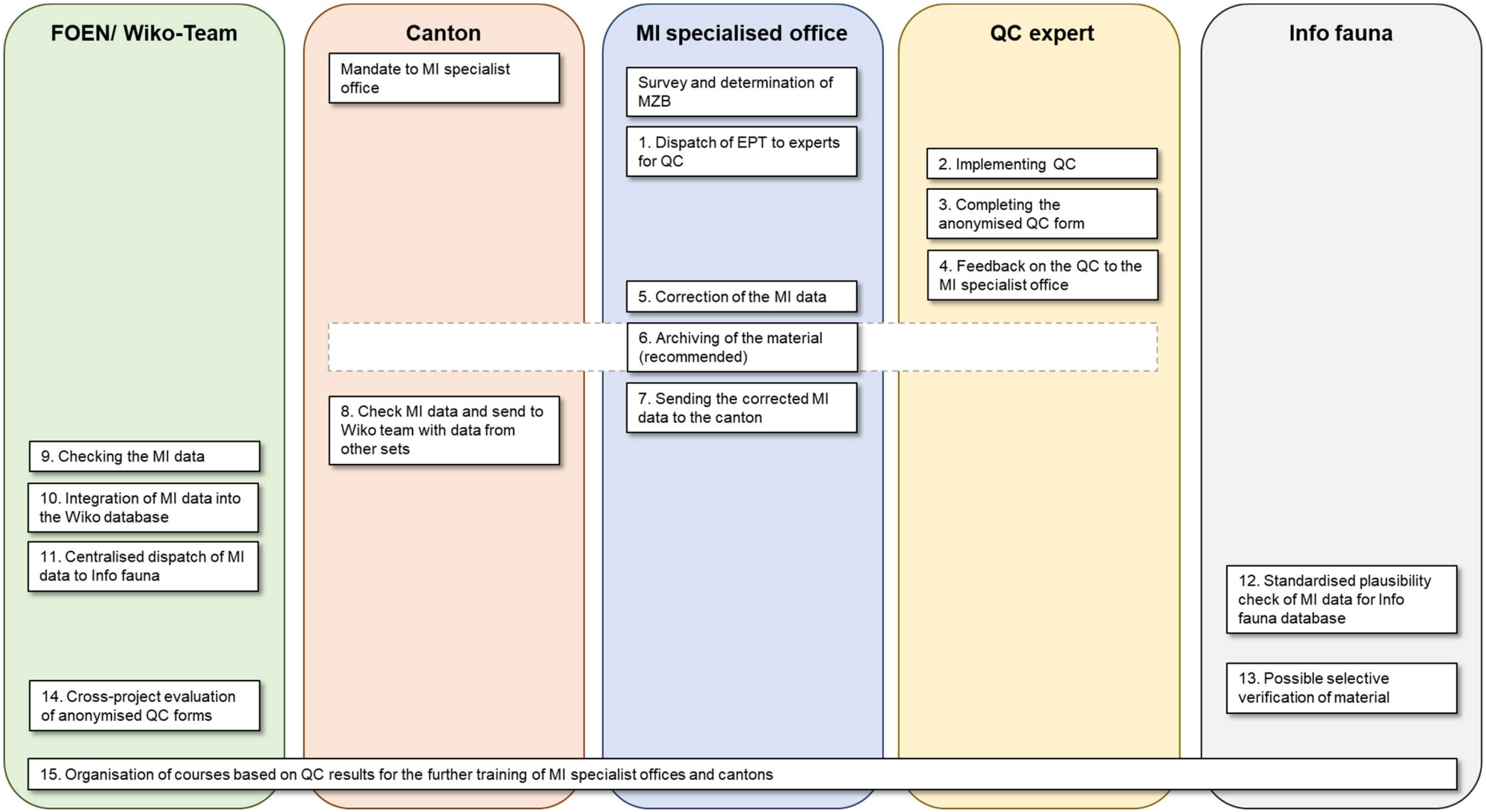


Figure 6.2: Visualization of the step-by-step process of quality control (QC) of the macroinvertebrate (MI) data in the context of indicator set 6.

Evaluation

The method for evaluation of the more detailed data (e.g. EPT species) has not yet been finalised. For the time being, therefore, only the raw is to be submitted, i.e. the data entry form from Indicator Set 6, the photos of the sample points and the shapefile (see attachments).

If an interpretation of the results is nonetheless desired, then the following parameters could be suitable:

- Occurrence of additional EPT species in the restored section (if water quality is good)
- Occurrence of new habitats, progressively colonised by new taxa
- Change in habitat quality and distribution
- Change in the distribution of EPT species in the restored section (to be analysed in parallel with the surface-area percentages of the various habitats)
- Occurrence of taxa included in the Red List (link) or the list of national priority species (link)
- Change in relation to various ecological preferences (ecological traits) (further information available at: https://www.freshwaterecology.info/)
- General improvement in the IBCH evaluation or one of the two components thereof:
    - increase in the diversity class (DK) value
    - potential shift in the fauna indicator group (IG) towards taxa with higher sensitivity to contaminants (only possible if water quality has improved)

Calculation of the IBCH index is not in itself sufficient, as this also includes the ecological quality of the habitat and is not a direct restoration indicator. It must be analysed alongside other parameters such as diversity class (DK), fauna indicator group (IG), IBCH_2019_R (robust), total species (robustness), EPT, total non-native species and habitat evaluation.

Time required

Table 6.2: Overview of the time required in person-hours for the determination and evaluation of Indicator Set 6. General items (e.g. travel time) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Completion of survey grid	1	1.5-3	-	-
Collection of benthic macroinvertebrates	1	3-5	1	1.5
Sorting, identification and enumeration of organisms in the laboratory	1	8-15	-	-
More detailed analysis of EPT species	1	6-12	-	-
Quality control EPT species by experts*	1-3	1.5-5		
Total person-hours	20-40			

Notes: The time required partly depends on the diversity and abundance of the sorted taxa, and on the amount of organic material and filamentous algae in the samples. For example, the preparation and identification of samples from a variety of substrates in a lowland watercourse of the Jura will require about three times as much time as is required for samples from a coarse mineral substrate in a mountain watercourse.
*** Time required for the quality controls: A maximum of CHF 250 (incl. VAT) per order (E, P, T), i.e. a maximum of CHF 750 (incl. VAT) per survey can be claimed via program objective 1 of the program agreement.**

Further information

Data arising	• Data entry form Indicator Set 6: «KT_ProCode_ERHEBUNG_Set6_V#.xls» If a spring and summer sample is taken, the documents must be named as follows: «KT_ProCode_ERHEBUNG_Set6_V#_Frühling.xls» UND «KT_ProCode_ERHEBUNG_Set6_V#_Sommer.xls» • Photos from the sampling points jpeg: «KT_ProCode_ERHEBUNG_Set6_Probestelle1.jpeg», «KT_ProCode_ERHEBUNG_Set6_Probestelle2.jpeg», «KT_ProCode_ERHEBUNG_Set6_Probestelle3.jpeg», «KT_ProCode_ERHEBUNG_Set6_Probestelle4.jpeg», «KT_ProCode_ERHEBUNG_Set6_Probestelle5.jpeg», «KT_ProCode_ERHEBUNG_Set6_Probestelle6.jpeg», «KT_ProCode_ERHEBUNG_Set6_Probestelle7.jpeg», «KT_ProCode_ERHEBUNG_Set6_Probestelle8.jpeg» • IBCH survey grid: KT_ProCode_ERHEBUNG_Set6_Raster.xls • Modified IBCH laboratory protocol: KT_ProCode_ERHEBUNG_Set6_LaborProtokoll_V#.xls • EPT species list: KT_ProCode_ERHEBUNG_Set6_EPT_V#.xls • Sampling sites as point shapefile: KT_ProCode_ERHEBUNG_Set6_Probestellen.shp Elements of the file naming scheme (see Factsheet 5): • KT = two-capital-letter cantonal abbreviation (e.g. VD) • ProCode = project code • ERHEBUNG = survey time point (relative to restoration), i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number.
Attachments	The data entry form (which includes the IBCH survey grid and the laboratory protocols), the quality control form, the «Erläuterungen zu den Laborarbeiten» can be downloaded from: https://www.bafu.admin.ch/wirkungskontrolle-revit The MSP module (FOEN 2019; available in French/German) can be downloaded here

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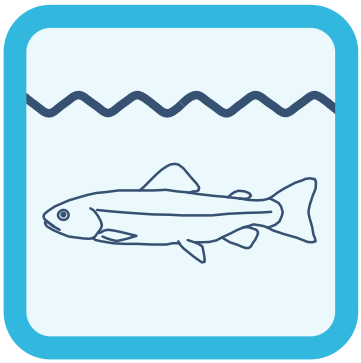
Technical Sheet: Indicator Set 7 Fish



Indicators

- 7.1 Fish community (in accordance with Woolsey et al. 2005; no. 9)
- 7.2 Age structure of fish population (in accordance with Woolsey et al. 2005; no. 8)
- 7.3 Ecological guilds of fish (in accordance with Woolsey et al. 2005; no. 10)

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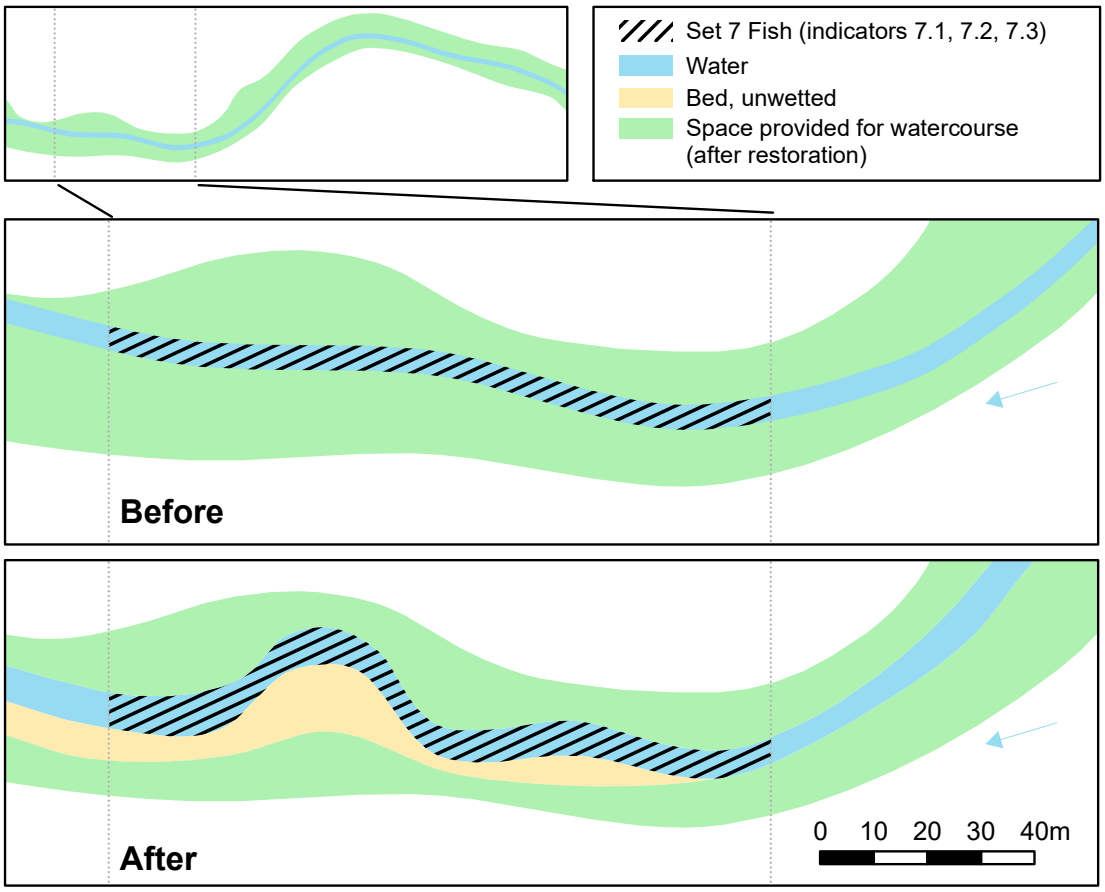
Principle

Fish are valuable biological indicators: as long-lived and mobile organisms, they reflect habitat conditions over extended periods and along lengthy river reaches. They are also widely distributed and usually relatively easy to identify. Indicator Set 7 investigates the diversity and relative abundance of fish species. Also of interest is the occurrence of different age classes, permitting conclusions as to reproduction and growth. Finally, guilds (i.e. ecological groups) are used to investigate the ecological requirements of the fish species present; this provides information on habitat diversity and resource availability.

