TERMS OF REFERENCE

Technical Design and Author's Supervision for a Small-Scale Pilot Riverbank Reinforcement and Public River Access at Tashir River Using Nature-Based Solutions

Location: Tashir community, Lori Province, Republic of Armenia

Program name: "Promoting Green Deal Readiness in the Eastern Partnership Countries (ProGRess)"; "Tashir – Climate Bridge"

GIZ grant no. 81320025

Package number: GIZ/ESF/CS/CQS - 2026/006

1. The Energy Saving Foundation has received a grant from the German Agency for International Cooperation (GIZ) under the program "Promoting Green Deal Readiness in the Eastern Partnership Countries (ProGRess)", co-financed by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of Germany and the European Commission, to cover the expenses of the "Tashir – Climate Bridge" project, and a portion of these funds is intended to be allocated for the procurement of the consulting services for "Study and Assessment of the Site of an Urban Bridge Crossing over the Tashir River in the City of Tashir", Preparation of Technical Design and Cost Estimate Documentation Package, and Provision of Author's Supervision, No. GIZ/ESF/CS/CQS - 2026/006.
2. The Energy Saving Foundation is now inviting eligible Consultants to submit EOIs for the assignment "Study and Assessment of the Site of an Urban Bridge Crossing over the Tashir River in the City of Tashir", Preparation of Technical Design and Cost Estimate Documentation Package, and Provision of Author's Supervision.
3. Interested eligible Consultants may obtain additional information at the following address: Energy Saving Foundation, RA, Yerevan, 26/1 Vazgen Sargsyan Ave., Erebuni Business Center, 4th floor, room 414, Artur Grigoryan, e-mail: Email: artgrigoryan@yahoo.com. Questions on tender documents can be clarified at the above-mentioned address, during working hours from 09.00 to 18.00.
4. Qualification criteria are:
    - General work experience of the Consultant (years) in in riverbank, waterfront, public-space, landscape, hydraulic, or civil infrastructure design– 10 points;
    - General work experience of the Consultant (number of implemented contracts) in the field of riverbank stabilization, erosion control, flood resilience, nature-based/hybrid solutions, riparian restoration, or riverfront public access over the last 5 years – 30 points;
    - Implementation of similar contracts over the last 5 years, within which the organization has carried out design works for at least 3 riparian landscapes (riverbank fortification, overpasses, viaducts) – 60 points.
5. The procurement will be carried out in accordance with the procurement procedure of the World Bank, using the "Company's Qualification-based selection" (CQS) method.
6. Consulting companies can cooperate with each other, in order to improve their qualifications. In this case, it is necessary to clearly indicate the form of cooperation: Joint Venture (JV) and/or consortium with a prime and sub-consultant. During the entire implementation of the contract, all members of the JV have joint responsibility, in case of being selected. In the case of a JV, consortium, or sub-consultancy arrangement, the proposal shall clearly indicate which legal entity and which certified/licensed personnel will be responsible for each part of the assignment and for signing/sealing the relevant sections of the design documentation.

Hereby, the Energy Saving Foundation ("Client") invites eligible consulting organizations ("Consultants") to submit requests of interest regarding the provision of below services. Interested Consultants must submit information on the required qualifications and relevant experience (information on the organization, experience/description of providing

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similar services, license to carry out landscape architectural design and development of urban development, as well as construction quality and site supervision , state registration certificate, contact information of the organization, etc.), in order to provide the specified services.

Background

This assignment aims to develop and pilot a small-scale intervention along the Tashir River to strengthen riverbank protection, reduce exposure to flood and mudflow risks, and improve safe community access to the river for recreational purposes. The site is prone to regular flooding, fluctuating water levels and soil erosion, hence, there is a need for a resilient and durable riverbank reinforcement. At the same time, the area presents an opportunity to create a small public recreational space, including stepped seating or an amphitheater-type riverfront setting, subject to confirmation of hydraulic safety, bank stability, public health conditions, wastewater/outfall constraints, and available space. This project is intended to pilot a solution that can be further replicated at scale in the future.

The intended intervention should combine technical riverbank reinforcement with nature-based climate resilience measures while creating a functional and attractive public waterfront edge that is safe, durable, maintainable, and environmentally responsive. To this end, thee Consultant shall confirm the exact intervention boundary, approximate riverbank length, affected public/municipal land, access points, and interface with the bridge and adjacent infrastructure during the inception stage.

