Step	Stage of protocol	Possible methodological approach	Potential selection population	Resulting selection population	Step product	Explanation	Example
Project Identification							
1	Review current status of water body and/or other aquatic resources	DPSIR (*current state*)	All water bodies	All water bodies w/ HYMO issues and status < good	List of all water bodies w/ HYMO issues and status < good	The WFD and other European directives stipulate that all rivers be assessed. The list of those that do not meet the minimum status requirement of "good" will be reviewed for potential HYMO rehabilitation project sites	Ex. A water body may have a lower than "good" status because of poor water quality due to high nutrient loads (QE). If the source of nutrients is erosion of legacy bank sediments in incised channels, there may exist HYMO rehabilitation potential. If the cause is over-application of fertilizers or failing wastewater treatment, then there is no HYMO rehabilitation potential and the water body can be dropped from the potential site list
2 (3)	Identify regional policy objectives	DPSIR (*drivers*)	Water bodies with RBMP or other plans	All Step 1 water bodies with HYMO issues and status < good, preferably with relevant RBMP	List of all water bodies w/ HYMO issues and status < good, including those with a RBMP or other plan.	RBMPs are required for all river basins. The list created in Step 1 should be reviewed against the RBMP to see how rehabilitation might be connected to other projects and future planning. The RBMP may have already identified certain rivers, river reaches or river types as priorities for rehabilitation. Issues of ownership, politics, finances, cultural resources, etc. may eliminate some sites from the potential projects list	Ex. Rehabilitation potential is also dependent on river basin management. Erosion of legacy bank sediments in a reach may be controlled by reducing storm water runoff and rehabilitating the reach channel and floodplain. However, if long-term basin planning includes removing an upstream dam in the future, it may be wise to start with the upstream dam removal and consider the channel rehabilitation later, as a subsequent dam removal may make a prior reach rehabilitation unnecessary or cause a future failure

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3 (2)	Identify water body goals and specific objectives	DPSIR (reference *state*)	Reference conditions benchmarks (BM) water bodies	Reference conditions BM water bodies for comparison to water bodies selected in Step 2	List of water bodies and their characteristics that can provide reference conditions BMs	Identify one or more reference rivers/reaches and the key quality elements (QE) and HYMO processes that will serve as reference condition benchmarks. These rivers/reaches will be used in Step 4 to assess potential rehabilitation sites, to identify causative issues affecting the impaired water body and the effective actions to rehabilitate in Steps 5a, 5b, to provide the monitoring framework and/or serve as a monitoring control in Step 8	Ex. The "high" status water quality BM reference condition for the nutrient QE is a lower nutrient concentration than the existing condition. The HYMO BM is minimal bank erosion and a channel with a floodplain that is active on average 3 times a year
Project formulation							
4	Compare water body status with objectives	DPSIR (*impacts*)	Step 2 potential water body sites	Water bodies with QE deficits determined by comparing Step 3 reference sites with Step 2 potential rehabilitation sites	Analysis QE deficits for Step 2 water bodies	Analyse the QE deficits resulting in the status < good. A HYMO processes deficit analysis should be completed using the BM reference conditions for the relevant QEs	Ex. QE deficit: The nutrient concentration is too high for "good" status. HYMO process deficits: The existing incised channel overflows only in the 25+ year recurrence event and bank erosion is significant, w/d ratio too low
5a (5)	Identify issues affecting the water body both directly and indirectly	DPSIR (*pressures*)	Cause and effect issues of HYMO degradation resulting in QE deficits	HYMO degradation cause and effect issues for QE deficits identified in Step 4	List of causes and effects for the QE deficits for the Step 2 water bodies	Examine both basin hydrology and in-stream hydraulics for causes and effects of HYMO process degradation and identify which causes must be addressed to achieve "good" status. Be sure to include potential human activity changes (land uses), without which a rehabilitation project will fail or with which will not be	Ex. Hydrology: Percent basin impervious surface area is high leading to large flow and minimal sediment delivery regimes with high erosion potential. Hydraulics: Streambed incised to bedrock causing bank erosion and failure. Water quality: Stored nutrients released from eroding bank sediments.