Parameters	Quantitative electrofishing (3 runs) to determine the following parameters: • number of species and guilds present • density [individuals/ha] and biomass [kg/ha] of all fish species present, and for each guild, species and age class (0+ fish, juveniles, adults; only for typical species) • relative species abundance as a percentage of the total number of individuals
Applicability	The methods are suitable for small and medium-sized watercourses which are fishable by wading over 95% of the wetted area. For deep, fast-flowing watercourses where quantitative electrofishing is not possible, the fish community is to be assessed in a project-specific manner, with no strict methodological requirements, by means of appropriate techniques (e.g. point abundance sampling, strip fishing, net fishing, juvenile counting, etc.) and expert evaluations.
Special considerations	The evolution of the three indicators over time is strongly dependent on the development potential of the waterbody, e.g. sources for recolonisation and their connectivity. As a result of restoration, there may also be changes in the fishability of the subsection, e.g. due to the emergence of deep pools or large, dense collections of woody debris. In certain situations (e.g. mass catches of large fish), smaller fish species and juveniles can be easily overlooked. The fishing teams must ensure that all species and age classes are appropriately sampled. Fish populations may be directly influenced by stocking, angling or pollution.
Survey site	Subsection (see Fig. 7.1)
Timing	Mean low flow, good transparency. Late summer/autumn (favourable time in terms of development of juveniles) “Before” and “after” survey under comparable conditions and in the same season. Disturbance and damage to the fish community should be kept to a minimum (no fishing during extreme temperatures, avoidance of the spawning and incubation period).
Material	Equipment for electrofishing, holding, anaesthetisation and measurement of fish.

Figure 7.1: Survey site for the indicators from Indicator Set 7 before and after restoration.



Survey

The individual steps involved in the survey are explained below, in chronological order. The procedure for electrofishing is in accordance with the ongoing revision of the "Fish – Regional scale level" module of the Modular Stepwise Procedure (MSP, Schager & Peter 2004).

* Tools from the original source of the technical sheets presented here (Woolsey et al. 2005) will be updated in the coming years in coordination with the revision of the MSP. The original tools are available for download at: www.rivermanagement.ch > Produkte & Publikationen > Hilfsmittel für die Praxis > Rhone-Thur-Projekt.

Step	Description	Indicator
Survey of current species set	• Quantitative electrofishing of the subsection surveyed in Indicator Set 1 (at least 100 m and at most 200 m long). • Electrofishing in an upstream direction in three runs. Barrier (e.g. stop net, electrical barrier) installed at the upstream and, if necessary, the downstream end. • Identification, measurement (to 1 mm) and weighing (to 1 g; <10 cm to 0.1 g) of all captured individuals. If there is a high abundance of juvenile or small fish (e.g. mass catches of cyprinids): counting and weighing in species-specific groups (see Fig. 7.2). • For all separately measured individuals, abnormalities or injuries are to be recorded in accordance with the code on the field form.	7.1, 7.2, 7.3
Processing of capture results	• Estimation of population for species with adequate capture numbers per electrofishing run. The choice of method is left to the user, but the same method must be used for the "before" and "after" surveys. • The electrofished area is the result of the mean wetted width (determined in Indicator Set 1) x length electrofished.	7.1, 7.2, 7.3

Determination of typical species set	• If available: use of data on historical fish populations. • Use of a theoretical reference, based on biocoenotic classification/fish regions, taking account of particular local conditions (e.g. lake outflow, groundwater inflow; major catchment (Rhône, Rhine, Doubs, etc.)). • The typical species set remains the same for the duration of the outcome evaluation.	7.1, 7.2, 7.3

Determination of presence/absence	• Comparison of species set with typical species set:
	  • absence: a species listed in the typical species set does not occur in the current species set.
	  • presence, typical: a species found in the current species set is also included in the typical species set.
	  • presence, non-typical: a species is found in the current species set, but not in the typical species set.
	• Calculation of dominance structure: relative species abundance as a percentage of the total number of individuals.
	• Calculation of density and biomass: number and biomass of all fish per hectare. For this, the total number or the biomass of all fish is divided by the electrofished area.
		7.1

Determination of age classes (typical species only)	For typical species: determination of the abundance and density of three age classes (0+ fish, juveniles, adults) using a length frequency distribution chart (see Fig. 7.3).	7.2

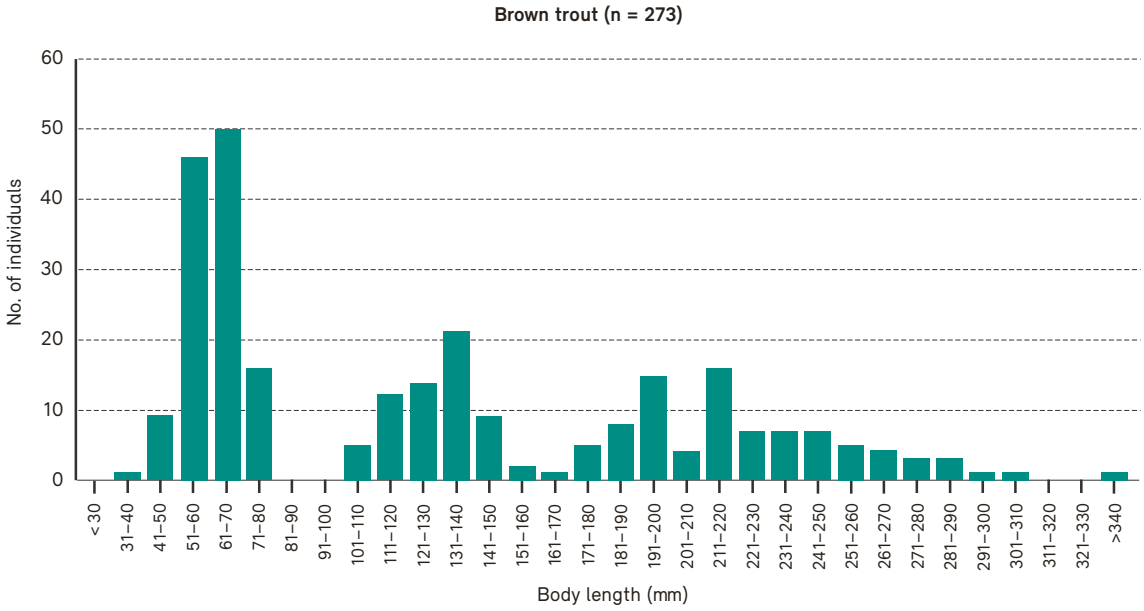
Determination of guild membership and diversity	• Assignment of species to ecological guilds in accordance with Table 7.5 (see also the species list in the data entry form for Indicator Set 7)
	• Separately, for the current species set (before/after) and for the typical species set:
	  • Determination of guild number, i.e. number of guilds for each area (e.g. temperature, migration).
	  • Determination of guild strength, i.e. density for each guild and area (e.g. temperature, migration).
		7.3

Figure 7.2: Measurement and weighing of captured fish. The following rules apply:
All fish are identified to species level and individually measured and weighed (* = I), example in blue.
Exception: simplified procedure for mass catches of fish <10 cm:

- *First 100 fish of each species:* measured individually and weighed individually (* = I; example in purple) or in groups (* = G; example in red).
- *From 100 fish of a given species:* length no longer measured. To be counted and weighed in groups (no. of fish and total weight of group, * = G), example in green.

No.	Fish species	No. of fish	Individual/ group	Total length [mm]	Weight [g]	Deformities/ abnormalities	Comments	Tagging	Run
1	Brown trout	1	I	452	950	A	Angling injury, left		1
2	Bullhead	1	I	131	25				1
3	Barbel	1	I	253	140				1
4	Chub	1	I	76	4				1
5	Chub	4	G	60	7				1
6	Chub		G	55					1
7	Chub		G	57					1
8	Chub		G	54					1
501	Barbel	15	G		60				2
502	Chub	20	G		65				2
503	Bullhead	19	G		54				2
504	Loach	25	G		105				2

Figure 7.3: Example of a length frequency distribution chart. Electrofishing of the Schwendibach (Appenzell Innerrhoden) on 22 August 2000 (Schager & Peter 2001). The length class width is 10 mm. With larger class widths, analysis of age structure is scarcely possible.



Evaluation

The assessment methods given below derive from the original Indicator method sheets included in the "Handbook for evaluating rehabilitation projects in rivers and streams". These provide guidance and are to be revised in the coming years on the basis of experience accumulated in the STANDARD and EXTENDED outcome evaluation, and in synergy with the ongoing revision of the MSP module "Fish – Regional scale level" (e.g. inclusion of biomass).
Because of the difficulties involved in capture and identification, fish smaller than 30 mm are excluded from the evaluation.

Indicator	Description
7.1 Fish community	• The current species set (before or after restoration) is compared with the typical species set. For this purpose, Table 7.1 (adapted from Schmutz et al. 2000) can be used. • The scores for the 5 rows are added up. • The total is divided by 5. The final value resulting is a normalised value between 0 and 1.
7.2 Age structure of fish population	• For each typical species, density is evaluated using Table 7.2. • For each species, the sum of the scores for the 3 rows is divided by 3, resulting in a normalised value between 0 and 1. • The values for all typical species are averaged.
7.3 Ecological guilds of fish	• The guild number and strength of the current species set (before or after restoration) is compared with that of the typical species set. For this purpose, Table 7.3 can be used. The scores for the 2 rows are added up. • The sum of the scores for the 2 rows is divided by 2. The final value resulting is a normalised value between 0 and 1.

Table 7.1: Determination of evaluation scores for indicator 7.1 Fish community.

	Evaluation scores				
	0	**0.25**	**0.5**	**0.75**	**1**
Fish density*	Massive change (>100%)	Substantial change (50–100%)	Marked change (approx. 50%)	Slight change (approx. 25%)	No change (approx. 10%)
Biomass	Massive change (>100%)	Substantial change (50–100%)	Marked change (approx. 50%)	Slight change (approx. 25%)	No change (approx. 10%)
Typical species (no. of species)	Most absent (>80%)	Many absent (60–80%)	Several absent (40–60%)	Certain species absent (20–40%)	(Almost) none absent (<20%)
Non-typical species (no. of individuals)	Dominate the community (>50%)	Considerable proportion (10–50%)	Numerous specimens present (2–10%)	Individual specimens present (<2%)	None present
Dominance structure**	Massive change	Substantial change	Marked change	Slight change	No change

* Fish density may be subject to substantial annual variation. However, fish density is considered to be a parameter capable of rough evaluation.
** Evaluation based on the 3–4 dominant typical species (biomass and density).

Table 7.2: Determination of evaluation scores for indicator 7.2 Age structure of fish population.

	Evaluation scores				
	0	**0.25**	**0.5**	**0.75**	**1**
0+ fish	Absent	Individual specimens	Low abundance	Medium abundance to adequate density	Adequately represented
Juveniles	Absent	Individual specimens	Low abundance	Medium abundance to adequate density	Adequately represented
Adults	Absent	Individual specimens	Low abundance	Medium abundance to adequate density	Adequately represented

Table 7.3: Determination of evaluation scores for indicator 7.3 Ecological guilds of fish.

	Evaluation scores				
	0	**0.25**	**0.5**	**0.75**	**1**
Guild number (no. of guilds)	Most guilds absent	Many guilds absent	Several guilds absent	Certain guilds absent	No guilds absent
Guild strength (density per guild)	Complete change	Fundamental change	Marked change	Slight change	No change

Time required

Table 7.4: Estimated time required in person-hours for the determination and evaluation of Indicator Set 7. General items (e.g. travel time) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation for electrofishing	1	3		
Electrofishing in the field per 5 m watercourse width	1–7	5–7	2–12	5–7
Data processing (e.g. entry)			1	2–4
Data evaluation	1	12		
Total person-hours	20–64		12–88	

Notes: -

Further information

Data arising	• Data entry form Indicator Set 7: KT_ProCode_ERHEBUNG_Set7_V#.xls Elements of the file naming scheme (see Factsheet 5): • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	The field protocol, data entry form and other tools can be downloaded at: https://www.bafu.admin.ch/wirkungskontrolle-revit

Table 7.5: Ecological guilds taken into consideration (adapted from Schmutz 2000). A list showing the guild membership of fish species found in Switzerland is included in the data entry form for Indicator Set 7, available at: https://www.bafu.admin.ch/wirkungskontrolle-revit

General flow preference	rheophilic	preference for flowing water
	indifferent	no clear preference for flowing or standing water
	limnophilic/stagnophilic	preference for standing water
Dependence on structures	structure dependent	strongly dependent on structures
	moderately structure dependent	living close to structures
	structure independent	not dependent on any essential structures
Temperature tolerance	oligo-stenothermal	entire life cycle restricted to a small range of relatively low temperatures
	meso-eurythermal	adapted to moderate temperatures, with greater variability in temperature requirements, according to developmental stage and season (e.g. minimum temperatures in spring/summer for successful reproduction).
Preferred spawning substrate	polyphilic	no particular spawning substrate requirements
	lithophilic	stones
	pelagophilic	open water
	phytophilic	vegetation
	psammophilic	sand
	ostracophilic	shells
	speleophilic	cavities/caves
Feeding type	detritivorous	filtering algae and detritus from sediments
	benthivorous/insectivorous	feeding on benthic resources/insects
	piscivorous	feeding on fish/predatory – mainly fish, but also a low proportion of terrestrial and other aquatic resources.
	planktivorous	filtering mainly zooplankton but also phytoplankton
	omnivorous/euryphagous	eating a wide variety of foods
	herbivorous	feeding on plants
Migration type	short	migrating over short distances (a few kilometres); spawning migration confined to freshwater
	medium	migrating over medium distances (up to 100 km or more); spawning migration within freshwater (potamodromous)
	long	migrating over long distances (several hundred kilometres); spawning migration between fresh and salt water (diadromous)
Tolerance to pollution/ degradation	tolerant	not sensitive to anthropogenic disturbances
	intolerant	sensitive to anthropogenic disturbances

Longevity	short-lived	individuals live less than 5 years
	intermediate lifespan	individuals live for 5–15 years
	long-lived	individuals live for more than 15 years

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Technical Sheet: Indicator Set 8 Riparian vegetation

Indicators:

- 8.1 Plant species (in accordance with Woolsey et al. 2005, no. 47)
- 8.2 Plant communities (in accordance with Woolsey et al. 2005, no. 50)
- 8.3 Temporal shift in the mosaic of floodplain vegetation categories (in accordance with Woolsey et al. 2005, no. 49)

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http://www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, German and Italian.