The target riverbank area is additionally affected by existing sewage/wastewater pipelines and/or outfalls discharging into the river. These conditions shall be taken into account in the assessment and design of the pilot intervention, as they may affect water quality, environmental conditions, public health, user safety, visual quality, and the feasibility of creating recreational access to the river. The assignment shall therefore consider not only shoreline/riverbank stabilization, but also the interface between the proposed public riverfront improvements and the existing sewage/drainage infrastructure in the project area.

2. Objective of the Assignment

The objective of this assignment is to engage a qualified multidisciplinary consulting firm/team with demonstrated experience in riverbank stabilization, flood-resilient public spaces, nature-based or hybrid infrastructure, and landscape/public realm design., to prepare the feasibility study, comparative options analysis, concept design, and detailed technical design documentation for a small-scale pilot project for riverbank fortification at Tashir River, integrating nature-based solutions, flood resilience, and recreational public access.

The assignment shall result in a technically sound, buildable, climate-resilient, and cost-effective design package for piloting a reinforced riverbank edge that combines natural and structural defenses and supports public use.

In addition to preparing the technical design documentation, the Consultant shall develop the proposed intervention in a modular and prioritized implementation format, allowing the Client to procure and implement discrete sections or components of the riverbank fortification works in accordance with available budget. The modular structure shall enable phased procurement without undermining the technical integrity, safety, hydraulic performance, or resilience objectives of the overall design. The design package shall be suitable for procurement, permitting/approval procedures, and implementation in accordance with applicable Armenian legislation, construction norms, environmental requirements, and municipal/utility coordination procedures.

The Consultant shall assess and address the presence of existing sewage/wastewater pipelines and discharge points within the target area and integrate technically appropriate solutions or recommendations into the design, so that the proposed riverbank fortification and public-access intervention is compatible with environmental, hydraulic, public health, and operational requirements.

3. Specific Objectives

- Assess the site conditions, hydrological constraints, erosion/flood/mudflow exposure, sewage/wastewater infrastructure constraints, and public-space opportunities. [Note: bridge technical assessment and hydrological assessment of riverside will be provided, however, the Consultant shall review the hydrological/flood assessment provided by the Client, confirm whether it is sufficient for the proposed design, identify any gaps, and establish design assumptions for the intervention. Where the available data are insufficient, the Consultant shall clearly state additional data requirements or justified assumptions.]
- Develop and compare feasible riverbank reinforcement options, including nature-based, hybrid, and structural retrofit measures.
- Propose a preferred solution that improves resilience to floods and mudflows while protecting nearby community assets and users.
- Integrate recreational access to the river through a safe and attractive public realm concept, potentially including stepped seating/amphitheater features, viewing terraces, and controlled water access.
- Prepare complete and examined technical design documents suitable for procurement and pilot implementation.
- Develop a modular, phased, and procurement-ready costing structure that allows the Client to implement priority areas based on available financing (on a cost-optimal basis).
- Assess sewage/wastewater pipelines and outfalls/outlets entering the river in the target area and integrate design responses, phasing implications, and coordination recommendations.

4. Scope of Services

Task 1. Inception and Site Review

The Consultant shall review all existing background information, maps, available surveys, previous studies, utility information, planning constraints, and relevant legislation/standards. The Consultant shall conduct a site visit and document the site's physical, environmental, hydraulic, landscape, public-use, and utility conditions.

- Review of cadastral/land ownership constraints, existing utilities, underground and above-ground infrastructure, access restrictions, and any known easements or maintenance corridors.
- Review of topography, existing bank profile, soil/geotechnical conditions if available, drainage patterns, erosion trends and surfaces, vegetation, and access conditions.
- Review of river dynamics, including seasonal water level fluctuation, flood levels, velocity patterns if data are available, and implications for bank treatment and public access. [Note, hydrological and hydraulic data related to Tashir river shall be provided by the Client]
- Identification of site constraints and opportunities for a small public amphitheater or stepped riverfront edge.
- Stakeholder consultations with the Client, local authorities, utility/service providers, and community representatives as needed.

