Developing a Monitoring Framework for the Scottish Rivers Fund

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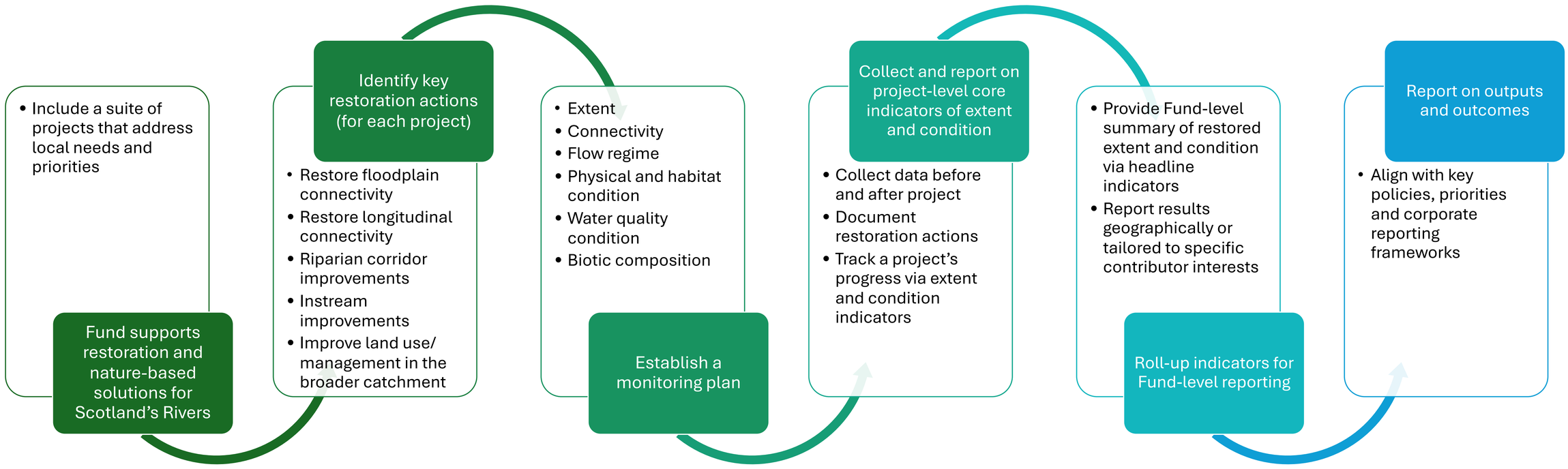
The **Scottish Rivers Fund** is a national collaborative effort led by Fisheries Management Scotland to facilitate the investment needed to restore healthy, resilient river catchments.

The **Monitoring Framework** provides:

- A clear and consistent monitoring approach to ensure projects are successful in delivering verified, long-lasting, and additional environmental outcomes consistent with Scotland's principles for high integrity investments.
- A flexible and adaptable approach to track outputs, outcomes and performance for individual projects and support reporting at the Fund level.

How monitoring informs Fund reporting:



Steps to develop an effective monitoring plan:

Step 1: Take a place-based approach to project planning

Evaluate existing information to understand the catchment and local context, including key pressures and impacts.

Consider what is achievable at the site, and ensure the proposed project is suitable, given both the environmental and social context.

Potential data sources to inform site context include:

- Catchment plans (e.g., Fisheries Management Plans other strategic plans)
- Scotland River Temperature Monitoring Network
- National Electrofishing Programme for Scotland
- Scotland's Environment Map
- Scotland's River Basin Management Plan and Water Classification Hub
- SEPA's River Recovery Potential
- Biodiversity datasets and citizen-science monitoring

Step 2: Set clear goals and objectives

Explain *why* the project is needed. Identify what Fund outcomes will be supported by the project.

Describe *how* a project will address impacts and improve functions, including the set of actions that will be implemented to meet the project objectives.

Well-crafted objectives are **SMART** and help to link project activities to specific outcomes.

Specific: what will be accomplished?
Measurable: how to measure change?
Achievable: what is the target condition?
Realistic: what is realistic, given the resources available?
Time-bound: when will objectives be met?

Step 3: Identify the indicators and methods to track changes over time

Select indicators relevant to the project goals and objectives and key ecosystem functions.

Select from established methods that are appropriate for the scale and complexity of the project.

Indicators are observable or measurable **attributes** that provide information on the structure, composition and/or function of ecosystems. They can be used to evaluate ecosystem extent and condition, and track progress towards achieving outcomes.

The Monitoring Framework includes a list of possible site-level indicators and established methods organized by attribute (i.e., hydrology, connectivity, physical habitat, biological composition, water quality).