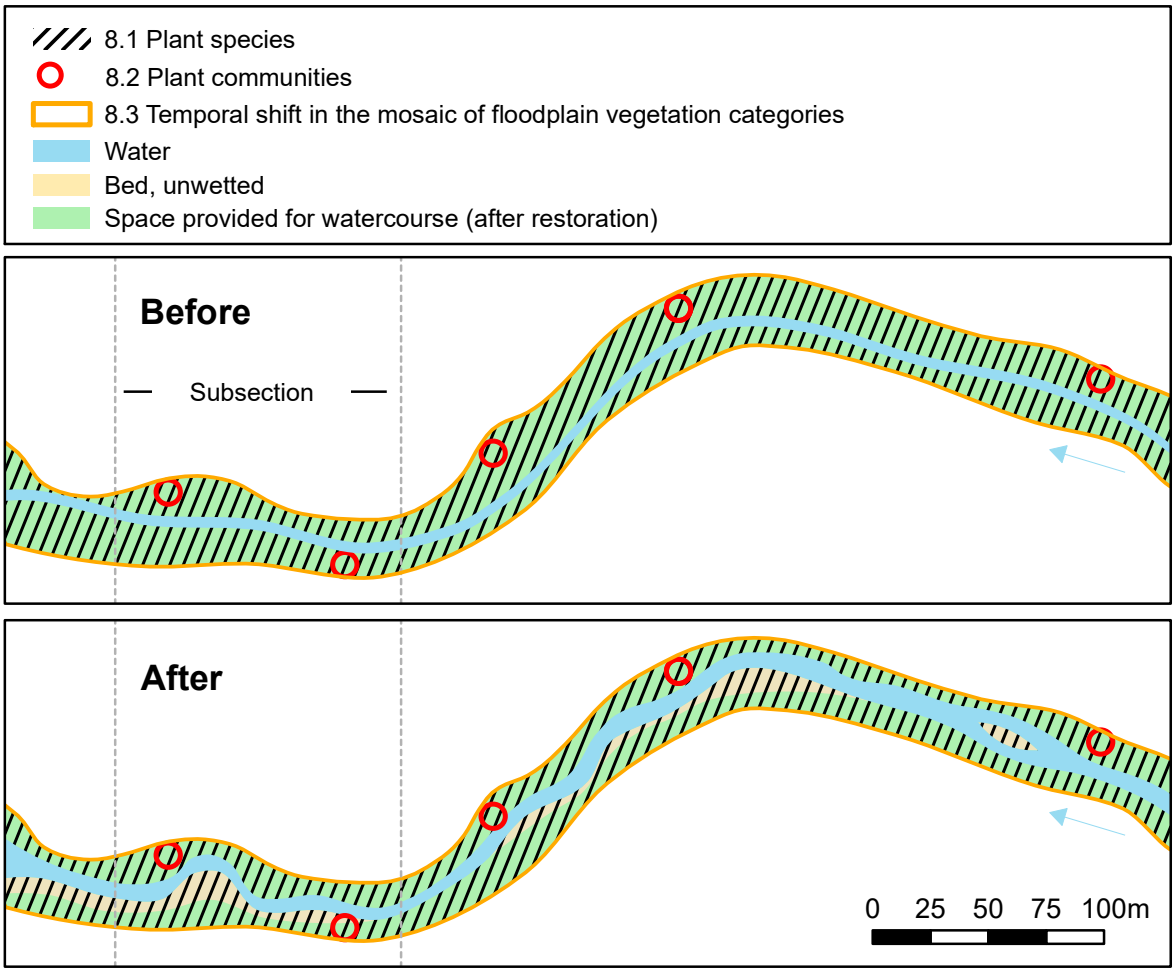
This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

Natural riparian and floodplain vegetation is extremely valuable ecologically: it promotes lateral connectivity, provides a habitat and food source for many animals, stabilises the banks and, in hot summers, reduces the water temperature through shading. The development of natural, diverse riparian vegetation is dependent on ecosystem dynamics. But even where the dynamics are intact or have been restored, riparian and floodplain vegetation can be adversely affected by invasive species. The indicators in this set can be used to evaluate both the dynamics and degradation of riparian and floodplain vegetation.

Parameters	• Indicator 8.1 (Plant species): For at least three species, the number of individuals per unit area or the colonised area is determined. Target species and/or neophytes may be selected. Suitable target species include not only rare, threatened or national priority species: other species may also be selected as target species so long as they are indicators of a specific habitat which is to be promoted or restored by the restoration project. • Indicator 8.2 (Plant communities): In permanently marked plots, the plant communities are described by means of phytosociological surveys. A survey comprises a complete list of the vascular plant species present along with their covers. • Indicator 8.3 (Temporal shift in the mosaic of floodplain vegetation categories): Based on orthophotos, a formation/vegetation map is prepared and then verified in the field. The map consists of a mosaic of polygons, described by standardised parameters such as floodplain formation or vegetation unit, height, vegetation cover and proportions of pioneer species (Gallandat et al. 1993, Cole 2002, Bonnard et al. 2008).
Applicability	The determination of this indicator set is dependent on project size: All projects: determination of indicator 8.1 Medium-sized and large projects and individual projects: additional determination of indicator 8.2 or 8.3.
Special considerations	• Vegetation data can be collected over an extended time frame during the vegetation period. Large-scale floods can transform the habitat and modify or destroy floodplain vegetation within a short period. • Any bank planting undertaken as part of restoration is to be explicitly recorded in the raw data for each species (incl. type of planting, e.g. sowing, cuttings, etc.). • The methodology employed for indicator 8.2 allows the raw data to be evaluated according to the WSL approach for monitoring the effectiveness of habitat conservation in Switzerland (WBS) (Bergamini et al. 2019) and the phytosociological approach (Gillet et al. 1991).
Survey site	Restored section, in the space provided for the watercourse (see Fig. 8.1)
Timing	A single survey during the vegetation period (forest: May–July, open areas: June–August). It should be noted, however, that the “after” survey must be carried out in the same period (+/- 2 weeks) as the “before” survey. Otherwise, the areas and coverage for indicators 8.1 and 8.2 may differ considerably.
Material	• Indicator 8.1 (Plant species): General survey material (see Factsheet 8), identification literature, recent aerial photograph for mapping. • Indicator 8.2 (Plant communities): General survey material (see Factsheet 8), metal or wooden stakes, 20 m measuring tape, identification literature, standard survey form, magnifier, possibly a current aerial photograph for orientation purposes. • Indicator 8.3 (Temporal shift in the mosaic of floodplain vegetation categories): Orthoimages (e.g. true color images such as swissimage[1]), geodata[2] to support mapping, GIS, general survey material (see Factsheet 8) for verification of the map in the field. 1: https://www.swisstopo.admin.ch/de/geodata/images/ortho/swissimage10.html#download 2: https://map.geo.admin.ch/?lang=de&topic=ech&bgLayer=ch.swisstopo.pixelkarte-farbe&layers=ch.bafu.landesforstinventar-vegetationshoehenmodell_relief,ch.bafu.landesforstinventar-vegetationshoehenmodell,ch.swisstopo.swissalti3d-reliefschattierung_monodirektional,ch.swisstopo.swisssurface3d-reliefschattierung_monodirektional&E=2793695.75&N=1164253.19&zoom=10&layers_opacity=1,0.5,1,1

Figure 8.1: Survey site for the indicators from Indicator Set 8.



Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator

Preparation: selection of plant species (target species and/or neophytes)	• After an initial inspection (on foot) of the project perimeter, the target species and/or neophytes are defined. Examples of suitable species can be found in the document «Ufervegetation_Ind.8.1_Empfehlung_Beispiele.xls» (under auxiliaries on the FOEN website). This document contains two Tables: the first lists recommended target species and neophytes by biogeographical distribution and elevation; the second is a more comprehensive species list, providing a more detailed ecological characterisation of each species, incl. examples of guide values for the evaluation. Neither of the Tables is exhaustive, and it is recommended that locally relevant species should also be selected.
	• For each species selected, the type of survey is defined – there are two possibilities:
	  • the number of individuals (e.g. *Myricaria germanica* if fully grown, *Chondrilla chondrilloides*) or
	  • the colonised area is to be determined (e.g. *Calamagrostis pseudophragmites, Impatiens glandulifera)*.
	• Further examples can be found in the second Table of the document «Ufervegetation_Ind.8.1_Empfehlung_Beispiele.xls».
	• At least three species must be selected.
		8.1

Survey of plant species	• For each species selected, the entire project perimeter is inspected and the number of individuals or the colonised area is determined. • If the colonised area is determined for a species, it must be recorded on a map as precisely as possible and the total area in m^2 calculated. • If the number of individuals is counted for a species, the areas where the species is found must also be recorded on the map (although the same degree of precision is not required). In addition, the exact number of individuals must be indicated for the entire project perimeter. • All areas are subsequently digitalised, e.g. using GIS. • The survey may also be performed with the aid of an appropriate app. In this case, digitalisation of areas is not required as this is done directly in the field. Suitable apps for surveying individuals are for example FlorApp (see survey indicator 8.2) and QField, and QField is also suitable for surveying colonised areas. • In all cases, i.e. before and after restoration, the entire project perimeter is investigated (meaning on both shores), even if it has been remodelled between two surveys. This means that the project perimeter must be precisely defined at the time of the "before" survey.	8.1
Phytosociological survey	• Within the project perimeter, minimum five permanently marked plots are established. If possible, these are to be positioned by the specialist where target habitats may develop. Target habitats are habitats according to Delarze et al. (2015), which can occur along watercourses. The following target habitats were defined for indicator set 8:	8.2
	2.1.2.2. Flussufer- und Landröhricht 2.1.4. Bachröhricht 2.2.5. Schwemmufervegetation alpiner Wildbäche 2.3.2. Nährstoffreiche Feuchtwiesen (Sumpfdotterblumenwiese) 2.3.3. Feuchte Hochstaudenflur (Spierstaudenflur) 2.5.1. Einjährige Schlammflur (Zwergbinsenflur) 2.5.2. Mehrjährige Schlammflur (Zweizahnflur) 3.2.1.1. Alluvionen mit krautiger Pioniervegetation 5.1.3. Feuchter Krautsaum (Tieflagen) 5.1.4. Feuchter Krautsaum (höhere Lagen) 5.3.6. Auen-Weidengebüsch 5.3.8. Gebirgs-Weidengebüsch 6.1.2. Weichholz-Auenwald 6.1.3. Grauerlen-Auenwald 6.1.4. Hartholz-Auenwald 7.1.1. Feuchte Trittflur 7.1.6. Mesophile Ruderalflur (Steinkleeflur)	
	• It is important that the number and locations of the permanently marked plots are the same before and after restoration, so that a direct comparison can be made. It is left up to the operators how they ensure precise localisation of the permanently marked plots even after a number of years – e.g. precise determination of the coordinates of the centre of the permanently marked plot (taking the average of repeated GPS measurements) or marking methods like magnetic probes as used in biodiversity monitoring. • The permanently marked plots are circular, comprising an inner (R1) and an outer circle (R2). The areas of the circles are the same as in the WBS method (Fig. 8.2): R1: area = 10 m^2, radius = 1.78 m R2: area = 200 m^2, radius = 7.98 m • In R1, a complete vegetation survey is performed. In R2, the vegetation of the shrub and tree layer is surveyed (Tab. 8.1), i.e. the woody species taller than 0.5 m (approx. knee height). For each species, its cover is indicated according to the Braun-Blanquet scale. • Info Flora's smartphone application FlorApp simplifies the survey in permanent plots, eliminates the need to transcribe data later, and guarantees up-to-date and consistent nomenclature. Flo-rApp can be obtained free of charge at the following link: https://www.infoflora.ch/en/get-involved/my-observations.html	