Task 2. Site Analysis and Design Criteria

The Consultant shall establish a clear design basis for the intervention, including design flood and water level assumptions, required level of bank protection and slope stability, safety requirements for public access in fluctuating water conditions, accessibility and inclusive design principles, material durability, maintenance requirements, and climate resilience considerations.

The design basis shall include consideration of the location and condition of sewage/wastewater pipelines and river outfalls within the site. The Consultant shall establish design criteria to ensure that the proposed intervention does not obstruct the functioning or maintenance access of existing essential infrastructure unless replacement or relocation is proposed; does not create unsafe public use areas adjacent to sewage discharge points or contaminated wet zones; takes into account water quality and sanitation-related risks when locating seating, steps, overlooks, or direct river access points; integrates technically appropriate screening, protection, rerouting interface details, or exclusion zones where needed; and reflects likely flood and backflow conditions affecting sewage/drainage outfalls during high-water

events. Considering that varying water level, the design should ensure edge protection, non-slip surfaces, railings/guarding where needed, safe gradients, warning signage, restricted access during high water, lighting if applicable, and universal accessibility, shdfd technically feasible. Furthermore, as a result of the design, the intervention must not increase flood, erosion, backwater, or sediment problems upstream or downstream.

Commented [AO2]: As a safeguard mechanism, for public access near a fluctuating river, the ToR could ask for edge protection, non-slip surfaces, railings/guarding where needed, safe gradients, warning signage, restricted access during high water, lighting if applicable, and universal accessibility to the extent technically feasible.

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Task 3. Feasibility Study and Comparative Analysis of Reinforcement Measures

The Consultant shall prepare a feasibility study assessing alternative reinforcement and public-space solutions for the site. At minimum, the alternatives shall include a predominantly structural/engineered solution, a predominantly nature-based solution, and a hybrid solution combining structural stabilization with ecological and landscape-based measures.

The comparative analysis shall assess each option against technical feasibility and constructability; flood and mudflow resilience; performance under fluctuating river levels; erosion control effectiveness; public safety; environmental and landscape benefits; maintenance needs and lifecycle implications; indicative capital cost and value for money; suitability for pilot implementation and replication elsewhere; and compatibility with existing sewage/wastewater pipelines, outfalls, and related utility infrastructure. The comparative assessment shall be presented in a clear matrix with qualitative and, where possible, quantitative scoring against agreed criteria.

For each option, the Consultant shall evaluate the effect on water quality and environmental performance, implications for safe recreational use and public perception of the site, additional capital and maintenance costs associated with addressing outfalls or pipeline conflicts, and whether implementation of the option is dependent on prior utility works.

Needless to emphasize that nature-based measures shall be prioritized where technically feasible, but the preferred option shall be justified based on site-specific hydraulic, geotechnical, safety, environmental, maintenance, and cost considerations.

Task 4. Assessment of Existing Sewage/Wastewater Pipelines and Outfalls

Tashir Community is currently developing a new water and wastewater masterplan. The Consultant shall identifying interfaces, risks, required coordination, and design measures necessary for the pilot intervention.

The Consultant is required to identify potentially overlapping such infrastructure, assess their impact on the proposed intervention, and provide technically grounded design responses and/or coordination recommendations sufficient for the Client to make informed implementation and procurement decisions, . THe parallel effort supported by UNDP is targeting restructuring of the wastewater management masterplan in Tashir Community. The Consultant will be expected to engage in coordination dialogue with engaged Consultants working on the masterplan to ensure that the water, drainage, and wastewater infrastructure is laid/renovated in harmony with the Consultant's vision of the amphitheater.

The Consultant shall clearly distinguish between measures that can be incorporated directly into the pilot design; measures that require separate works by the responsible utility or public authority; and constraints that limit the type or location of recreational access that can safely be provided.

Task 5. Concept Design

Based on the approved preferred option, the Consultant shall prepare a concept design for the pilot intervention. The concept design shall include, as relevant, riverbank fortification; nature-based stabilization measures; hybrid protective elements; public-access components such as stepped seating/amphitheater form, overlook platform, pedestrian paths, river-viewing areas, and controlled access to the water; drainage and surface runoff management; universal accessibility and public safety measures; emergency/flood restriction measures, and operational limitations during high-water events; preliminary planting strategy; lighting concept; and material palette.

