Environmental and Social Guidance Note for Hydropower Projects

European Bank
for Reconstruction and Development

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Abbreviations

E&S	Environmental and Social
ESMS	Environmental and Social Management System
ESP	Environmental and Social Policy
EU	European Union
FI	Financial Intermediaries
GHG	Greenhouse Gas
GIP	Good International Practices
PR	Performance Requirement
SEP	Stakeholder Engagement Plan

Introduction

Hydropower projects

In the context of this guidance note, the term "hydropower" covers a large variety of energy schemes or projects, including greenfield schemes and the rehabilitation or modification of existing schemes.

Hydropower schemes are generally classified as either storage schemes or run-of-river schemes. Storage schemes typically consist of a dam that holds back water, raises its level and creates an artificial reservoir ("impoundment area") that can be used to change the downstream river flow through regulation.

The reservoir and the dam often form a significant barrier to the continuity of a river ecosystem and its functions, including sediments transit, fish migrations, and use of the river. Water from the reservoir can either be turbined at the base or toe of the dam or it may be diverted to a powerhouse located further downstream before being discharged back to the river bed.

Conversely, run-of-river schemes typically rely on smaller cross-river structures rather than storage schemes, and have no or only a limited storage capacity: they consist of an intake which collects and diverts water via channels or pipes to the turbine(s) in the powerhouse. Despite the lack of an impoundment, the diversion of water can also result in significant fragmentation of both aquatic ecosystems (by-passed river reach) and terrestrial ecosystems (construction of above ground structures such as canals and penstocks).

Hydropower schemes can also refer to a variety of sizes and complexities of infrastructure, including:

- micro-hydropower
- hydropower cascade, a sequence of hydropower schemes on the same river
- pumped-storage hydropower, a storage reservoir fed by water pumped up from a lower waterbody during off-peak hours, and from which the same water is turbined back to the waterbody during peak hours
- complex schemes that include a variety of interconnected storage reservoirs and production plants.

The energy produced by a hydropower scheme is equally proportional to (i) time ("use factor"), (ii) the turbined water discharge and (iii) the difference in height between the upstream and the downstream waterbodies ("head"). Hydropower plants may be used for base load or peak energy generation, but are increasingly used to balance power supply and demand.

The operation of hydropower schemes can be subject to rapid operational changes which in turn can translate into a number of impacts or risks to people and ecosystems as a result of the artificially induced flow and level variations.

This guidance note equally addresses the environmental and social challenges (and good international practices to address such challenges) associated with the construction, physical footprint and operation of hydropower schemes.

Objectives of the guidance note

This guidance note aims at providing an overview of the key environmental and social risks that should be considered during the preparation, implementation and monitoring of hydropower projects. The target audience includes those involved in hydropower projects subject to the EBRD's Environmental and Social Policy (ESP, 2014). This particularly includes EBRD clients, staff and consultants working on hydropower projects directly or indirectly financed by the EBRD.

The guidance note is consistent with the objectives and performance requirements (PRs) of the EBRD's ESP as well as with the EBRD's 2013 Energy Strategy. The guidance note provides recommendations and requisites for compliance with each performance requirement and clarifies the issues that are specific to hydropower projects. This guidance note complements the ESP but does not replace it.

The guidance note looks at environmental and social issues only: technical or economic assessments are outside of its scope.

Scope of the guidance note

The guidance note was prepared for all greenfield, extension or modernisation projects where the primary purpose is the production of hydropower. This includes in particular:

- storage, run-of-river, and pumped-storage hydropower schemes
- single and multipurpose schemes
- large regulation reservoirs for hydropower
- large dams[1]
- small and micro hydropower.[2]

Although it does not intend to specifically cover them, where relevant, the guidance note might be useful for some aspects of the following types of projects:

- dams that are not related to hydropower production (tailing dams, flood protection dykes, irrigation reservoirs, and so on)
- marine hydropower (tidal power plants, tidal turbines, and so on).

[1] The EBRD refers to the definition of large dams of the International Commission on Large Dams (ICOLD): a dam with a height of 15 metres or more from the foundation. Dams that are between 5 and 15 metres high and have a reservoir volume of more than 3 million cubic metres are also classified as large dams.

[2] There is no international consensus on the definition of a Small Hydropower and the EBRD does not have a specific definition for it.