Determination of floodplain formations	Determination of the temporal shift in the mosaic involves three steps: • Aerial photography / determining availability of aerial photographs (map.geo.admin.ch; freely available from swisstopo since 01.03.2021) • Initially* aerial photographs are used to prepare a map of the floodplain formations, e.g. with 3D-GIS (stereo interpretation). The following formations are distinguished: 1. water 2. bare or sparsely vegetated floodplain sediments 3. floodplain area with herbaceous vegetation 4. softwood floodplain forest 5. hardwood floodplain forest 6. other forest 7. other areas Formations 1–5 are typical of floodplains and thus of particular relevance for the evaluation. The working scale is adapted to the particular question and lies between 1: 5,000 and 1:10,000. • In order to limit the time required for mapping the formations on the site image, a minimum scale should be defined in the GIS used. This can limit a too detailed demarcation. In addition, the thickness of the lines can be increased on the screen, which automatically results in more generalized mapping. Some notes on formation delineation: - Softwood floodplain is recognizable by bright green in the orthoimage and uniform woody structure. - Hardwood floodplain forest is distinguished from the other forests by the tree species composition and terrain characteristics (top-down approach). • Subsequently, the map is verified in the field and amended if necessary (Optionally, vegetation units can be mapped.)	8.3

***** Demarcation and identification keys are defined in advance to ensure consistency and reproducibility (Bonnard et al. 2008). For this purpose, the following tools (in French/German) are to be used (available for download on the FOEN website):

- M-1-TGA (low-lying floodplains) GIS-based orthophoto interpretation: Section 2.3 (pp. 4–7)
- M-8-TGA (low-lying floodplains) field mapping:
  - Appendix A4: Interpretation of Table for description of vegetation
  - Appendix A8: Mapping of vegetation formations
  - Appendix A1: Legend for vegetation map

Figure 8.2: Dimensions of R1 and R2 of the permanently marked plots

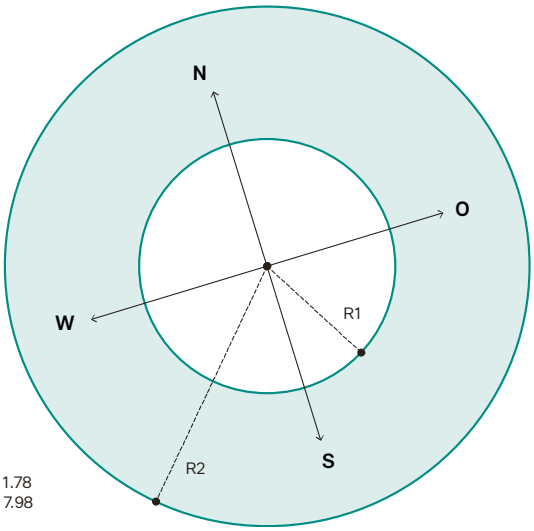


Table 8.1: Stratification of vegetation.

	Layer	Definition
T	Tree layer	Woody plants > 3 m
S	Shrub layer	Woody plants between 0.5 and 3m
H	Herb layer, high	Woody plants < 0.5 m and all herbaceous plants regardless of their height

Evaluation

The evaluation approaches given below are based on the original indicator method sheets from the "Handbook for evaluating rehabilitation projects in rivers and streams". They are provided for guidance and will be revised in the coming years, based on experience accumulated in the course of the STANDARD and EXTENDED outcome evaluations.

Indicator	Description
8.1 Plant species	For the analysis, the raw data (number of individuals, colonised area in m^2) is normalised to a dimensionless value between 0 and 1. This can be done in three steps. The formulas for all three steps are stored in the evaluation document "Auswertung_Set1_Set8_1_02" (under auxiliaries on the FOEN website). This document also contains calculation examples. **Step 1: Extrapolation to 1km stream length.** The data collected in the project perimeter are extrapolated to 1km flow length. Example: Along a 251m long rehabilitation section, 181 individuals are counted for target species X on the right bank and 73 individuals on the left bank, i.e. a total of 254 individuals on 251m. Extrapolated to 1km of stream length, 1'011.95 individuals are counted. **Step 2: Definition of the guide values.** For each species, 0- and 1-guide values are defined, where the 0-guide value reflects the number of individuals or colonized area under non-natural conditions and the 1-guide value reflects the number of individuals or colonized area under near-natural conditions. The 0 and 1 guide values should be adapted to the species. For example, a species such as Salix elaeagnos, which is widespread and occurs on various substrate types, is assigned higher guide values than, for example, Myricaria germanica: the germination of M. germanica is possible exclusively on banks of fine, moist sand. These site conditions do not occur everywhere or in every year. *Example: For the target species X, a 0-guide value of 50 individuals per km stream length is set and a 1-guide value of 2,000 individuals per km stream length.* **Step 3: Calculation of the standardized value.** The extrapolated value from step 1 is translated into a standardized value between 0 and 1. To do this, use a value function that slopes linearly between the two standard values from step 2. For target species, the slope of the value function is positive (see example Fig. 8.3) and for neophytes it is negative (see example Fig. 8.4). *Example: For the target species X with 1,011.95 individuals per km stream length, a standardized value of 0.49 is obtained.*

Figure 8.3: Example of normalisation of the results for target species – distribution of *Myricaria germanica*; guide values for number of individuals arising from seed dispersal along 1 km stream length: 0 guide value: ≤10, 1 guide value: ≥500.

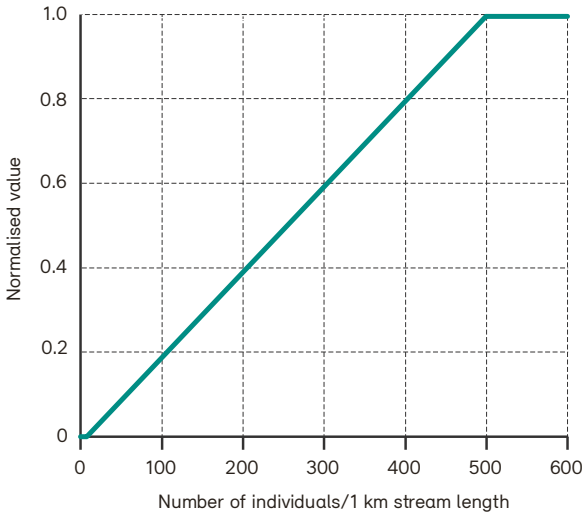
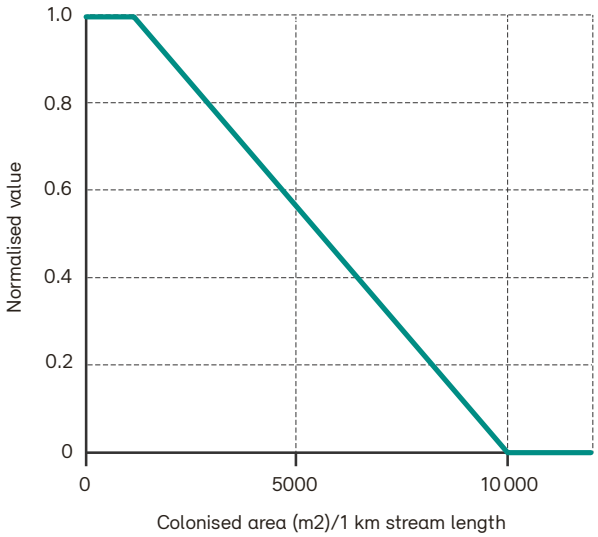


Figure 8.4: Example of normalisation of the results for neophytes – distribution of *Solidago canadensis*; guide values for area (m^2) colonised by neophytes along 1 km stream length: 0 guide value: ≥1 ha, 1 guide value: ≤1000 m^2.



8.2 Plant communities

The data from the phytosociological surveys can be used for two analyses, which are explained in more detail below - a comparison with the species lists of the Delarze habitats (analysis 1, mandatory) and the calculation of the score TypoCH of InfoFlora (analysis 2, optional). Analysis 1 results in an evaluation of the indicator using a standardized value; for Analysis 2, no standardized evaluation is available at this time.

Preparation: Combination of species lists: For the two analyses, the species lists of the two circles R1 and R2 are combined for each permanent plot.

Analysis 1 (Mandatory):
Similarity to species lists of Delarze habitats.

The assessment proceeds in four steps. Steps 1-3 occur at the individual permanent plot level, Steps 4-5 occur at the project level, i.e., across all surveyed permanent plots.

Step 1: Calculation of Similarities: For each permanent plot, the similarity of the combined species list to the societies of all 131 habitats is calculated according to Delarze et al. (2015). Similarity is expressed using the Jaccard coefficient (Legendre & Legendre 1984). This coefficient (SJ_{ij}) is calculated as follows:

$$SJ_{ij} = \frac{a}{a + b + c}$$

where
a = number of species occurring in both surveys i and j
b = number of species only occurring in survey i
c = number of species only occurring in survey j
i = Combined species list in the permanent plot (R1, R2)
j = Species list for the habitat according to Delarze et al. 2015

For automatic calculation of the Jaccard coefficient, there are different options (e.g. with Excel, Vegedaz, R). The species lists of the habitats according to Delarze et al. (2015) can be viewed on the InfoFlora website (https://www.infoflora.ch/en/habitats/full-list.html) or obtained from InfoFlora. In Vegedaz, the assignments can be made automatically, i.e. the species lists of the Delarze habitats are deposited. Vegedaz can be obtained from the following link: https://www.wsl.ch/en/services-and-products/software-websites-and-apps/vegedaz.html . Instructions for calculating the Jaccard coefficient can be found in the file "Ufervegetation_8.2_Anleitung_Vegedaz_1_01" under auxiliaries on the FOEN website.

Step 2: Determination of the highest similarities: For each permanent plot, the highest Jaccard coefficient is identified among the 17 target habitats on the one hand, and among the remaining 114 habitats on the other.

Step 3: Averaging: The highest Jaccard coefficients identified in Step 2 for the target habitats are averaged across all permanent plots.

Step 4: Standardization: The mean value for the target habitats is standardized to dimensionless values between 0 and 1. The following applies:
Guide values: Jaccard similarity coefficient

- 0 guide value: ≤0.1
- 1 guide value: ≥0.5

Between the two guide values the curve is linear (Fig. 8.5).
The following formula can be used to calculate the standardized value (SV):

$$SV = (Mean\ Jaccard\ coefficient - 0.1) * 2.5$$

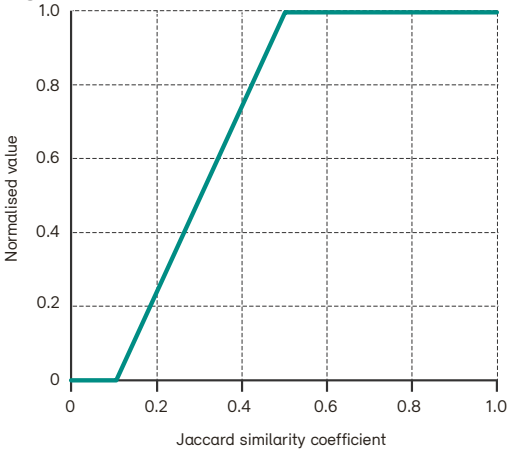
Analysis 2 (optional): Calculation of Score TypoCH from InfoFlora.

A score ("Score TypoCH") is calculated per permanent plot for each vegetation survey for each Delarze habitat. This can be done directly during the survey using FlorApp or as part of the evaluation using Vegedaz (see Vegedaz instructions "Ufervegetati-on_8.2_Anleitung_Vegedaz_1_01" under auxiliaries on the FOEN website). The Delarze habitat with the highest score is the one best described by the Vegetation data.
For each plant found in the field that is also on the list of the respective habitat, the score increases. Characteristics of the species are weighted differently (Table 8.2): In Delarze et al. (2015), a distinction is made for each habitat between character species (marked with a filled-in cloverleaf) and species less strictly tied to the habitat (marked with an unfilled-in cloverleaf). Furthermore, it is taken into account whether these are dominant species that help shape the habitat (marked in bold in Delarze et al. 2015) or not. In addition, the information of the cover ratio from the vegetation survey in the field is added.
Across all habitats, this results in a distribution of different scores. Habitats with few characteristic species or few species achieve lower scores than species-rich habitats.