The concept design shall show the location of existing sewage/wastewater pipelines and discharge points affecting the site and indicate how they are addressed in the proposed design. This shall include, as relevant, protection and detailing of outfall interfaces within the stabilized riverbank, screening or architectural/landscape treatment of visually

intrusive pipeline elements, reconfiguration of access routes or gathering areas to avoid unsafe or polluted interfaces, proposed ecological buffer or planted treatment areas where appropriate and technically justified, and any restricted-access zones required for health, safety, utility maintenance, or operational reasons.

Task 6. Detailed Technical Design Documentation

The Consultant shall develop the approved concept into a detailed technical design package sufficient for tendering and implementation of the pilot works.

- General arrangement plan.
- Setting-out plans.
- Grading and levels plans.
- Riverbank sections and profiles.
- Detailed construction drawings for stabilization, retaining, revetment, steps, pathways, seating, drainage, and related elements.
- Planting plans and plant schedules.
- Material specifications and workmanship requirements.
- Technical specifications.
- Bill of quantities.
- Designer's cost estimate.
- Implementation phasing, if required.
- Maintenance and operations recommendations.

The detailed technical design package shall also include drawings, details, specifications, and cost implications related to sewage/wastewater infrastructure interfaces within the project area, including utility coordination drawings; sections and details for outfall protection, integration, concealment, extension, or bank interface treatment; provisions for inspection and maintenance access to relevant pipelines and outfalls; notes identifying works that require utility-owner approval or separate execution; and bill of quantities items and cost estimates for all sewage/outfall-related works included within the pilot intervention.

All drawings shall be submitted in PDF and editable CAD format; bills of quantities (BOQs) and cost estimates shall be submitted in Excel; reports shall be submitted in Word and PDF.

In regard to environmental and social management topic, the construction-stage controls shall be embedded in the technical design documentation, such as: temporary works, construction sequencing, erosion and sediment control during construction, protection of the river from construction pollution, site reinstatement, quality control/testing requirements, and health and safety requirements.

Task 7. Modular Costing, Phasing, and Procurement Structure

The Consultant shall develop a modular costing and implementation structure for the proposed riverbank fortification and public access works. The purpose of this task is to enable the Client to procure and implement the intervention in separate packages, sections, or modules depending on funding availability, while ensuring that each module is technically coherent and contributes to the overall protection and resilience concept.

- Divide the proposed intervention into clearly defined modules, sections, or procurement lots, based on logical physical areas, functional components, or implementation phases.
- Ensure that each proposed module is, to the extent feasible, a standalone and buildable package, or clearly identify any dependencies between modules.
- Indicate which modules are priority/essential, which are recommended secondary modules, and which may be implemented as future expansion elements.
- Prepare a cost breakdown by module, including estimated quantities, unit costs, subtotals, and total cost per module.

- Identify any shared, enabling, or preliminary works that may need to be procured upfront to allow later modules to function properly.
- Provide phasing scenarios showing what can be implemented under different budget envelopes, including a minimum viable intervention, an intermediate option, and a full preferred option. The minimum viable intervention shall mean the lowest-cost package that still provides technically coherent bank stabilization, public safety, and no-regret enabling works.
- Explain the technical, safety, hydraulic, sewage/outfall, and operational implications of implementing only certain modules and deferring others.
- Ensure that modularization does not compromise overall flood resilience, erosion control, bank stability, public safety, water quality protection, or environmental performance.

Where sewage/wastewater pipeline or outfall works are required, the Consultant shall identify such works that are essential enabling measures for safe implementation of riverbank fortification or public-access components, such works that may be procured as separate modules or utility packages, dependencies between utility works and landscape/civil works, and risks associated with implementing public-access or amphitheater elements before sewage-related issues are addressed.

Task 8. Resilience, Environmental, and Safety Integration

The design shall explicitly demonstrate how it reduces erosion and improves resilience to flooding and mudflows; performs under changing water levels and wet-dry cycles; minimizes adverse environmental impacts; uses nature-based features where technically appropriate; protects users from slip, scour, inundation, and edge hazards; can be maintained by the responsible local entity with realistic resources; and takes into account the public health, sanitation, and environmental implications of sewage/wastewater discharges in the project area.

Task 9. Stakeholder Review and Design Finalization

The Consultant shall present the feasibility findings, concept design, modular costing structure, and detailed design documentation to the Client and key stakeholders; incorporate comments; and finalize the package for implementation.