Environmental and social assessment of hydropower projects

Categorisation of hydropower projects

The EBRD categorises hydropower projects in accordance with the ESP, taking into account the environmental and social impacts they may generate or the sensitivities of the environmental and social characteristics of the location. Hydropower projects involving one of the following components will in most cases be considered as Category A by the EBRD (see appendix 2 of the 2014 ESP) and would therefore require an independent and participatory Environmental and Social Impact Assessment:

- large dams, as defined by ICOLD
- large-scale logging (including the large scale loss of forested areas as a result of reservoir impoundment)
- construction of high voltage overhead electrical power lines more than 15 kilometres and 220kV or more
- significant involuntary resettlement or economic displacement
- significant adverse social impacts
- significant environmental impacts, including projects which are planned to be carried out or are likely to have a perceptible impact on sensitive locations, including nature protection areas, critical habitat or other ecosystems which support priority biodiversity features, areas of archaeological or cultural significance, and areas of importance for indigenous peoples or other vulnerable groups.

Small or micro hydropower schemes which do not include a large dam will be categorised following the same approach used for larger schemes, especially taking into account the sensitivity of the location.

Typical environmental and social issues at key development stages of hydropower projects

It is important to note that the EBRD's requirements are not always applied or used as guidance from the early stages of hydropower projects, but instead might need to be applied to projects that have progressed to an advanced stage of preparation or construction. In such cases, the appraisal will include a gap analysis of the project in its current stage against this Guidance Note to identify whether any additional studies, design changes and/or mitigation measures are required to meet the EBRD's requirements.

The EBRD considers that effective prevention and mitigation of risks and impacts requires that environmental and social aspects are taken into account and addressed from the early stages of the planning and development of a hydropower project.

An indicative description of the environmental and social issues that are typically expected to be assessed during the preparation of a hydropower project is presented in the following table, in parallel with the main steps of the technical and economic assessment. This table can be used for both greenfield projects and projects at existing hydropower schemes.

PROJECT DEVELOPMENT STAGE	TECHNICAL & ECONOMIC ISSUES	ENVIRONMENTAL & SOCIAL ISSUES
Concept	• Assessment of alternative locations and site identification • Preliminary dam height • Energy production potential • Associated structures	Review (at regional level) of: • Land acquisition, land use • Population (socio-economic status and distribution) • Transboundary risks and downstream notification practices • Other regional infrastructure developments or programmes • Protected areas and species (national/regional) • Use of water bodies • Indigenous peoples • Gender gaps.

PROJECT DEVELOPMENT STAGE	TECHNICAL & ECONOMIC ISSUES	ENVIRONMENTAL & SOCIAL ISSUES
Pre-feasibility	• Dam location • Dam type • Reservoir size • Reservoir footprint • Operation concept • Associated structures • Preliminary cost estimate and economic assessment	Environmental and social scoping, including a review at local level of: • Land use and land tenure • Downstream water uses • Potential losses of (or losses of access to) public and private assets or production means or of recreational or cultural use • Cumulative impacts and/or risks of interference with other regional infrastructure developments or programmes • Protected areas and species • Vulnerable groups/people • Applicable E&S laws, regulations, good international practice and sponsor's policies • Stakeholder mapping and engagement planning.
Feasibility	• Structures and operation details • Cost estimate and economic assessment • Operation mode	Environmental and social due diligence (including an impact assessment for category A projects). Assessment of adequacy with all PRs, including: • Layout and footprint of the main, associated, and incidental infrastructures • Work site organisation (access and supply, camps, temporary land use, borrow and spoil areas, and so on) • Comprehensive baseline covering the physical environment (hydrology, sediments, water quality, natural hazards) and biodiversity (habitats and species, terrestrial and aquatic) • Reservoir management and water quality • Downstream impacts (geomorphology, water quality, hydrology, sediments, habitats) • Minimum downstream flow regime: legal, environmental, and socio-economic requirements • Expected long term changes (land use conversion, influx, fragmentation, greenhouse gas emissions, and so on) • Public safety • Socio-economic condition and composition of population, including sex and age-disaggregated data. Analysis of potential socio-economic impact on the population's existing activities and conditions (such as access to employment and skills, finance, services), differentiated by age, gender and vulnerable groups • Change in land use/acquisition of land which may result in the loss of livelihood/income • Resettlement and livelihood restoration • Gender inclusive stakeholder engagement.
Detailed studies and construction	• Detailed design • Construction supervision • Power purchase agreement • Operation permit	• Ensure dialogue between the technical and environmental/social specialists so that the design takes account of and addresses the environmental and social due diligence findings to avoid or minimise impacts • Scheduling and implementation of environmental and social actions required as a result of the due diligence • Permits and authorisations • Design, construction, operation and ownership of planned associated facilities • Occupational health and safety supervision • Stakeholder engagement, with a focus on needs related to the construction phase • The construction and operations ESMPs are typically issued at this stage.