Table 8.2: Consideration of species characteristics in the calculation of the score TypoCH according to Delarze et al. (2015). Only species included in the species lists of the Delarze habitats are taken into account.

Character species?	Dominant species?	Coverage	Contribution Score
Character species	no	irrelevant	4
Character species	yes	< 5%	4
Character species	yes	> 5%	8
Less strictly habitat bound	no	irrelevant	1
Less strictly habitat bound	yes	< 5%	1
Less strictly habitat bound	yes	> 5%	2

Figure 8.5: Normalisation of the Jaccard similarity coefficient**.**



8.3 Temporal shift in the mosaic of floodplain vegetation categories

The maps produced are stored in the GIS; these are condition maps (example in Fig. 8.6). The areas of the various formations (or units) are calculated. The formulas for both analyses are stored in the evaluation document "Auswertung_Set1_Set8_1_02" (under "Hilfsmittel" on the FOEN website).

Analysis 1: Diversity of floodplain formations

The diversity of floodplain formations describes the complexity of the mosaic of floodplain habitats. Thus, an even distribution of floodplain formations characterises a dynamic system. By contrast, the dominance of one or two formations indicates an impoverished floodplain system. The diversity of existing floodplain formations is calculated using the Shannon index (H'), as follows:

$$H' = -\sum(\ln p_i \times p_i)$$

where:

p_i = Area of existing floodplain formations *i* as a proportion of the total area
i = Floodplain formations such as water, softwood floodplain forest, etc. (see Survey ind. 8.3)

The range of the Shannon index depends on the number of floodplain formations.
For the evaluation, the values of the Shannon index are normalised to a dimensionless value (= degree of satisfaction). For this purpose, it must previously be estimated how many floodplain formations would occur at this site under natural conditions (potential number of formations). This depends partly on the elevation: if a watercourse lies below 1000 m asl, the number of floodplain formations can be assumed to be 5. The 0 and 1 guide values for the Shannon index will vary according to the potential number of floodplain formations (Table 8.3).
Between the two guide values the curve is linear (Fig. 8.7, example for 5 formations).

Analysis 2: Proportion of pioneer formations

Within the study perimeter, the area colonised by pioneer formations is determined. Herb communities and softwood floodplain forests are considered to be pioneer formations. In channelised systems, formations of these types are largely lacking. They are, however, promoted by watercourse restoration.
The curve of the value function is stepped (Fig. 8.8). A proportion of pioneer formations between 0 and 10% corresponds to a normalised value of 0. With a proportion of 50–60%, a maximum of 1 is attained. For proportions over 80%, the normalised value remains at 0.5, owing to the increased value and the rarity of pioneer formations.

Figure 8.6: Map of the Ile Falcon floodplain formations (Sierre/Siders, canton of Valais).
Condition: 1995–1999–2000–2002. Brown: non-floodplain area; violet: softwood floodplain forest more than 5 m high; pink: softwood floodplain forest less than 5 m high; yellow: pioneer herb communities; dark grey: sediments transported artificially as a result of gravel extraction; light grey: natural sediments; blue: water.

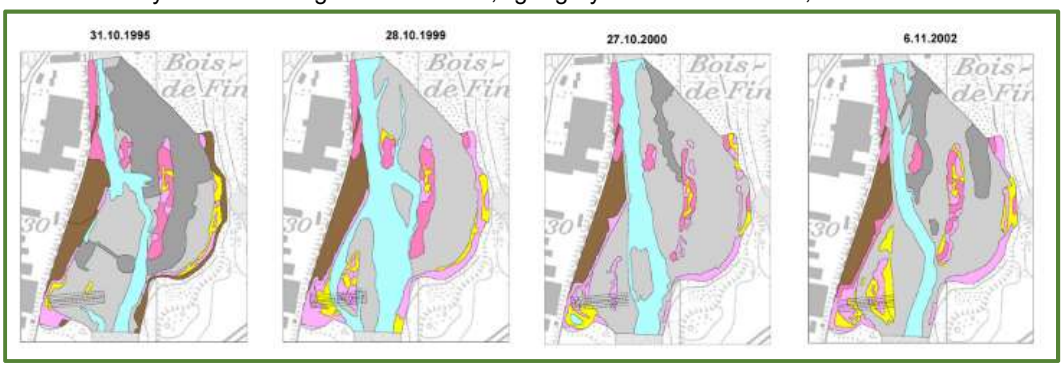


Table 8.3: 0 and 1 guide values for the Shannon index as a function of the potential number of formations.

Potential number of formations	0 guide values	1 guide values
3	≤0.34	≥0.95
4	≤0.43	≥1.20
5	≤0.50	≥1.40
6	≤0.55	≥1.55
7	≤0.60	≥1.70

Figure 8.7: Normalisation of the Shannon index: curve for five formations.

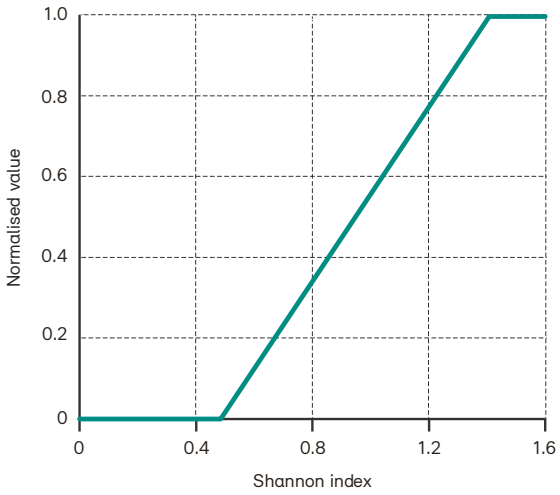
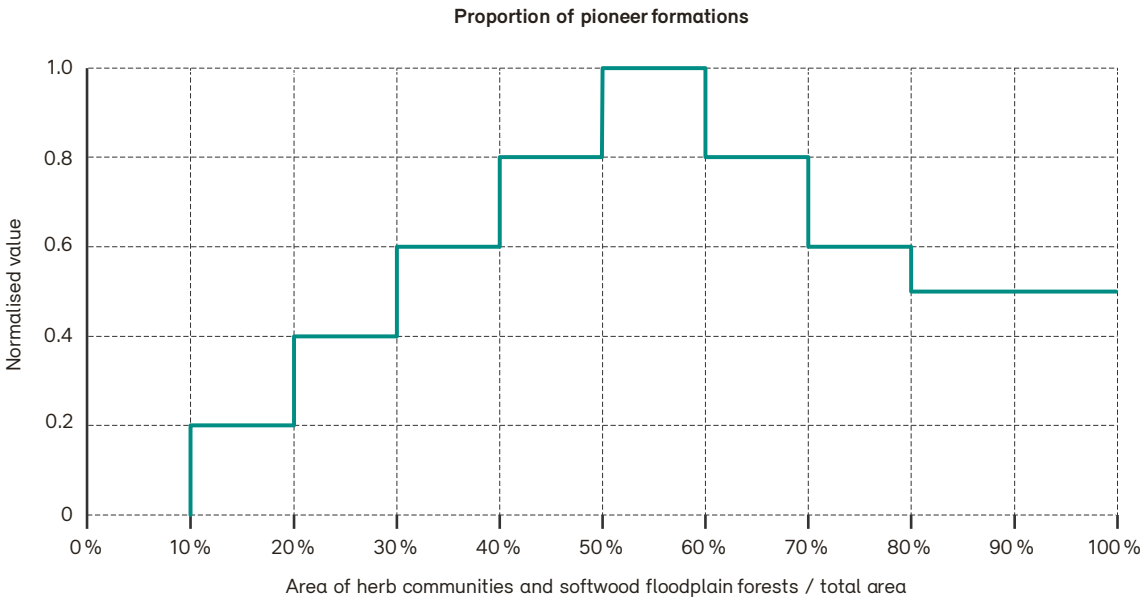


Figure 8.8: Normalisation of the results for pioneer formations.



Time required

As the determination of indicators from this indicator set varies according to project size, a combined presentation of the time required is not included here. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Table 8.4: Estimated time required in person-hours for the determination and evaluation of indicator 8.1 (Plant species). General items (e.g. travel time for fieldwork) are not taken into account.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Bank survey (1 km, 1 species)	1	2		
Data entry, mapping and evaluation	1	2		
Total person-hours	4			
Notes: -				

Table 8.5: Estimated time required in person-hours for the determination and evaluation of indicator 8.2 (Plant communities). General items (e.g. travel time for fieldwork) are not taken into account.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Installation of permanently marked plot. Phytosociological survey (1 permanently marked plot)	1	1.5		
Data entry and evaluation (1 permanently marked plot)	1	2		
Total person-hours	3.5			
Notes: The time required for surveys is largely dependent on the accessibility of the permanently marked plots. The duration given here was defined for a readily accessible permanently marked plot.				

Table 8.6: Estimated time required in person-hours for the determination and evaluation of indicator 8.3 (Temporal shift in the mosaic of floodplain vegetation categories). General items (e.g. travel time for fieldwork) are not taken into account.

Step	Specialists		Assistants	
	Persons	Time per person (h)	Persons	Time per person (h)
Ordering of orthophotos	1	1		
Demarcation, aerial photograph interpretation (20 ha, 1:10,000)	1	8		
Mapping of floodplain formations (20 ha, 1:10,000)	1	3		
Optional: field surveys (20 ha, 1:10,000)	1	(9)		
Optional: mapping of vegetation units (20 ha, 1:10,000)	1	(5)		
Total person-hours	12 (26)			
Notes: -				

Further information

Data arising	• Excel form Indicator Set 8: KT_ProCode_ERHEBUNG_Set8_V#.xls
	• GIS files, ideally as shapefiles:
	  • KT_ProCode_ERHEBUNG_Set8_Ind8_1
	  • KT_ProCode_ERHEBUNG_Set8_Ind8_2
	  • KT_ProCode_ERHEBUNG_Set8_Ind8_3
	
	Elements of the file naming scheme (see Factsheet 5):
	• KT = two-capital-letter cantonal abbreviation (e.g. BE)
	• ProCode = project code
	• ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED)
	• V# = version number of the Excel form

Attachments	The field protocol, the Excel form (including data table) and other tools can be downloaded at: https://www.bafu.admin.ch/wirkungskontrolle-revit

Liste of changes

Relevant changes since the last version are marked in green.

Date (mm/yy)	Version	Changes	Responsibility
4/2020	1.02	Correction of spelling mistakes, small conceptual adjustments	Eawag
4/2020	1.02	Minor graphical adjustments	Eawag
4/2020	1.02	Specification marking permanent plots	Eawag
4/2020	1.02	Technical additions about aerial photo interpretation	Eawag
4/2020	1.02	Reduction of survey costs Indicator 8.3	Eawag
7/2021	1.03	Minor graphical adjustments	Eawag
7/2021	1.03	Specifying habitats from Delarze et al. 2015.	Eawag
7/2021	1.03	Stereo aerial images are no longer a prerequisite	Eawag
1/2022	1.04	Correction of Figure 8.1 regarding the survey location of indicator 8.3	Eawag
1/2023	2.01	Minor graphical and textual adjustments (e.g. moving some illustrations)	Eawag
1/2023	2.01	Specification of the time of the survey	Eawag
1/2023	2.01	Detailed description of the evaluation of indicator 8.1 incl. calculation example	Eawag
1/2023	2.01	Adaptation of the assessment of indicator 8.2 Plant communities (comparison with several target habitats as well as further habitats according to Delarze et al. 2015, use of score TypoCH, detailed description of the procedure).	Eawag
1/2023	2.01	Indicator 8.3 Temporal shift in the mosaic of floodplain vegetation categories: Introduction of notes on the identification of floodplain formations.	Eawag
3/2024	2.02	Specification of digitalisation options in the field for indicator 8.1.	Eawag

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Federal Department of the Environment,
Transport, Energy and Communications DETEC

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Water Division

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Technical Sheet: Indicator Set 9 Avifauna

Indicator(s):

- 9.1 Bird species

Publication details

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PDF download:
http://www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, German and Italian.