5. Expected Deliverables

Deliverable 1. Inception Report Including methodology, workplan, data needs, team composition, and schedule.

Deliverable 2. Site Analysis Report Including site assessment, photographic documentation, constraints/opportunities analysis, preliminary design criteria, summary of hydrological/flood considerations, and a mapped inventory and preliminary assessment of all identified sewage/wastewater pipelines, outfalls, and related utility conflicts within the project area.

Deliverable 3. Feasibility Study and Comparative Options Analysis Including at least three options, comparative matrix, recommended option, and justification, as well as a comparative assessment of how each option addresses sewage/wastewater infrastructure constraints and river discharge points.

Deliverable 4. Concept Design Package Including plans, sections, visuals/3D views as needed, outline specifications, and indicative cost range.

Deliverable 5. Detailed Technical Design Package Including full drawings, technical specifications, bill of quantities, cost estimate, implementation-ready design documentation, and all relevant drawings, notes, specifications, and cost items related to sewage/wastewater infrastructure interfaces included within the design scope.

Deliverable 6. Modular Implementation and Costing Plan Including a breakdown of the proposed intervention into discrete modules or procurement packages; narrative justification for the modularization approach; cost estimate for each module and for the overall project; prioritization matrix distinguishing essential, recommended, and

optional/future modules; implementation scenarios corresponding to different indicative budget levels; and summary of technical dependencies, sequencing requirements, and risks associated with partial implementation.

Deliverable 7. Maintenance and Management Note Including maintenance requirements, inspection schedule, vegetation establishment needs, watering/replanting needs, invasive species control, inspection after major rainfall/high-flow events, outfall/interface maintenance considerations, indicative annual maintenance budget, and trigger points for remedial action, and recommendations for post-construction monitoring.

Deliverable 8. Final Assignment Report Including summary of design rationale, resilience features, identified sewage/wastewater issues affecting the site, proposed design responses, items requiring action by utilities or local authorities, implications for phased implementation and public use, implementation recommendations, and annexed final design documents.

Each deliverable shall be subject to Client review. The Consultant shall present the inception findings, feasibility/options analysis, concept design, and final design package to the Client and key stakeholders.

6. Key Design Principles

- Safety first in a flood-prone and dynamically fluctuating river environment.
- Preference for nature-based and hybrid solutions where technically feasible and cost-effective.
- Protection of the community and public assets from erosion, flooding, and mudflows (the intervention shall not increase flood, erosion, sedimentation, or safety risks upstream, downstream, or on the opposite bank).
- Provision of attractive, controlled, and inclusive public access to the river.
- Respect for landscape character, ecological function, and water quality considerations.
- Integration of sewage/wastewater outfall constraints into the design and phasing logic.
- Durability, buildability, and manageable maintenance requirements.
- Public access shall be conditional on safe hydraulic, structural, environmental, and sanitation conditions.
- Pilot-scale practicality with potential for replication.
- Modular, phased, and procurement-ready design and costing structure.

7. Author's Supervision

Author's supervision is carried out based on the provisions set forth below, as well as in accordance with the requirements of the Civil Code of the Republic of Armenia and the author's supervision contract signed between the Client and the Consultant/Author.

The Consultant:

1. Submits to the Client the list of personnel performing author's supervision, indicating the head of the author's team,
2. Monitors the compliance of the implementation of the facility with the requirements and solutions of the approved design,
3. Timely resolves issues related to the design that arise during construction, coordinating them with the Client,
4. Records deviations from the design solutions in the relevant section of the general construction log, informing the Client thereof,
5. If necessary, makes amendments and additions to the design solutions in accordance with the established procedure,
6. Visits the construction site within the timeframes stipulated by the contract, as well as upon special request of the Client,
7. Bears responsibility for the fulfillment of obligations assigned under this instruction and the contract.

Author's supervision shall be considered completed when the handover-acceptance act is issued and approved by the Client in accordance with the established procedure, unless otherwise stipulated by the contract.

During the construction phase:

- The Consultant is obliged to eliminate deficiencies arising due to its fault and to amend the design at its own expense, without additional charges to the Client.
- The Consultant shall coordinate with the Client all proposals and drawings that differ from the original design.
- The Consultant shall comply with construction site safety regulations.