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						needed. Issues of time and spatial scales must be addressed at this point.	
5b (5)	Identify appropriate HYMO process rehabilitation actions	DPSIR (*responses*)	HYMO process rehabilitation actions	Appropriate HYMO process rehabilitation actions to address Step 5a HYMO QE causes relevant to the achievable EPs for Step 4 sites	List of types of HYMO rehabilitation actions to achieve each acceptable EP	Achieving the reference BM conditions may be possible, but probably is not. After determining causes and effects (Step 4), identify what processes must be addressed and what endpoints (EP) are acceptable for achieving "good" status. Select the set of hydrologic and hydraulic processes to be considered for rehabilitation actions to achieve these EPs. Spatial scale issues should be addressed	Ex. Increase basin infiltration capacity to reduce storm runoff flow, reconfigure channel geometry erosion and deposition competence to dynamic equilibrium and the floodplain to flood on average 3 times per year. The watershed is partially built-out so infiltration zone sites are somewhat limited. There is room to reconstruct a floodplain
6	Review and select appropriate HYMO rehabilitation techniques	SMART (*specific)*	HYMO rehabilitation techniques to meet EP	Appropriate HYMO rehabilitation techniques relevant to Step 5b HYMO process actions	Report on specific implementable techniques	For each HYMO action there is a plurality of implementation techniques, each with a specific design and engineering effort, cost, operation and maintenance requirements, spatial and temporal requirements, and efficiency	Ex. Disconnect impervious surfaces with infiltration zones using a combination of hard and soft techniques. Reconfigure channel and FP geometry and resistance for the equilibrium flow and sediment transport regimes. Watershed open space limitations may require some retrofitting of built areas
7	Prioritisation of rehabilitation projects and justification	SMART (*attainable*)	Recent rehabilitation project costs for the relevant techniques	Cost effective technique(s) for each project site	Analysis of cost effective technique(s) and costs for each project site	Cost benefit analysis – including integration of multiple objective scenarios. Highly engineered techniques tend to be very costly and may require costly operation and maintenance efforts. Success monitoring may require high tech installations and expertise. The costs	Ex. Soils are appropriate for infiltration zones and existing, upland open space should be used. If there is insufficient open space, creation of wetlands in a constructed floodplain might be considered, which may address 2 or more of the deficits. Open space preservation and

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						(damage, legal, replacement, etc.) of failure may also be high (flooding, etc.).	reforestation schemes should be preferred and engineered infiltration systems should be avoided where possible.
8	Design monitoring programme (BACI/BA/CI) and key indicators	SMART (*measurable*)	Existing and new monitoring protocols for the key indicators	Key indicators to be monitored and monitoring protocol	Programme of key indicators and monitoring protocol for each rehabilitation site	The monitoring program must be designed prior to implementation of the rehabilitation project. Data from controls or reference sites may be needed for engineering design and "before" monitoring must begin at least 1 year before changes are made. Depending on the type of changes proposed, a considerably longer "before" monitoring program may be required. Time and spatial scales of monitoring should be carefully considered. Any change in the watershed or channel is a disturbance and the response time and space will vary	Ex. A "before" monitoring programme should include piezometric and percolation studies of potential infiltration sites. In addition, a complete geomorphologic study is needed of the stream and riparian areas. If sediment transport and stream flow data are needed, the studies should start several years before implementation. If a reference reach is being used for channel design purposes, the geomorphologic study of the reference channel must be done in advance of any engineering design, cost determination, or permitting. Reduction in nutrient concentrations may be quick and monitored only for several years at the immediate site. Stability of the reconfigured channel may need to be monitored over several decades depending on flood recurrence. Results of channel monitoring may result in renewed nutrient concentration monitoring

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Project implementation							
9	Implementation		Selected rehabilitation sites and watersheds	Rehabilitated sites and watersheds	Completed rehabilitation project	Most rehabilitation projects have several parts, some of which should be implemented consecutively and some simultaneously. The temporal scales of disturbance and recovery must be considered	Ex. Infiltration zones should be implemented first as they may have an effect on stream flow, sediment supply, flood periodicity, and erosion rates. Reduction in bank erosion may sufficiently reduce nutrient load (EP) so that channel geometry reconfiguration is not needed to address the nutrient concentration QE deficit, though it may be desirable for other reasons
Post-project actions							
10	Monitoring	SMART (*relevant, time-bound*) WISE approach or participation ladder	Rehabilitated site(s) and appropriate parts of the watershed	Monitoring results	Periodic monitoring results reports	Key indicators are all monitored at appropriate temporal and spatial scales	Ex. The "after" monitoring programme included real-time water quality (nutrient, turbidity, etc.) and flow monitoring, monthly bank erosion rate monitoring, and an annual channel geometry survey. Nutrient concentration was reduced, but the acceptable EP was not reached. The expected flow reduction did not occur
11	Evaluation	SMARTER (*evaluate*)	Monitoring results	Successes and failures of rehabilitation project	Report and proposed corrections	Most projects experience a mix of success and failure. Sometimes corrections are easily identified. Monitoring and subsequent evaluation should be conducted	Ex. The infiltration zones were studied to determine if they were functioning as designed. Some plantings had failed and some zones were undersized. Corrections were proposed

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12	Update goals and restoration management actions	SMARTER (*re-evaluate*)	Evaluation results	Immediate corrections and future monitoring, evaluation, and rehabilitation	Revised rehabilitation goals and management actions	Updating goals and revising management actions are iterative processes and periodicity will depend on HYMO processes, monitoring results, changing patterns of human activity, etc	Ex. Repair and expansion of the infiltration zones will be completed immediately. Monitoring will continue for another 2 years. If the EP is not reached, reconfiguration of channel geometry and floodplain will be considered