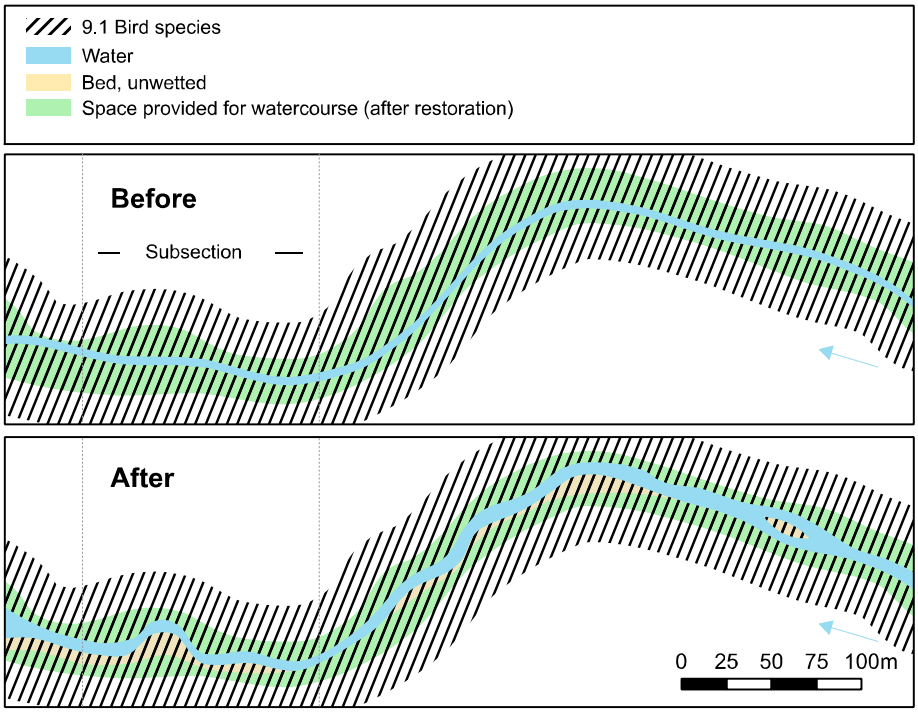
This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

Riparian and floodplain habitats are an essential component of river ecosystems. The more near-natural the watercourse, the greater the diversity and quality of the habitats. The occurrence and abundance of many bird species are dependent on such habitats providing suitable nesting sites or adequate food resources. Indicator Set 9 (Avifauna) involves the mapping of breeding bird territories and determination of the number and abundance of target species before and after restoration. Target species are those bird species which are to be promoted by the restoration measures.

Parameters	The investigation covers three points relating to the status and development of avifauna: (i) number of species and territories for all breeding bird species, (ii) number of species and territories for defined target species, (iii) number of species and territories for Red List species.
Applicability	For breeding bird surveys, there are various recommendations concerning the minimum size of the habitat area to be investigated, depending on the particular question to be studied. The area should be at least large enough to allow for the occurrence of the rarest target species in a restoration project (Glutz 1962, Robbins et al. 1989). The larger the area investigated, the more meaningful the results will be. It is recommended that a minimum area of 5 ha, or a river section at least 500 m in length, should be defined for a survey.
Special considerations	The goals in relation to habitats and associated avifauna must be defined at the beginning of the restoration project. The target species which are to be promoted by the restoration measures should also be defined. The first survey visit must have taken place at low altitudes by mid-May at the latest.
Survey site	Restored section in the area provided for the watercourse, including the buffer zone (see Fig. 9.1)
Timing	At least three survey visits should take place between the end of April and the end of June – or possibly mid-July at higher elevations (e.g. in the Engadine). As a rough guideline, surveys are to be performed every 2 weeks.
Material	General survey material (see Factsheet 8), field glasses. Two copies of a map (one spare copy), list of abbreviations and criteria, GPS equipment, possibly torch.

Figure 9.1: Survey site for the indicator from Indicator Set 9.



Survey

The survey is performed using the simplified territory mapping method, with at least three survey visits (Schweizerische Vogelwarte 2006, Knaus & Schmid 2014a). This method is also used for the Breeding Bird Atlas, the Common Breeding Bird Monitoring (MHB) programme and Indicator Z7 of the FOEN Biodiversity Monitoring programme (Koordinationsstelle BDM 2014).

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Selection of target species	• In the project, the target species are defined which are to be promoted by the restoration measures. Recommended target species can be found in Tables 9.1 and 9.2 at the end of this document, which include details of the species' biogeographical and altitudinal distribution and habitat requirements. Possible criteria for the selection of target species are: a) Species typical of natural or near-natural aquatic ecosystems (including sparsely vegetated ruderal areas, tall herb stands, softwood/hardwood floodplain forest, open waters, standing water) b) Species typical of a particular habitat in accordance with the restoration goal c) Red List species d) Priority species for conservation efforts	9.1
Contact with the Swiss Ornithological Institute	• At least a month before the fieldwork, the person responsible for mapping contacts Roman Bühler from the Ornithological Institute (roman.buehler@vogelwarte.ch, 041 462 99 27) and provides the following information: 1. Who is to perform the mapping (e-mail address of the ornitho.ch account)? Several mappers may be involved. 2. Within what perimeter is the mapping to take place? Ideally, a GIS file of the restoration project perimeter (including buffer zone*) should be submitted. *It is recommended that a buffer zone extending 50–100 m around the project perimeter should be defined and included in the surveys. When territory delineation is performed, it can then be determined whether an uncertain territory lies inside or outside the project perimeter. • The Ornithological Institute undertakes the background work required to ensure that the data can be digitalised and analysed with Terrimap Online (http://tmo.vogelwarte.ch/). • The Ornithological Institute contacts the mappers and instructs them on the procedure for fieldwork: dispatch of paper field maps (daily maps), instructions for the use of Terrimap Online, and for mapping and territory delineation.	9.1
Definition of the survey route	• The person responsible for mapping defines the route for the survey visit. The route should be defined in such a way as to cover the essential parts of the area under investigation. • After restoration, the route may need to be slightly modified.	9.1
Walkover surveys	• Three survey visits are performed in the early hours of the morning (see above for timing and frequency). In the case of large watercourses, it may not be possible to cover both banks in one morning – i.e. two walkovers per time point may be required. • The first survey visit must be completed at low elevations by mid-May at the latest. • During each walkover, all birds heard or sighted in an "auditory observation corridor" approx. 50 m wide are recorded on the daily maps received from the Ornithological Institute.[1]	9.1

Digitalisation of survey data and territory delineation	• The completed daily maps are copied, scanned or photographed in adequate quality (back-up copy for mappers). • The daily maps are digitalised by the mappers using Terrimap Online, according to the instructions provided by the Ornithological Institute. • The Ornithological Institute reviews the digitalised daily map. After completion of the control, the results (ZIP file with species maps, GIS data and precinct table) can be downloaded within Terrimap Online (save icon in the precinct view).	9.1
Data submission to federal authority	• Using the results downloaded directly from Terrimap Online (after control by the ornithological station!), the data entry form for Indicator Set 9 (Avifauna) can be completed by the person responsible for mapping. This form is submitted to the federal authority, together with the results downloaded from Terrimap Online (entire ZIP file), as part of the data submitted for restoration project outcome evaluation.	9.1

[1]Explanatory note for surveys (from Schweizerische Vogelwarte 2006, see also Knaus & Schmid 2014a and b):
A territory is assumed to exist if at least one of the following conditions is met (with three walkover surveys):

- Breeding evidence, i.e. nest with adult incubating, eggs or young, or eggshells from nestlings; adult feeding or removing a fecal sac; distraction display by adult; recently fledged young.
- Individual displaying territorial behaviour (male singing or engaged in courtship display, also – in certain species such as warblers – intense warning calls near the nest) or intraspecific same-sex aggression recorded during one walkover.
- Two grouped records not involving display of territorial behaviour. This criterion relates to species whose song is not particularly complex or conspicuous, or to species with group territories, such as the Long-tailed Tit, Spotted Flycatcher, White Wagtail or Eurasian Tree Sparrow.

Evaluation

At present, no evaluation is to be performed using a normalised value between 0 and 1 since, as yet, the data available from before/after comparisons in restoration projects is not sufficient to permit meaningful definitions.
However, based on the mapping of breeding bird territories, various interpretations can be made with regard to the emergence/disappearance of species or changes in species density (see the example of Ruppoldingen under https://www.bafu.admin.ch/wirkungskontrolle-revit -> Hilfsmittel).

Time required

Table 9.3: Estimated time required in person-hours for the determination and evaluation of Indicator Set 9. General items (e.g. travel time for fieldwork) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	**Specialists**		**Assistants**	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation	1	2–3		
Breeding bird mapping surveys	1	9–12		
Digitalisation of survey	1	2–3		
Total person-hours	13–18			

Notes: The time required per mapping will vary according to bird density and the accessibility of the terrain. For bird-rich lowland sample areas, it will be approx. 5–15 minutes per hectare, and on open farmland approx. 2 minutes per hectare.

Further information

Data arising	• Data entry form Indicator Set 9: KT_ProCode_ERHEBUNG_Set9_V#.xls • Export file (ZIP) from Terrimap Online (downloadable by clicking the save button in the Terrimap Online precinct view). Rename file to "KT_ProCode_Collection_Set9_TMOdata". Elements of the file naming scheme (see Factsheet 5): • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = version number of the data entry form
Attachments	The data entry form and other tools can be downloaded at: https://www.bafu.admin.ch/wirkungskontrolle-revit

List of changes

Relevant changes since the last version are marked in green.

Date (mm/yy)	Version	Changes	Responsibility
4/2020	1.02	Correction of spelling mistakes, small conceptual adjustments	Eawag
4/2020	1.02	Minor graphical adjustments	Eawag
1/2023	1.03	Correction of typographical errors, addition of author team at time of first observation, conceptual adjustments and clarifications, update of Red List.	Eawag
3/2024	1.04	The contact person at the Ornithological station is now Roman Bühler.	Eawag

Table 9.1: Non-exhaustive list of possible target species and their geographical (biogeographical regions in accordance with FOEN 2022) and altitudinal distribution (ordered systematically). Bold type indicates species of non-human-modified watercourses (Spaar & Pfister 2000), which occur almost exclusively on natural and near-natural watercourses or are primarily concentrated in these habitats. Other species included in this Table are the Garden Warbler, Common Nightingale and Golden Oriole (species of near-natural forests, which are part of natural or near-natural aquatic ecosystems), as well as the Goosander and Collared Sand Martin.

	Jura	**Central Plateau**	**North side of the Alps**	**Western Central Alps**	**Eastern Central Alps**	**South side of the Alps**
Colline	- Goosander - **Common Sandpiper** **- Common Kingfisher** - Collared Sand Martin - **Grey Wagtail** - **White-throated Dipper** - Common Nightingale - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - Collared Sand Martin - **Grey Wagtail** - **White-throated Dipper** - Common Nightingale - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - Collared Sand Martin - **Grey Wagtail** - **White-throated Dipper** - Common Nightingale - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Common Nightingale - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Common Nightingale - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Common Nightingale - Garden Warbler - Golden Oriole
Montane	- Goosander - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler - Golden Oriole	- Goosander - **Little Ringed Plover** - **Common Sandpiper** - **Common Kingfisher** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler - Golden Oriole
Subalpine			- **Little Ringed Plover** - **Common Sandpiper** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler	- **Little Ringed Plover** - **Common Sandpiper** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler	- **Little Ringed Plover** - **Common Sandpiper** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler	- **Little Ringed Plover** - **Common Sandpiper** - **Grey Wagtail** - **White-throated Dipper** - Garden Warbler
Alpine			- **Grey Wagtail** - **White-throated Dipper**	- **Grey Wagtail** - **White-throated Dipper**	- **Grey Wagtail** - **White-throated Dipper**	- **Grey Wagtail** - **White-throated Dipper**

Table 9.2: Ecological characterisation of the recommended target species of natural and near-natural aquatic ecosystems (ordered systematically). Bold type indicates species which occur almost exclusively on natural and near-natural watercourses or are primarily concentrated in these habitats. Detailed information on individual species is available at: *https://www.vogelwarte.ch/en/birds/birds-of-switzerland/*. * The List of National Priority Species is soon going to be revised.