PROJECT DEVELOPMENT STAGE	TECHNICAL & ECONOMIC ISSUES	ENVIRONMENTAL & SOCIAL ISSUES
Commissioning and operation	• Dry and wet tests • Energy production	• Reinstatement and closure of temporary sites • Ecosystems monitoring • Stakeholder engagement, with a focus on risks and needs related to the operation • Implementation of environmental and social actions required as a result of the due diligence • Monitoring and adaptive management
Closure/dismantlement		• Occupational health and safety • Temporary nuisances • Public safety • Reinstatement • Ecosystems monitoring

Application of the EBRD's performance requirements to hydropower projects

This section presents guidance for the application of the EBRD's performance requirements to hydropower projects.

The following recommendations do not replace the requirements of the individual PRs or the EBRD's requirements under the ESP but identify and provide further guidance on typical environmental and social issues related to hydropower projects.

PR1 - Assessment and Management of Environmental and Social Impacts and Issues

Project description, development stages and operation

Project developers should promote the integration of environmental and social issues during feasibility studies and detailed design.

The EBRD's 2014 Environmental and Social Policy definition of the "project" refers to the defined set of business activities for which EBRD financing is sought. The EBRD has adopted a comprehensive set of specific performance requirements (PRs) that the projects are expected to meet.

The environmental and social assessment of hydropower projects should be based on a well-developed project description that includes a technical description and schedule of the planned development stages, typically:

- underground (such as tunnels, underground electromechanical equipment) and on-land works (all works that are undertaken before the river closure)
- river works: cofferdams, river diversions, river closures and dams
- planned construction and rehabilitation works in the case of existing projects
- reservoir filling
- operation details such as drawdown of reservoir, operating hierarchy (if multipurpose) and operating regime throughout the year and on a monthly, daily and/or hourly basis.

The project description should include details of both the construction stages and the operation mode of the hydropower scheme, including seasonal flow regulation or peak energy production.

Associated activities or facilities

Hydropower projects may be associated with activities or facilities which are not parts of the project but which may be directly or indirectly influenced by the project, or could present a risk to the project.

These associated activities and facilities may exist solely because of the project, may be essential for the project's viability and may either be under the control of the client or carried out by, or belong to, third parties.

The EBRD's PRs do not apply to these associated activities or facilities but the environmental and social assessment process will need to identify and characterise potentially significant environmental and social issues associated with them, as defined by Performance Requirement 1 (PR1), paragraph 9.

These activities or facilities may be operated or owned by third parties and may include, for example: existing hydropower schemes or other water use upstream or downstream of the project; new roads, transmission lines and substations or quarries; ship locks or navigation canals; river works; dredging; erosion control or river bank protection works; tourism and so on In the case of multipurpose reservoirs, all infrastructures or facilities aimed at serving the reservoir purposes are considered to be associated facilities.

Environmental and social baseline

The environmental and social assessment process will be based on available recent social and environmental baseline data at an appropriate level of detail. The baseline conditions should be characterised to a degree that is proportional and specific to the anticipated risk and significance of impacts.

The baseline assessment will consider, but will not be limited to, the physical environment (hydrology, sediments, water quality, natural hazards), biodiversity (habitats and species, terrestrial and aquatic) and socio-economic condition and composition of population, including sex and age-disaggregated data. Additional baseline studies, including field studies, may need to be undertaken if appropriately comprehensive or detailed data is not readily available. Where appropriate, the baseline data collection needs to capture seasonal variations.

Environmental and social assessment

The assessment of environmental and social risks and impacts of hydropower projects should systematically identify and where relevant assess the specific issues related to cumulative impacts, transboundary impacts, indirect impacts and disaster risks.