8. Duration and Level of Effort

The expected duration of the assignment is approximately 12-16 weeks from contract signature, subject to timely availability of input data and review comments. If additional surveys, investigations, or approvals are required, the schedule may be adjusted accordingly..

- Inception and site assessment: 2 weeks
- Feasibility and comparative analysis: 2–3 weeks
- Concept design: 2-3 weeks
- Detailed design and costing: 4–6 weeks
- Finalization: 2 weeks

9. Consultant Profile and Qualification Requirements

The assignment may be undertaken by a multidisciplinary consulting firm led by a landscape architect.

A multidisciplinary consulting firm led by a landscape architect and including, either in-house or through associates, expertise in hydraulic/hydrology engineering, geotechnical engineering, civil/structural engineering, wastewater/utility coordination, and ecology/bioengineering.

Key Personnel Qualification Requirements

The Consultant's proposed team / key personnel shall meet the following minimum qualification requirements:

- Team Leader/Landscape Architect (key expert):

- At least 7 years of relevant experience in landscape architecture, riverbank restoration/stabilization, waterfront public-space design, flood-resilient landscape/public realm, or nature-based/hybrid infrastructure and recreational space projects.
- The Team Leader may be a landscape architect, civil/hydraulic engineer, or other relevant professional, provided the full team includes the required multidisciplinary expertise.
- Demonstrated experience in developing technical design documents.
- Experience with nature-based solutions, ecological stabilization, or green-gray infrastructure.
- Experience in addressing utility conflicts, wastewater outfalls, or related interface conditions in public-space/infrastructure projects is an asset.
- Excellent graphic, technical, and report-writing skills.

- Hydraulic/hydrology engineer (key expert_:

- At least 5 years of relevant professional experience in Hydraulic/hydrology.
- Proven professional experience, with experience in at least 2 similar projects, responsible for design water levels, flood assumptions, velocity/shear assessment, scour risk, hydraulic compatibility of the proposed works, and confirmation that the intervention does not increase risk upstream/downstream.

- Geotechnical engineer and civil/structural engineer (key expert):

- At least 5 years of relevant professional experience in Civil Engineering / Geotechnical Engineering.
- Proven professional experience, working with embankments, with experience in at least 2 similar projects.

- Wastewater/utility coordination specialist (key expert):

- At least 3 years of relevant professional experience in water supply/wastewater utilization.
- Proven professional experience in wastewater, drainage, utility mapping, outfall/interface assessment, utility-owner coordination, and integration of utility constraints into civil/landscape design, in at least 2 similar projects.

- Ecology/bioengineering specialist (key expert_:

- At least 3 years of relevant professional experience in Ecology/bioengineering.
- Proven professional experience in tackling critical environmental challenges by combining applied ecology, hydrology, and environmental bioengineering to build resilient nature-based solutions.

- Landscape Designer (non-key expert):

- At least 3 years of relevant professional experience in Landscape designing.
- Proven professional experience in Landscape designing and Drainage & Grading: Designing the land/embankment to manage water runoff and ensure proper water flow away from structures. Can be combined with the Team Leader.

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10. Reporting and Coordination

The Consultant shall report to the designated Client focal point. All major outputs shall be submitted for review and approval before proceeding to the next stage. The Consultant shall coordinate closely with relevant municipal, environmental, infrastructure, wastewater/utility, and community stakeholders identified by the Client.

11. Facilities and Inputs to Be Provided by the Client

The Client may provide available background information, existing studies, maps, available surveys, utility information, hydrological/hydraulic survey, bridge structural appraisal, zoning plans, photos and drone footage, and facilitate access to the site, local authorities and key stakeholders. The Consultant shall identify any additional data required to complete the assignment. If any required input data are unavailable or insufficient, the Consultant shall identify the gap, explain its impact on design reliability, and propose proportionate means to address it.

Commented [AO4]: In addition to what is noted, is any of the following available, if yes, then add it accordingly:

topographic survey,
hydrological/flood assessment,
bridge assessment,
cadastral information,
utility maps,
wastewater/outfall information,
photos,
municipal planning constraints,
stakeholder contacts.