Species name	**Indicates the presence of the following habitat structures:**	**Habitat** (classified in accordance with Delarze et al. 2015)	**Preferred watercourse size** (small, medium-sized, large)	**Red List status, as of 2021**	**National Priority Species status, as of 2017***
Goosander	Natural cavities in rocks and trees (nesting sites)	1, 1.1, 1.2, 3, 3.4, 6, 9, 9.2	Medium-sized, large	Near threatened	Priority 2
Little Ringed Plover	Sparsely vegetated gravel, sand and silt islands and banks	1, 1.2, 3, 3.2	Medium-sized, large	Endangered	Priority 1
Common Sandpiper	Gravel, sand and silt banks largely composed of fine sediment, and pioneer vegetation	1, 1.2, 2, 2.0, 2.1, 5, 5.3, 6, 6.1	Medium-sized, large	Endangered	Priority 1
Common Kingfisher	Abundant perching sites, steep eroded banks	1, 1.1, 1.2, 2, 2.1, 3, 3.2, 6, 6.1	Small, medium-sized, large	Vulnerable	Priority 1
Collared Sand Martin	Sandy/gravelly steep faces	2, 2.0, 3, 3.2	Medium-sized, large	Endangered	Priority 1
Grey Wagtail	Streams with gravelly or rocky banks	1, 1.1, 1.2, 2, 2.0, 2.1, 3, 3.2, 5, 5.1, 5.3, 6, 6.1, 6.3, 9, 9.2	Small, medium-sized, large	Least concern	-
White-throated Dipper	Watercourses of all kinds with relatively clean water, availability of nesting sites directly above the water or behind waterfalls	1, 1.1, 1.2	Small, medium-sized, large	Least concern	Priority 3
Common Nightingale	Rich, dense undergrowth	5, 5.3, 6, 6.1, 6.3	Small, medium-sized, large	Least concern	Priority 2
Garden Warbler	Woodland with dense shrubs, especially on damp ground	5, 5.3, 6, 6.1, 6.2, 6.3	Small, medium-sized, large	Vulnerable	Priority 2
Golden Oriole	Highly structured, sparse stands with tall single trees	6, 6.1, 6.2, 6.3	Medium-sized, large	Least concern	-

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Technical Sheet: Indicator Set 10 Society

Indicator(s):
- 10.1 Stakeholder acceptance (in accordance with Woolsey et al. 2005, no. 1)

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PDF download:
http://www.bafu.admin.ch/outcome-evaluation-resto
(not available in printed form)
This publication is also available in French, German and Italian.

This Indicator Set forms part of the Swiss STANDARD outcome evaluation and is to be used in conjunction with the practice documentation “Evaluating the outcome of restoration projects – collaborative learning for the future” (FOEN 2019). The indicators included in the Indicator Set derive from various sources (e.g. Woolsey et al. 2005; Modular Stepwise Procedure) and, where appropriate, have been updated or adapted for the practice documentation. An overview of the most important modifications made can be found in Factsheet 7.

Principle

The acceptance of a restoration project indicates how well the project and the entire process are received, e.g. by interest groups such as fishing or environmental associations. In the area of socioeconomic outcome evaluation, acceptance is an important indicator for sustainable river management. The greater the acceptance of a project, the easier it will be for restoration projects to be implemented in the same region in the future. The present indicator focuses on the interest groups involved in the planning process. It is thus not representative of acceptance among the population as a whole, but it does provide an indication of sentiment.

Parameters	Acceptance is described by the level of approval among interest groups before and after implementation of the project. The level of approval is determined using five standardised questions concerning the project goals, process and results, and general satisfaction. Each answer is assigned a score between 0 and 5, with 0 indicating very low and 5 very high satisfaction. The values determined for the five questions are then averaged.
Applicability	This Indicator Set can be chosen for all projects, including individual projects, and is not covered by the rule concerning the minimum and maximum number of sets to be selected.
Special considerations	The interviews are to be conducted by the project manager, or by a project team member chosen by the interest group. The interest groups must feel that they are being taken seriously, and the interviews should also permit the provision of information and explanations on the project. If the original representative of an interest group can no longer be interviewed for the first or second “after” survey (e.g. due to relocation, retirement, etc.), a different representative may be contacted. It is important that acceptance should be determined among the same interest groups before and after implementation of the project.
Timing	The acceptance survey is not season-dependent. The “before” survey should take place shortly before the start of construction work, i.e. after permission has been granted. In a departure from the general procedure for the STANDARD outcome evaluation, the first “after” survey for this Indicator Set is to be scheduled for years +1 to +2 after construction, and the second “after” survey for years +4 to +6.
Material	General survey material (see Factsheet 8)

Survey

The individual steps involved in the survey are explained below, in chronological order.

Step	Description	Indicator
Identification of interest groups (= stakeholder analysis)	• The identification of interest groups is a two-stage process: 1. First, those groups are identified which are involved in the planning of the restoration project (e.g. environmental associations, landowners, industry) 2. In addition, other local interest groups also need to be included, such as recreational users, associations or local authorities (tourism) • Information on possible interest groups can be found in the manual on participation in hydraulic engineering projects (BAFU 2019). As the number of interest groups is project-dependent, no minimum or maximum number of groups is specified here. • Based on the stakeholder analysis, interest groups or their representatives can be selected. One representative per interest group is sufficient. • Each interest group is assigned to one of seven categories. If necessary, more than one interest group per category can be surveyed. The categories are: a) environment (e.g. fishing, ornithology associations) b) agriculture (e.g. associations, farmers, tenants) c) drinking water d) recreational users e) landowners excluding agriculture (e.g. private individuals, communities) f) commune (if the canton is responsible for planning) g) other	10.1

Conduct of interviews	• The interest group representatives are each surveyed to determine the extent to which they approve of the project goals, process and results, and the project overall, based on the following five questions: 1. How satisfied are you in general with the restoration project? 2. Are the goals of the project in agreement with your goals? 3. How well is/was the planning process managed? 4. Were you sufficiently involved? 5. How do you rate the (planned) results? The level of approval reflects satisfaction with the process and the (planned) results. • The interview setting can be freely chosen (e.g. by telephone, following an advisory group meeting). • The form (cf. Indicator Set 10 field protocol) contains five standardised questions to be answered by all the representatives. Additional questions can be freely adapted to each interest group. The additional questions do not have to be included in the data reporting, but this is to be recommended, as they will provide the project team with valuable suggestions for improvements. • Each answer given by the respondents is assigned a score (0–5) by the interviewer, with 0 indicating very low and 5 very high satisfaction. Decimals may also be used. • If any responses show low or very low approval of the project, the reasons should be ascertained and recorded in the "Notes" column of the data entry form. Possible reasons include: a) insufficient involvement in project planning, b) inadequate attainment of ecological goals, c) excessive amount of land required, d) unattractive for recreational use, e) costs too high.	10.1
Completion of field protocol	• The questionnaire must be completed by the project manager during or after the interview.	10.1

Evaluation

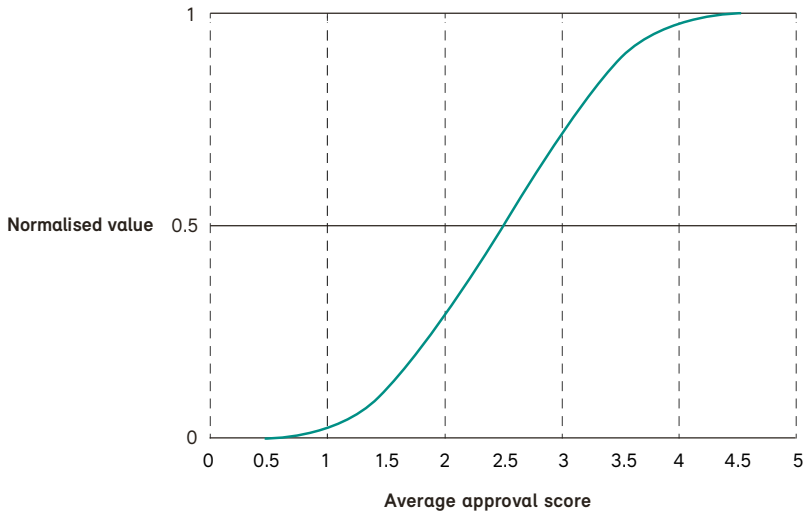
The evaluation approaches given below are taken from the original indicator method sheets in the "Handbook for evaluating rehabilitation projects in rivers and streams" (Woolsey et al. 2005). They serve as a guide and will be revised in the coming years on the basis of the experience accumulated in the STANDARD and EXTENDED outcome evaluations.

Indicator	Description
10.1 Acceptance	Ultimately, all the scores are combined; specifically, the average is determined, first, for each interest group and, subsequently, across all interest groups. Using Table 10.1, this average score can be assigned to an acceptance category. For normalisation, the average score from Table 10.1 is transformed into a value between 0 and 1 using a value function (Fig. 10.1), with the 1 guide value corresponding to very high and the 0 guide value very low acceptance on average. Medium acceptance represents a critical threshold since, if approval falls below this level, future restoration projects are very likely to be rejected in a vote by the communal assembly. A comparison with the level of acceptance determined prior to implementation of restoration can reveal whether a significant improvement has occurred after completion of the project. Previous studies have shown that acceptance after project completion is significantly greater than before the start of restoration work (Bratrich 2004).

Table 10.1: Categories of project acceptance.

Average score = 0–1	Average score = 1–2	Average score = 2–3	Average score = 3–4	Average score = 4–5
***very low* acceptance**	***low* acceptance**	***medium* acceptance**	***high* acceptance**	***very high* acceptance**
Respondents show on average *very low or a complete lack of* approval of the project.	Respondents show on average *low* approval of the project.	Respondents show on average *medium* approval of the project.	Respondents show on average *high* approval of the project.	Respondents show on average *very high* approval of the project.

Figure 10.1: Normalisation of the results.



Time required

Table 10.2: Estimated time required in person-hours for the determination and evaluation of Indicator Set 10. General items (e.g. travel time for survey) are not taken into account. A rough cost estimate can be found in Table 2.1 of Factsheet 2.

Step	**Specialists**		**Assistants**	
	Persons	Time per person (h)	Persons	Time per person (h)
Preparation (stakeholder analysis, arranging appointments)	1	3–4		
Conduct of interviews	1	6–8		
Digitalisation of responses and evaluation	1	2		
Total person-hours	11–14			
Notes: The time required per interest group is approx. 1h. No minimum or maximum is specified.				

Further information

Data arising	• Data entry form Indicator Set 10: KT_ProCode_ERHEBUNG_Set10_V#.xls Elements of the file naming scheme (see Factsheet 5): • KT = two-capital-letter cantonal abbreviation (e.g. BE) • ProCode = project code • ERHEBUNG = survey time point, i.e. VORHER (= before), NACHHER1 (= after 1), NACHHER2 (= after 2), or VERTIEFT (= EXTENDED) • V# = Version number of the data entry form
Attachments	The field protocol, data entry form and other useful documents are available at: https://www.bafu.admin.ch/wirkungskontrolle-revit

Glossary for the practice documentation
"Evaluating the outcome of restoration projects – collaborative learning for the future"

This glossary explains a selection of key terms from the factsheets and technical sheets.

Term (source)	Definition
Combined project	Flood protection project with additional financing under the WPA (increased space provided for waters, extended length).
Evaluation (BAFU 2012)	An evaluation comprises two elements – the *implementation evaluation* and the *outcome evaluation*.
EXTENDED outcome evaluation	Nationally standardised outcome evaluation of selected restoration projects, designed to answer specific practice-related questions, with the aim of supplementing and deepening the knowledge obtained from the *STANDARD outcome evaluation*.
Implementation evaluation (BAFU 2012)	An implementation evaluation is used to review whether the projects defined in the planned measures have been initiated; it also provides information on the measures implemented. The implementation evaluation, together with the *outcome evaluation*, forms part of the *evaluation*.
Indicator (Lorenz et al. 1997; Woolsey et al. 2005)	Indicators are measurable quantities which provide valuable information on the condition of an ecosystem and its relevant processes. Indicators yield both a measurement and a rating, i.e. a classification of closeness to a natural state or goal attainment. The step from measurement to rating is taken, for example, with the aid of a *value function*.
Indicator set	Synergies exist between numerous *indicators*, i.e. the relevant data collection procedures are similar, are conducted at the same site, or can be readily combined. *Indicators* which can be determined synergistically are combined into indicator sets. For the *STANDARD outcome evaluation*, 10 indicator sets are available.
Individual project (BAFU 2018)	Complex measures with spatial planning implications which need to reconcile various interests and to be coordinated at all levels (federal, cantonal, communal) are generally treated as individual projects. These are not included in a programme agreement, but are decided on individually at the federal level.
Objectives hierarchy (Reichert et al. 2011)	The breaking-down of a higher-level objective into a hierarchy of more concrete sub-objectives. The sub-objectives should each cover a relevant aspect of the corresponding higher-level objective and should as far as possible be complementary.
Outcome evaluation (BAFU 2012)	An outcome evaluation is used to investigate whether a restoration project which has been implemented shows the desired effects, i.e. whether the defined objectives have been met and the resources have been effectively deployed. The outcome evaluation, together with the *implementation evaluation*, forms part of the *evaluation*.
Project size	Based on construction costs, four different project sizes are distinguished in the *STANDARD outcome evaluation*: • Small projects: < CHF 250,000 • Medium-sized projects: > CHF 250,000 – CHF 1 m • Large projects: > CHF 1 m – CHF 5 m • *Individual projects*: > CHF 5 m The project size influences the scope of the *STANDARD outcome evaluation* (which indicators, how many at most).
Restoration (WPA Art. 4 let. m)	Re-establishment by means of civil engineering of the natural functions of channelled, straightened, covered or culverted surface waters.