The impacts of the project on climate (for example, greenhouse gas emissions and the impacts relevant to adaptation) and the vulnerability of the project to climate change should also form part of the assessment. All potential gender-specific risks and opportunities associated with hydropower schemes development, modernisation or operation should also be clearly and systematically identified within the frame of their assessment.

Assessment of alternatives

The assessment of alternatives for hydropower projects should address both (i) the energy production alternatives to the proposed scheme, (including both hydro and non-hydro projects, as well as the *no-project* alternative) and (ii) the alternatives and options that were envisaged and discussed between the technical and E&S teams during project preparation when optimising the location, size, structural design, construction principles and operation of the scheme (see the section "Optimisation of hydropower projects" below).

The assessment of alternatives should take into account relevant Strategic Environmental Assessments and other strategic level

documents, regional programmes, basin management plan or any bi-lateral/multi-lateral agreements related to the water body.

The assessment of alternatives shall also clearly describe whether the considered alternatives are under the control of the developer to implement at the project level, or whether they were decided at the strategic level by third parties (for example, by a competent national authority).

Optimisation of hydropower projects

The development of new hydropower schemes or the upgrade of existing ones typically offer multiple opportunities to avoid or minimise adverse environmental or social impacts in accordance with mitigation hierarchy. These opportunities can be related to the design of the scheme, its operation mode or the organisation of works.

The optimisation of hydropower schemes implies an early dialogue between the technical and E&S specialists involved in the preparation of the project. Such dialogue should take place early on in project development and be documented, particularly the consideration of different alternatives (see above).

Where the EBRD's requirements are applied late in the planning or construction phases of a project, the coordination of technical and environmental and social assessments in the earlier phases should be reviewed.

International and local competences

To ensure both the application of good international practices and due consideration of the local context, a balanced mix of international and local E&S experts with hydropower sector specific experience should be involved in the preparation of category A hydropower projects.

Regional and transboundary impacts

As part of the project scoping and in order to meet UNECE EIA Convention ("Espoo Convention") objectives, the E&S assessment of hydropower projects should include a review of the regional or transboundary impacts that the scheme is likely to have under normal or emergency situations, including:

- impacts on fauna migrations and seasonal migration of people such as transhumance
- impacts of potential disruption of sediment transport to the hydrodynamic balance of downstream wetlands and estuary ecosystems
- in addition to the above, for transboundary basins
- potential impacts on transboundary water availability and water quality
- the operator's E&S obligations in application of existing transboundary water management agreements and regulations
- potential impacts under normal and emergency conditions.

PR2 - Labour and Working Conditions

Workforce influx

Hydropower projects typically generate a large number of job opportunities during construction or large scale rehabilitation but then require a very limited number of staff for their operation.

Depending on the project's social context, the variation in the number of workers can be associated with a wide range of social or environmental risks, community tensions or gender-related issues that should be anticipated at the project preparation stage, particularly when the required workforce is significant compared to the total project area population. These may include cultural changes, increased pressure on existing resources and services, inflation, competition for employment, health impacts, workers' accommodation management, and an influx of opportunistic service providers.

Projects in remote locations

Projects located in remote locations should take into consideration the specific environmental and social challenges arising from the temporary and permanent disturbances generated by the project development, the presence of workers and the increase of human activities such as traffic, pressure on resources, noise and pollution risks, and so on.

With this aim, specific provisions related to migrant labour and workers' accommodation should be taken into consideration in early project planning stages, in accordance with IFC/EBRD guidance notes on workers' accommodation.

Local employment

Hydropower projects are a potential source of local employment during construction (and, to a much lesser extent, also in operation) but due to the technical skills required, many projects generate only short-term and/or semi or unskilled positions for the local population. This can bring short-term benefits in relation to income but it can also divert resources from other industries (for example, the agriculture sector).

A labour plan can assist with managing employment issues and should include identification of the project's labour needs, the envisaged training opportunities and enhancements (such as skills upgrading/ training opportunities for women) and a clear outline of how the employment process will be communicated and managed. It can also identify potential opportunities in the wider project supply chain.