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12. Evaluation Criteria for Selection

- General work experience of the Consultant (years) in in riverbank, waterfront, public-space, landscape, hydraulic, or civil infrastructure design– 10 points;
- General work experience of the Consultant (number of implemented contracts) in the field of riverbank stabilization, erosion control, flood resilience, nature-based/hybrid solutions, riparian restoration, or riverfront public access over the last 5 years – 30 points;

- Implementation of similar contracts over the last 5 years, within which the organization has carried out design works for at least 3 riparian landscapes (riverbank fortification, overpasses, viaducts) – 60 points.

13. Additional Safeguard Clauses

The Consultant shall ensure that the proposed modularization is not merely financial in nature, but is based on a technically justified sequencing logic that preserves the structural stability, hydraulic function, public safety, sanitation considerations, and climate resilience performance of the intervention at each stage of phased implementation.

Requirements and Limitations for Nature-Based Solutions (NbS) for Riverbank Fortification

Nature-based solutions for riverbank protection use living or natural materials — vegetation, bioengineering, or hybrid systems — to stabilise banks while maintaining ecological function. Defining their requirements and limitations involves four intersecting dimensions: engineering performance, ecological function, regulatory compliance, and site conditions.

A. Hydraulic and Structural Performance

- The solution must withstand the design flood event (typically 10-, 50-, or 100-year return period), precipitation statistics to be provided
- Shear stress resistance of the bank surface must meet or exceed calculated bed shear from peak flow velocity
- The toe of the bank must be protected against scour, which is the most common failure mode — NbS alone often cannot achieve this without supplementary hard elements
- Settlement and deformation tolerances must be defined, particularly for saturated and saturating soil conditions

Note: Vegetation-only solutions are generally suitable only under lower-energy hydraulic conditions; any velocity, shear-stress, slope, or scour thresholds used in the design shall be justified by the Consultant based on site-specific analysis and recognized guidance. . In high-energy rivers, gorge sections, or channels with significant bedload transport, NbS cannot function as a standalone solution and must be combined with hard engineering (riprap toe, sheet piling, or gabions at the waterline) measures. Potential infiltration prevention towards the foundations of nearby structures should also be prevented.

B. Vegetation Establishment

- Species selection must be site-specific: native /endemic and non-invasive riparian species (willows, alders, sedges, reeds) adapted to the local hydrogeological zone, flood frequency, and local soil moisture regime.
- A minimum root penetration depth and lateral root density must be specified — typically 0.5–1.5 m depth for effective bank reinforcement
- An establishment period of 2–5 years must be planned for (including replanting, watering where needed, invasive species removal, inspection after flood events, and community/municipal maintenance responsibilities), during which the bank is vulnerable and may require temporary protection (erosion control blankets, brush mattresses). Instruction manual shall be produced for the local community on system maintenance and protection.
- Planting density, season, and method (live stakes, fascines, coir rolls, riparian seeding) must be engineered to the slope gradient and exposure

C. Geotechnical Stability

- Slope geometry must satisfy static and dynamic stability — generally slopes no steeper than 1:1.5 (V:H) for vegetated banks without structural reinforcement
- Soil cohesion, internal friction angle, and saturation behaviour must be assessed; NbS perform poorly in non-cohesive, highly permeable sandy or gravelly banks without bioengineering support
- Seepage and pore water pressure must be managed — unexpected saturation can cause mass failure regardless of surface vegetation

Note: NbS require space: a wider, shallower bank profile is needed compared to hard engineering, which can be impractical in urban settings with constrained riparian corridors, existing infrastructure close to the bank, or active land use immediately behind the bank line. They cannot replicate the near-vertical profile achievable with sheet piling or mass concrete walls.

D. Maintenance Regime

- A defined inspection and maintenance schedule is a functional requirement, not optional: vegetation must be managed (cutting, replanting after flood damage, removal of invasive species) to sustain effectiveness
- Maintenance access corridors along the bank must be preserved in the design

Note: The critical window of 2–5 years before full root development is a structural vulnerability — a significant flood event during this period can cause failure and set back the entire investment. This makes NbS unsuitable as a sole emergency or rapid-response measure

E. Monitoring

- Baseline survey (topographic, bathymetric, ecological) before implementation
- Periodic monitoring of bank geometry, vegetation cover, and root development over the establishment phase
- Trigger thresholds for remedial action must be defined in advance