Term (source)	Definition
STANDARD outcome evaluation	Nationally standardised outcome evaluation to assess *typical goals of restoration projects* on the basis of a large number of projects receiving funding from a federal restoration credit.
Typical goals of restoration projects	Nine goals which can be assessed as part of the *STANDARD outcome evaluation*. The nine goals were identified in a multistep process on the basis of four documents: the Waters Protection Act, Waters Protection Ordinance, Explanatory Report on the Amendment of the Waters Protection Ordinance (BAFU 2011) and Handbook on Programme Agreements (BAFU 2015). The decisive factors were the frequency with which goals were mentioned, amenability to influence by restoration projects, and the availability of *indicators*.
Value function (Eisenführ & Weber 2003; Schlosser et al. 2013)	A value function can be used to determine, for an indicator, the degree of goal attainment or closeness to a natural state. In this process, a rating – i.e. a dimensionless value between 0 (non-natural) and 1 (near-natural) – is assigned to a measured value (e.g. depth variability at bankfull discharge). The value function can reflect different associations (e.g. linear).

Bibliography

This bibliography lists all sources cited in the fact sheets, technical sheets or in the glossary.

Arscott, D.B., Tockner K., Ward, J.V., 2001. Thermal heterogeneity along a braided floodplain river (Tagliamento River, northeastern Italy). Canadian Journal of Fisheries and Aquatic Sciences 58 (12): 2359-2373.

BAFU/ Bundesamt für Umwelt, 2011. Erläuternder Bericht zur Änderung der Gewässerschutzverordnung. BAFU, Bern.

BAFU/ Bundesamt für Umwelt (Hrsg.), 2012: Einzugsgebietsmanagement. Anleitung für die Praxis zur integralen Bewirtschaftung des Wassers in der Schweiz. BAFU, Bern. Umwelt-Wissen Nr. 1204.

BAFU/ Bundesamt für Umwelt (Hrsg.), 2015: Handbuch Programmvereinbarungen im Umweltbereich 2016 – 2019. Mitteilung des BAFU als Vollzugsbehörde an Gesuchsteller. BAFU, Bern. Umwelt-Vollzug Nr. 1501.

BAFU/ Bundesamt für Umwelt (Hrsg.), 2018: Handbuch Programmvereinbarungen im Umweltbereich 2020 – 2024. Mitteilung des BAFU als Vollzugsbehörde an Gesuchsteller. BAFU, Bern. Umwelt-Vollzug Nr. 1817.

BAFU/ Bundesamt für Umwelt (Hrsg.), 2019: Methoden zur Untersuchung und Beurteilung von Fliessgewässern (IBCH_2019). Makrozoobenthos – Stufe F. 1. aktualisierte Ausgabe, November 2019; Erstausgabe 2010. BAFU, Bern. Umwelt-Vollzug Nr. 1026.

BAFU/ Bundesamt für Umwelt (Hrsg.), 2019: Handbuch für die Partizipation bei Wasserbauprojekten. Betroffene zu Beteiligten machen. BAFU, Bern. Umwelt-Wissen Nr. 1915.

BAFU/ Bundesamt für Umwelt (Hrsg.), 2022: Die biogeografischen Regionen der Schweiz. 1. aktualisierte Auflage 2022. Erstausgabe 2001. Bundesamt für Umwelt, Bern. Umwelt-Wissen Nr. 2214: 28 S.

Bergamini, A., Ginzler, C., Schmidt, B.R., Bedolla, A., Boch, S., Ecker, K., Graf, U., Küchler, H., Küchler, M., Dosch, O., Holderegger, R., 2019. Zustand und Entwicklung der Biotope von nationaler Bedeutung: Resultate 2011–2017 der Wirkungskontrolle Biotopschutz Schweiz. WSL Berichte 85. 104 S.

BDM Coordination Office 2014: Swiss Biodiversity Monitoring BDM. Description of Methods and Indicators. Federal Office for the Environment, Bern. Environmental studies no. 1410. 103 pp.

Bonnard, L., Roulier C., Thielen, R., Gsteiger, P., Cosandey, A.-C., Hausammann, A., Rast, S., 2008. Handbuch Erfolgskontrolle Auen. Biotopinventar BAFU, Auen. Service conseil Zones alluviales/Auenberatungsstelle. Yverdon-les-Bains et Berne. CD. Fiches: M-1-TGA GIS-gestützte Orthofotointerpretation. M-7-TGA GIS-gestützte FIR 3D Luftbild-Interpretation.

Chapman, M.G., 1999. Improving sampling designs for measuring restoration in aquatic habitats. Journal of aquatic ecosystem stress and recovery 6: 235-251.

Cole, C.A., 2002. The assessment of herbaceous plant cover in wetlands as an indicator of function. Ecological indicators 2: 287-293.

Delarze, R., Gonseth, Y., Eggenberger, S., Vust, M., 2015. Lebensräume der Schweiz: Ökologie, Gefährdung, Kennarten. Ott Verlag, Thun.

Eisenführ, F., Weber, M., 2003. Rationales Entscheiden. Springer-Verlag.

Gallandat, J.-D., Gobat, J.-M., Roulier, C., 1993. Kartierung der Auengebiete von nationaler Bedeutung. Schriftenreihe Umwelt. BUWAL, Bern.

Gillet, F., De Foucault, B., Julve, P., 1991. La phytosociologie synusiale intégrée: objets et concepts. Candollea 46: 315-340.

Gillet, F., 2004. Guide d'utilisation de Phytobase 7, base de données phytosociologiques. Documents du Laboratoire d'Ecologie végétale, Institut de Botanique, Université de Neuchâtel. 39 pp.

Glutz von Blotzheim, U., 1962. Die Brutvögel der Schweiz. Verlag Aarauer Tagblatt, Aarau.

Gostner, W., Schleiss, A., 2012. Index für hydro-morphologische Diversität. In: Merkblatt-Sammlung Wasserbau und Ökologie. BAFU, Bern. Merkblatt 3.

Höckendorff, S., Tonkin, J.D., Haase, P., Bunzel-Drüke, M., Zimball, O., Scharf, M., Stoll, S., 2017. Characterizing fish responses to a river restoration over 21 years based on species traits. Conservation biology 31: 1098-1108.

Hunzinger, L., Schälchli, U., Nitsche, M., Kirchhofer, A., Pfaundler, M., Roulier, C., Rüesch, T., 2018. Sanierung Geschiebehaushalt – Massnahmenplanung. Ein Modul der Vollzugshilfe Renaturierung der Gewässer. BAFU, Bern. Umwelt-Vollzug. Entwurf zur Anhörung. 08.11.18.

Kail, J., Brabec, K., Poppe, M., Januschke, K., 2015. The effect of river restoration on fish, macroinvertebrates and aquatic macrophytes: a meta-analysis. Ecological indicators 58: 311-321.

Känel, B., Michel, C., Reichert, P., 2017. Methoden zur Untersuchung und Beurteilung der Fliessgewässer. Makrophyten -Stufe F (flächendeckend) und Stufe S (systembezogen). BAFU, Bern. Entwurf.

Knaus, P., Schmid, H., 2014a. Die vereinfachte Revierkartierung – eine rationelle Methode für Brutvogel-Bestandesaufnahmen. Schweizerische Vogelwarte, Sempach.

Knaus, P., Schmid, H., 2014b. Beispiele von Reviergrössen bei vereinfachten Revierkartierungen. Schweizerische Vogelwarte, Sempach.

Knispel, S. 2020. Rapport final - Projet « Plécoptères (EPT) adultes en complément de NAWA_SPEZ 2018 ». Akuatik, Yverdon.

Kondolf, G. M., 1995. Five elements for effective evaluation of stream restoration. Restoration Ecology 3: 133-136.

Legendre, L., Legendre, P., 1984. Ecologie numérique. Vol. 1 et 2. Masson, Paris. 595 pp.

Lorenz, C.M., Dijk, G., Hattum, A., Cofino, W.P., 1997. Concepts in river ecology: Implications for indicator development. Regulated Rivers: Research & Management 13: 501-516.

Pfaundler, M., 2005. Ordnung im Schweizer Gewässernetz?! Flussordnungszahlen nach Strahler für das digitale Gewässernetz 1:25'000 der Schweiz. BAFU, Bern.

Pfaundler, M., Duebendorfer, C., Zysset, A. 2011. Methoden zur Untersuchung und Beurteilung der Fliessgewässer. Hydrologie – Abflussregime Stufe F (flächendeckend). BAFU, Bern. Umwelt-Vollzug Nr. 1107.

Reichert, P., Borsuk, M.E., Hostmann, M., Schweizer, S., Spörri, C., Tockner, K., Truffer, B., 2007. Concepts of decision support for river rehabilitation. Environmental Modelling and Software 22(2), 188-201.

Reichert, P., Schuwirth, N., Langhans, S.D., 2011. MCWM – Ein Konzept für multikriterielle Entscheidungsunterstützung im Wassermanagement. Wasser Energie Luft 103: 139-148.

Robbins, C.S., Dawson, D.K., Dowell, B.A., 1989. Habitat area requirements of breeding forest birds of the Middle Atlantic states. Wildlife Monographs 103: 3-34.

Roni, P., Liermann, M.C., Steel, E.A., 2005. Steps for designing a monitoring and evaluation program for aquatic restoration. In: Monitoring Stream and Watershed Restoration. American Fisheries Society Bethesda, Maryland.

Roni, P., Beechie, T., 2013. Stream and watershed restoration: a guide to restoring riverine processes and habitats. John Wiley & Sons, Ltd.

Roni, P., Åberg, U., Weber, C., 2018. A review of approaches for monitoring the effectiveness of regional river habitat restoration programs. North American Journal of Fisheries Management 38: 1170-1186.

Schaffner, M., Pfaundler, M., Göggel, W., 2013. Fliessgewässertypisierung der Schweiz. Eine Grundlage für Gewässerbeurteilung und -entwicklung. BAFU, Bern. Umwelt-Wissen Nr. 1329.

Schager E., Peter A., 2004. Testgebiete – Fischbestand und Lebensraum. Fischnetz Publikation. Eawag, Kastanienbaum.

Schager, E., Peter, A., 2001. Bachforellensömmerlinge Phase I. Teilprojekt-Nr. 00/12. Fischnetz-Publikation. Eawag Dübendorf.

Schälchli, U., 2002. Kolmation - Methoden zur Erkennung und Bewertung. Fischnetz-Publikation. Eawag Dübendorf.

Schlosser, J.A., Haertel-Borer, S., Liechti, P., Reichert, P., 2013. Konzept für die Untersuchung und Beurteilung der Seen in der Schweiz. Anleitung zur Entwicklung und Anwendung von Beurteilungsmethoden. Umwelt-Wissen Nr. 1326. BAFU, Bern.

Schmid, H., Bonnard, L., Hausammann, A., Sierro, A., 2010. Aktionsplan Flussuferläufer Schweiz. Artenförderung Vögel Schweiz. Hg. v. BAFU, Schweizerische Vogelwarte, Schweizer Vogelschutz SVS/BirdLife Schweiz. Bern, Sempach und Zürich. Umwelt-Vollzug Nr. 1028.

Schmid, H., Spiess, M., 2008. Brutvogelaufnahmen beim BDM-Z7 und MHB: Anleitung zur Entscheidfindung bei Grenzfällen und zur Revierausscheidung. Schweizerische Vogelwarte, Sempach.

Schmidt, B.R., Fivaz, F., 2013. Fliessgewässer-Abschnitte mit hoher Artenvielfalt oder national prioritären Arten - Grundlagendaten für die Planung von Revitalisierungen. CSCF Neuenburg.

Schmutz, S., Kaufmann, M., Vogel, B., Jungwirth, M., 2000. Grundlagen zur Bewertung der fischökologischen Funktionsfähigkeit von Fliessgewässern. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

Schweizerische Vogelwarte, 2006. Revierkartierung. Avifaunistik-Merkblatt. Sempach, 9 Seiten.

Vonlanthen, P., Périat, G., Kreienbühl, T., Schlunke, D., Morillas, N., Grandmottet, J.-P., Degiorgi, François, 2018. IAM - Eine Methode zur Bewertung der Habitatvielfalt und Attraktivität von Fliessgewässerabschnitten. Wasser Energie Luft 110: 201-207.

Weber, C., Åberg, U., Buijse, A.D., Hughes, F.M.R., McKie, B.G., Piégay, H., Roni, P., Vollenweider, S., Haertel-Borer, S., 2017. Goals and principles for programmatic river restoration monitoring and evaluation: Collaborative learning across multiple projects. Wiley Interdisciplinary Reviews: Water e1257.

Woolsey, S., C. Weber, T. Gonser, E. Hoehn, M. Hostmann, B. Junker, C. Roulier, S. Schweizer, S. Tiegs, K. Tockner & A. Peter. 2005. Handbook for evaluating rehabilitation projects in rivers and streams. Publication by the Rhone-Thur project. Eawag, WSL, LCH-EPFL, VAW-ETHZ. 108 pp.