PR3 - Resource Efficiency, Pollution Prevention and Control

Efficient use of land and construction materials

The optimisation of hydropower projects (see PR1, above) requires the following:

- The definition of the location and footprint of the planned infrastructure and reservoir should take into account environmental and social aspects, and in particular the loss of resources or access to resources (agricultural and pasture land, fisheries, timber and non-timber forest products, underground mineral resources, and so on)
- Temporary land use, quarries and spoil areas should to the maximum extent be located inside the future reservoir footprint. Where this is not feasible, rehabilitation plans are required post construction
- Excavated materials should to the maximum extent be re-used as materials for construction activities and road base.

Efficient use of water resources

Hydropower projects can be either a tool or a risk for the efficient use of water resources. The EBRD promotes all actions that allow a project to meet the objectives of the EU Water Framework Directive,[3] in particular basin-level cooperation, information sharing and coordinated management.

In this respect, the environmental and social assessment of hydropower projects should address the following:

- Identification and impacts assessment of changes to water flow, water level or river bed morphology and any impacts or changes to downstream water availability
- Net water use or losses generated by the scheme during impoundment (reservoir filling) and operation (evaporation and infiltration, offtakes for consumptive uses)
- Identification of all types of water or river uses (environmental and social receptors) that may be potentially affected by water changes to availability or fluctuation
- Water quality changes downstream and in the reservoir (taking into account the influence of the inputs into the river in the catchment area).

Environmental parameters (flow, level, temperature, water quality) monitored at the hydropower scheme level should be disclosed publicly through a dedicated project web page and made available locally, particularly in areas where internet use is not widespread.

Critical parameters such as minimum flow requirements should be monitored and disclosed in real time if their application is not physically enforced by the dam design.

Pollution risks during construction or large rehabilitation

The construction or large scale rehabilitation of hydropower schemes increases the risk of accidental or intentional pollution of water bodies.

Works associated with critical water pollution risks should be identified in the early project preparation stages, and risk avoidance and/or minimisation measures should be developed and implemented accordingly, including the set-up of a permanent or integrative monitoring mechanism during these critical stages. Depending on the type of risk, good international practices include, for example, permanent visual supervision, continuous monitoring (when technically feasible) or integrated indicators that measure ecosystems quality and changes over time (biological index, diatoms, and so on)..

Pollution risks during impoundment

The environmental assessment of the project should address the potential risks of pollution associated with reservoir impoundments. The origin of these risks can be either natural (geology, biomass) or artificial (landfills, industrial sites, underground storages).

The following issues should be addressed:

- biochemical balance, including oxygen concentration, stratification and eutrophication risks
- large pollutants sources in the catchment area
- micro-pollutants and the risks of bio accumulation.

Pollution risks during operation

Pollution risks associated with the operation of hydropower should be minimised. The use of pesticides by the hydropower scheme developer or operator should be monitored and reported annually to the EBRD. Pesticides should be used through direct applications on the targeted plant only and should not be used where they may migrate to waterbodies.

Pollutant-free turbines and hydro-mechanical equipment (for example, oil-free, formaldehyde free) should always be the preferred technology. Where oil is used, the quantities of oil consumed by the hydropower plant should be monitored in a way that allows measuring the volumes of oil that are released into the environment. The wastes collected at intakes and other cross-structures should be sorted, monitored and reported annually to the EBRD. None of the wastes collected at the intake should be discharged into the downstream river bed.

Waste management

Both the construction and operation of hydropower projects are associated with the generation of significant volumes of wastes. In addition to typical construction wastes, hydropower projects may also generate large quantities of waste from vegetation clearing, either in the reservoir or at construction sites. Operation-related wastes differ from construction wastes – they typically include waste oils, dredged materials or floating waste collected at intakes screens. Where readily accessible and authorised disposal solutions are not available, waste management plans should be prepared and implemented on the basis of a detailed assessment of the nature and volumes of wastes.

Greenhouse gas (GHG) emissions

In application of good international practices, the environmental assessment should include a lifecycle (or 100 year) assessment of GHG emissions for greenfield reservoir projects. In the case of

[3] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for community action in the field of water policy.

large reservoirs, the risk of methane emissions as a result of the development of anoxic conditions should be addressed. For the sake of comparison with other sources of energy, the lifecycle assessment of GHG emissions should include a calculation of annual emissions during the construction, impoundment and operation periods.

The EBRD can provide technical assistance to hydropower developers willing to improve the sustainability and compensate the GHG emissions of the schemes they develop through reforestation programs.