F. Geometric Constraints

- NbS require space: a wider, shallower bank profile is needed compared to hard engineering, which can be impractical in urban settings with constrained riparian corridors, existing infrastructure close to the bank, or active land use immediately behind the bank line
- They cannot replicate the near-vertical profile achievable with sheet piling or mass concrete walls

G. Depth of Protection

- Protection is primarily surface and shallow-root; NbS do not address deep-seated or rotational slope failures, which require geotechnical interventions
- Toe scour remains the principal unresolved vulnerability — NbS cannot prevent undermining from below without supplementary engineering at the waterline

H. Flood Frequency Sensitivity

- Banks subject to very frequent inundation (high flood recurrence) limit vegetation establishment due to physical disturbance and anaerobic soil conditions

- Conversely, banks that are too rarely flooded may not sustain the moisture regime that riparian species require

I. Invasive Species Risk

- Riparian corridors are highly vulnerable to invasive plant colonisation; if not actively managed, NbS plantings can be outcompeted or the solution can inadvertently spread problematic species downstream

7. Quantification and Standards Gap

- Unlike hard engineering, NbS lack a fully harmonised set of design standards in European or international codes — there is no equivalent of a Eurocode for bioengineering. In the absence of a single harmonized engineering code for all NbS/bioengineering applications, the Consultant shall justify the design using recognized international guidance, site-specific hydraulic and geotechnical assessment, empirical evidence, professional judgement, and a defined monitoring and adaptive management plan.
- Performance verification relies on empirical data, site monitoring, and professional judgement rather than deterministic calculation, which complicates permitting and liability assignment.
- This is an active regulatory gap in the EU context, partially being addressed through the **EU Nature Restoration Law (Regulation 2024/1991)** and guidance under the EU Biodiversity Strategy, which may be considered as contextual references for ecosystem restoration and resilience objectives, but detailed engineering design codes remain underdeveloped.

I. Climate Uncertainty

Flood frequency, precipitation intensity, and drought periods are all shifting under climate projections; NbS designed to current hydrological baselines may underperform under future conditions, requiring adaptive management provisions to be built into the design from the outset

Hybrid Approach as Best Practice: In most professional applications, the state of the art is a **hybrid system**: hard engineering at the toe (riprap, sheet pile, or gabion) to address scour and high-velocity shear, combined with NbS on the upper bank and transition zone. This captures the erosion resistance and structural reliability of hard engineering where stresses are highest, while delivering the ecological, aesthetic, and long-term cost benefits of NbS across the majority of the bank face.

References Informing this Draft

This draft incorporates concepts commonly reflected in nature-based flood protection guidance, including system-scale analysis, comparison of green/gray/hybrid options, quantitative performance assessment, ecosystem integration, and adaptive management.

International NbS and river engineering guidance shall be used to inform the design, but shall not replace site-specific engineering assessment, applicable Armenian requirements, or Client/authority approvals.

- **World Bank, 2017,** Implementing Nature-Based Flood Protection: Principles and Implementation Guidance
- **IUCN, 2020,** Nature-based Solutions, NNBF guideline is available via https://ewn.erdc.dren.mil/international-guidelines-on-natural-and-nature-based-features-for-flood-risk-management/
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- **Engineering With Nature / ERDC,** International Guidelines on Natural and Nature-Based Features for Flood Risk Management
- SEPA Best Practice Design Guide, Accessible via sepa.org.uk (search "riverbank protection best practice"). —
- How Trees help Protect Riverbanks from Erosion Sustainable Riverbank Protection

Commented [AO5]: Correct, there is no single Eurocode-style design standard covering all bioengineering cases. However, the World Bank guidance and NNBF guidelines are appropriate references for planning, design, implementation, and adaptive management.

The NNBF guideline is available via https://ewn.erdc.dren.mil/international-guidelines-on-natural-and-nature-based-features-for-flood-risk-management/?utm_source=chatgpt.com

Commented [AP5R2]: Added to the list below

- HR Wallingford — Green Approaches in River Engineering (2017) Available via hrwallingford.com.
- **European Commission — Nature-Based Solutions Research & Innovation Hub**: Available at research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions
- Engineering With Nature: **International Guidelines on Natural and Nature-Based Features for Flood Risk Management available at** https://ewn.erdc.dren.mil/international-guidelines-on-natural-and-nature-based-features-for-flood-risk-management/