Matrix for selecting indicators and methods for monitoring based upon the scale, risk and complexity of a project:

Innovative projects with risk of failure. Monitor using detailed hydromorphic studies (e.g., fluvial audit) and established ecological methods.		Complex and innovative projects. Consider engaging academic or research partners with experience conducting large-scale scientific studies.	High	Risk and complexity
Established techniques in new environments or relatively untested techniques. Combine simple methods with hydromorphic/habitat assessments or additional function-based indicators that inform specific project objectives. Use methods that can be applied at the reach or project scale.		Same as <- but consider monitoring methods that are applicable at larger scales. Consider linking into citizen-science or other established catchment-scale monitoring efforts.	Medium	
Established techniques over small scales, where objectives also relate to water quality or biological communities. Monitor using simple methods (below); add ecological indicators to inform water quality and/or biological objectives. Rely on established methods.		Established techniques over a large scale where objectives also relate to water quality or biological communities. Monitor using simple methods (as below); but also include ecological indicators and established methods to inform water quality and/or biological objectives. Consider linking into citizen-science or other established catchment-scale monitoring efforts.	Low	
Established techniques over a small scale where objectives focus on restoring the physical environment. Monitor using simple methods such as fixed-point photography and visual surveys.		Established techniques over a large scale where objectives focus on restoring the physical environment. Same as <- but also consider linking into citizen-science or other established catchment-scale monitoring efforts.		
Small	Medium	Large		
Scale .				

Adapted from the River Restoration Centre's Practical River Restoration Appraisal Guidelines for Monitoring Options (PRAGMO) See https://www.therrc.co.uk/monitoring-guidance

Key Environmental Outcomes:

Biodiversity and Ecosystems
Projects can improve the quality, extent and resiliency of instream, riparian, floodplain, and other non-floodplain habitats within the broader catchment. Higher quality habitats often means more resilient and diverse biological communities.

Climate adaptation and resilience
Projects that support improved habitats, water quality and water quantity outcomes create resilience to changes in temperatures, droughts and flooding, improving a river's absorbing capacity and the ability to be resilient and adaptable to a changing climate.

Water Quantity
Projects can support improved hydrological processes via improved water management actions and improved runoff and infiltration processes, restoring more natural flow regimes and availability within low flow periods.

Cold, Clean Water
Projects can improve the how water runs off the land, reducing nutrients and sediments reaching the river after it rains, and can improve regional ground water connections and increase vegetation and tree cover, which also affect instream temperatures, meaning colder waters for fish.

Monitoring Framework Example:

This section provides an example of three projects with different goals, objectives and indicators are 'rolled-up' and reported together within the Fund.

Project 1: A small gravel augmentation project, where substrate will be added to targeted riffle sections within a 100m reach.

Project:	Gravel Augmentation		
Committed restoration extent:	Area (hectares) Project length (km) Connected corridors (km)	0.6 0.1	
Outcome Themes:	☐ ☑ ☐ ☐	Cold, Clean Water Biodiversity and Ecosystems Water Quantity Climate Adaptation and Resilience	
Level of complexity:	Established techniques over small scales, where objectives also relate to water quality or biological communities.		
Describe the goal(s) of the project:	**For each goal, describe the objective(s) for the project:** *objectives should be specific, measurable, achievable, results-oriented and time-bound*	**List the specific indicator(s) to monitor:**	
To improve instream habitat for [fish species/life stage]	Increase the area of juvenile fish habitat within the project reach.	Area of aquatic ecosystems restoration	
	Improve hydromorphic complexity, flow diversity and bed material patterns by adding substrate in targeted sections of the project reach.	SFCC Walkover or MoRPH surveys and fixed-point photography to assess indicators for hydromorphic units, bed material/substrate and flow diversity	
To improve [fish species/age class] populations within the project reach	Increase spawining activity for [fish species] within [x] years of augmentation	Redd Surveys	
	Increase [fish species/age class] densities by/to [target condition] within [x] years of augmentation	Fish Density - electrofishing	

Project 2: A project to restore meanders and reconnect the river to the adjacent floodplain within a 600m project reach.