PR4 - Health and Safety

Occupational health and safety

The systems and procedures developed to manage occupational health and safety risks associated with the construction and operation of hydropower schemes should address the following activities:

- works on or close to open waterbodies
- works in areas subject to intermittent or rapidly fluctuating water flows
- works with pressurised systems
- works on electrical systems
- works inside or on piped waterways
- heavy loads lifting
- interaction with external service providers
- emergency management.

Depending on the hydropower project configuration, other activities may need to be included such as work at height, tunnelling works, work in severe climate or altitude conditions, and so on.

Reservoir associated risks

The creation and operation of a reservoir induces a number of changes that can present a risk for the local population and should be addressed during project preparation. This particularly includes the potential risks associated with:

- banks' stability: steep slopes, erosion and landslide
- the formation of large still water body: change of navigation conditions, formation of waves, ice, and so on
- changes in reservoir water level
- infiltration: water table raise, water logging, and so on
- micro-climatic changes.

Downstream risks

The construction of hydropower schemes can at some key stages present significant risks for downstream users in terms of water availability (during diversion or impoundment) or water quality (river works, river diversion). These risks should be addressed during the environmental and social due diligence and mitigated.

The operation of hydropower schemes can induce rapid variations of downstream flow (i) on a routine basis (peak energy production, sediments flushing); (ii) in the case of occasional events (turbine shut down, sand trap flushing); or (iii) in relation to flood or emergency management (spillway opening or closing).

Rapid variations of downstream water level and velocity are among the main risks posed to the public by hydropower schemes. These risks should be assessed based on a review of the flow variations that can be generated by the combined operation of the various hydraulic structures of the proposed scheme. The way flow variations propagate and possibly attenuate downstream needs to be assessed with appropriate means such as modelling and verified through monitoring. The identification of receptors exposed to flow and regime variations should be consistent with the identification of downstream water uses (PR3 - section on efficient use of water resources and PR10 –Stakeholder Engagement).

The measures adopted to mitigate downstream flow variations should be proportionate to the frequency and rapidity of such variations and should take into account the nature of land use and behavioural variability of river users. These mitigation measures typically include a mix of structural (buffer reservoir, fences, signs), operational (sequential operation of turbines or gates, identification of lower risks days or hours) or communication actions (awareness campaigns, public information, warning signs, alarms).

The dam operator is expected to agree and set up real-time warning tools meeting good international practices (phone calls, SMS alerts, alarms, phone applications and so on) for river users who would be regularly exposed to flow variations and to communicate with them appropriately.

The disclosure of real-time flow information through the internet or other appropriate means and the organisation of open-day visits for the public and schoolchildren to raise public awareness are examples of good international practices aimed at informing and educating the public about downstream risks.

Natural hazards, technological risks and infrastructure safety

The assessment of natural hazards and technological risks that may affect the safety of hydropower schemes has to be undertaken on the basis of a comprehensive description of the events which, individually or combined, could directly or indirectly present a threat. This assessment has to take into account the changes (such as climate change, land use change) that can affect the nature of the risks faced by the hydropower scheme.

For large dams, this assessment has to be carried out as part of the design and should be made available in a form suitable for public consultation, together with a description of the structural and operational measures required to mitigate the risks and manage emergency situations.

Emergency plan and response

An emergency is an unexpected situation that cannot be fully controlled by the hydropower plant operator and threatens the lives of workers and/or the public. An emergency prevention and response plan is necessary to address any potential emergency situations over the lifecycle of the scheme as a result of a natural event, an unexpected flood (natural of caused by an upstream hydraulic structure) or an internal technical problem.

As a minimum, the emergency plan is expected to address the management of situations resulting from the following events (eventually combined):

- extreme natural floods
- abnormal flows resulting from the emergency operation of upstream dams
- abnormal flows resulting from the failure of natural dams (landslide dams, glacier lake outbursts)
- rapid change of permeability of the dam body, foundation or abutments
- loss of control of safety related structures (such as overflow spillways).

The emergency plan should be precautionary in nature and include prevention measures for those issues under the control of the operator, as well as response measures based on an assessment of the consequences of such events (including a dam break analysis for all large dams). The results of the assessment, including flooding maps for typical scenarios, should be shared with the relevant authority in charge of civil protection and emergencies, as well as local authorities.

The operator should then ensure that all operational staff have access to an up-to-date contacts list of people to be informed in case of an emergency situation. In areas where there is an effective civil protection organisation with resources to appropriately manage emergency situations and protect populations, the dam operator would not normally have the responsibility of directly informing the population exposed to such emergency situations as this would usually be the responsibility of the relevant civil protection organisation. Conversely, in areas where such a civil protection organisation does not exist, the dam operator may be expected to put in place the necessary measures to directly inform the population exposed to emergency situations associated with the dam.

Waterborne and communicable diseases

The construction and operation of hydropower schemes can result in an increase of the prevalence of waterborne diseases in the reservoir area or downstream, which should be addressed in both the short and the long term. This includes in particular:

- the proliferation of parasites or their larvae
- changes in the quality of water abstracted for other uses (including risks resulting from eutrophication or anoxic conditions)
- bio-accumulation of micro-pollutants (of natural or industrial origin) in the ecosystems and ultimately in fish consumed by the population.

In addition, large-scale worker influx during construction activities has the potential to result in the introduction of communicable diseases through community exposure or uncontrolled solid and liquid waste management practices.

Independent reviews for dams in high risk locations

Some dams may be considered high-risk during their operation or in case of failure or malfunction, and may consequently impact on the safety of workers and communities.

With reference to paragraph 21 of PR4 and in particular for all large dams, the project developer or operator should engage one or more qualified experts with relevant and recognised experience in similar projects, separate from those responsible for the design and construction, to conduct a review as early as possible in project development and throughout the stages of project design, construction, operation and commissioning.

PR5 - Land Acquisition, Involuntary Resettlement and Economic Displacement

Impoundment area

Dam projects that require the creation of an artificial reservoir can result in the loss of public and private infrastructure and cause large scale resettlement as a result of land being flooded and access to livelihoods being lost.

The impoundment area is defined as the highest water level increase that can occur upstream from a dam as a result of its operation. For maximum design flood conditions, this includes the maximum level in the reservoir (if any), as well as the maximum backwater levels in the rivers that are hydraulically influenced by the dam.

The impoundment area of existing hydropower schemes can increase as a result of improvement works such as the modification of hydraulic structures or dam heightening.

Understanding the extent of the impoundment area is essential for the identification of upstream environmental and social impacts. For reservoirs that are likely to result in significant environmental or social impacts, the use of precise topographical and socio-economic survey techniques and field works is necessary to clearly delineate the impoundment area during the project preparation phase and prior to public consultations.

Area subject to resettlement: upstream

The area subject to resettlement as a result of a reservoir creation or other required land take should be defined on the basis of the impoundment area and should take into account:

- the definitive loss of fixed assets and productive assets (agricultural land, pasture land, fisheries, etc.) located in the impoundment area
- the loss of access to fixed assets, productive assets or public services and infrastructures as a result of the reservoir impoundment (after having considered the feasible options to re-establish cross-river roads, including the possibility to use the dam crest as a public road)
- the need to establish a band of land around the impoundment area that will be subject to limitations in terms of construction or socio-economic activities
- legislation specific requirements, for example in the case where waterbodies banks are automatically part of the public domain up to a certain distance
- existing sanitary protection measures (for example, a 100 metre horizontal distance from the impoundment area where housing, agriculture and all other potentially polluting activities should be avoided).

Area subject to resettlement: downstream

Downstream resettlement is typically triggered when the operation of a hydropower scheme induces, without possible mitigation, any or all of the following:

- loss of and/or reduction in livelihoods due to river regime changes and its impacts on water use and other river related activities (fisheries, irrigation, tourism, gravel extraction), including fragile livelihoods and informal market activities
- the development of unacceptable risks for people living close to or using the downstream river as a result of rapid flow and level variations
- the loss of/reduction in livelihood as a result of water quality alteration, sediments transport disruption or the variations of water availability (daily or seasonal, in terms of flow or water level)
- regulatory stipulated exclusion zones within the proximity of power generation facilities.

Area subject to resettlement: other structures

The area subject to resettlement as a result of other necessary structures, including ancillary and/or associated infrastructures, should be identified at the early stage of greenfield project development and addressed in accordance with the mitigation hierarchy. This includes workers accommodation camps, batching plants, lay-down areas, waste rock (spoil) dumps, access roads and transmission-lines.