Project:	Remeandering and floodplain reconnection		
Committed restoration extent:	Area (hectares) Project length (km) Connected corridors (km)	6.3 0.6	
Outcome Themes:	☑ ☑ ☑ ☑	Cold, Clean Water Biodiversity and Ecosystems Water Quanity Climate Adaptation and Resilience	
Level of complexity:	Innovative projects with risk of failure.		
Describe the function-based goal(s) of the project:	**For each goal, describe the objective(s) for the project.** *objectives should be specific, measurable, achievable, results-oriented and time-bound*	**List the specific indicator(s) to monitor:**	
To restore a dynamic floodplain by reconnecting to the river, which will slow the flow, improve biodiversity and habitat diversity and increase resilience to flood and drought events.	Design new bed level to increase freqency of out-of-bank-flows and reconnect the river to existing and historic aquatic features within the floodplain at high flows.	Extent of restored areas; drone/LiDar imagery to map inundation area under different flow magnitudes; indicators of floodplain sediment deposition (e.g., depth, grain size, extent) and roughness (e.g., large wood, organic matter deposition and indicators of vegetation structure; depth to water table measures	
	To restore a meandering channel within the target reach by increasing channel length and restoring characteristic sinuosity for [x] river type.	Measurement of increased extent; key hydromorphic indicators (e.g., floodplain connectivity, lateral migration, hydromorphic features, flow types, large wood and other structures, organic matter retention) via fluvial audit or similar quantiatative method.	
	Improve riparian vegetation structure and complexity within [x] growing seasons by re-seeding and promoting establishment of native woody and non-woody vegetation on the edge, top of bank and within the floodplain of the re-meandered project reach.	Indicators of riparian and bank condition, including large wood, bank erosion, organic matter retention and other indicators within vegetation structure, e.g., as monitored via SFCC or Morph surveys;	
	increase invertebrate diversity by increasing channel and floodplain variability (e.g., instream habitats,	Species richness, or other relevant indices to document diversity	
	Increase numbers and species of over-wintering birds	Bird counts, species richness	

Project 3: Large scale riparian planting, with multiple, smaller project sites within a 9km stretch of the river.

Project:	Large scale riparian planting project (includes multiple project sites within the catchment)		
Committed restoration extent:	Area (hectares) Project length (km) Connected corridors (km)	5 2.5 9	
Outcome Themes:	☑ ☑ ☐ ☑	Cold, Clean Water Biodiversity and Ecosystems Water Quantity Climate Adaptation and Resilience	
Level of complexity:	Established techniques over a large scale where objectives also relate to water quality or biological communities.		
Describe the function-based goal(s) of the project:	**For each goal, describe the objective(s) for the project.** *objectives should be specific, measurable, achievable, results-oriented and time-bound*	**List the specific indicator(s) to monitor:**	
To restore a natural, functioning riparian corridor that improves water quality, expands wildlife habitat corridors, and improves climate adaptation and resilience within the catchment.	Reduce agricultural runoff from adjacent fields by establishing [x] meters of natural riparian vegetation on both sides of the channel in multiple reaches through fencing and land use changes.	Capture extent via restored area, km of restored riparian zone length and riparian zone width measurement. Monitor indicators for silt/fine sediment (Extended Riverfly) and runoff (land use change).	
	Improve riparian vegetation structure and complexity within [x] growing seasons by re-seeding and promoting establishment of native vegetation communities on the edge and top of bank at each project reach.	Indicators of riparian and bank condition, including large wood, bank erosion, and vegetation structure, as well as excessive siltation as monitored via SFCC or Morph surveys; monitor tree survival and natural sapling recruitment; aerial photography to capture changes in canopy cover.	
	Establish prevalent woody vegetation and canopy cover within [x] growing seasons by promoting natural recruitment and planting trees in strategic locations along each project length.		
	Reduce the extent of exessive bank erosion to less than [x]% of total bank length withn each project reach through targeted riparian planting in multiple reaches.		
	Increase length of connected riparian habitat corridors by strategic site selection within broader catchment.	Total length (km) of connected natural riparian corridor	

Summary of how these projects 'roll up' for Fund reporting:

Fund	11.9	hectares of restored area
Totals: 3 projects	3.2	kilometres of stream length restored
	9	kilometres of connected corridors

Totals per outcome:

Cold, Clean Water	Biodiversity and Ecosystems	Water Quantity	Climate Adaptation and Resilience
66% of projects are contributing to this outcome	100% of projects are contributing to this outcome	33% of projects are contributing to this outcome	66% of projects are contributing to this outcome
11.3 ha of restoration contributing to this outcome	11.9 ha of restored area contributing to to this outcome	6.3 ha of restoration contributing to to this outcome	11.3 ha of restoration contributing to to this outcome
3.1 km of restoration supporting cold, clean water	3.2 km of river and riparian habitats restored	3.2 km of river length with improved flows	3.1 km of river length supporting climate resilience
	9 km of connected corridors to improve biodiversity and ecosystems		

The *River Catchment Restoration Portfolio Project Monitoring Framework* was prepared in February 2025 by J. McCarthy (McCarthy Ecology) in collaboration with Fisheries Management Scotland and the Facility for Investment Ready Nature in Scotland (FIRNS) project Steering Group. The project was funded by FIRNS, which is delivered by NatureScot in collaboration with the Scottish Government and in partnership with the National Lottery Heritage Fund. J. McCarthy is currently funded under NERC's Integrating Nature Finance and Biodiversity Programme to promote good practice and synthesize knowledge for biodiversity markets and policy. A link to the monitoring framework is available at: https://fms.scot/nature-finance/