Economic opportunities associated with the reservoir

The creation of a reservoir can, in some cases, generate a number of economic opportunities but the nature and extent of these is highly dependent on factors such as the operation mode of the reservoir, accessibility to the reservoir banks, public safety or legislation.

The reservoir operation, particularly the extent and seasonality of its fluctuations, determines the need for specific preparatory measures to be undertaken before activities such as irrigation, fishing or navigation can be undertaken.

The economic opportunities should be assessed by the operator from viability, feasibility, operational, practical and legal perspectives before being discussed with the public.

PR6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources

Habitat changes

Depending on their layout and operation, hydropower projects can result in the loss, degradation, fragmentation and/or creation of habitats, such as:

- loss of habitats: destruction of habitats in the footprint of the scheme (that is, in the impoundment area and at the dam site) or as a result of the downstream flow and sediment regime change (excess of sediments or insufficient water flow during fish spawning season, insufficient or inappropriate flooding of wetlands)
- transformation of habitats: conversion of a river environment into a lentic environment, modification of water quality (physical or chemical), raising of the water table outside the impoundment area, seasonal reduction of water flows and levels
- fragmentation of habitats: the reservoir and the infrastructure associated with the dam (derivation and outlet channels, penstocks) can fragment terrestrial habitats and migration routes, while the dam and the reservoir can fragment aquatic habitats and migration routes and alter their ecological continuity
- creation of habitats: lake or wetland formation, creation of riparian habitats: reservoirs with no or limited level fluctuations are typically favourable for the development of rich riparian ecosystems, while reservoirs with significant seasonal drawdowns are typically unfavourable for the development of riparian ecosystems.

For hydropower schemes which have the potential to affect priority biodiversity features, critical habitats, or protected and/or internationally recognised areas, habitat mapping (including priority biodiversity features and critical habitats) should be undertaken before any site disturbance as part of the baseline studies in order to inform the biodiversity screening and the assessment of impacts on biodiversity and the application of the mitigation hierarchy.

Water quality

A change in water quality up and downstream of new hydropower schemes is a determining factor in the evolution of aquatic biodiversity following the construction of the scheme. Based on a baseline assessment of river sediment and water quality, the expected change in water quality should be assessed with a focus on the following aspects:

- sources of pollutants resulting from human activities or of geological origin and the risks they present to the environment or to the public as a result of their ingestion or bio-accumulation (heavy metals, pesticides, hydrocarbons and their derivatives, arsenic, and so on)
- assessment of the biochemical and nutrients balance of large reservoirs with a focus on the risks associated with eutrophication and the formation of an oxycline as a result of stratification (see PR3 – GHG emissions).

Depending on the ecology of the species they support, aquatic and riparian ecosystems are sensitive to a number of physical or biochemical quality parameters of water such as temperature, turbidity, acidity, oxygen content and so on.

Hydropower projects can induce significant changes of these quality parameters and consequently adversely impact the aquatic and riparian biodiversity. Where a hydropower project could result in the degradation of downstream water quality (or in the reservoir) that significantly threatens the biodiversity, mitigation measures should be developed.

Minimum flow

River reaches whose flow regime is significantly modified as a result of the construction or operation of a hydropower scheme should be subject to an assessment of minimum flow requirements.

This assessment should be based on a comprehensive assessment of the risks that the flow regime change is expected to cause to people or ecosystems.

Based on flow calculations, the minimum flow requirements should allow mitigating such risks, possibly in association with other structural or operational mitigation measures. The minimum flow requirement may vary by season according to the ecosystem needs. The minimum flow requirement is specific to each project and the species that individual riverine habitats support, as well as other social and environmental sensitivities.

Where minimum environmental flow requirements are specified by the legislation, the legal minimum flow value should be assessed against ecosystem needs with the aim to achieve no net loss of biodiversity. Environmental flow values higher than the legal minimum flow might be required at specific times of the year. It is important that such considerations are discussed with the technical advisers and the project economists to ensure economic viability and sustainable development of a project.

Aquatic biodiversity

A good understanding of the nature of aquatic ecosystems (habitats, riparian flora, macroinvertebrates, fish, aquatic and semi-aquatic mammals and amphibians) is the basis for an assessment of the impacts of a hydropower scheme on these ecosystems.

The construction of hydropower schemes can significantly affect aquatic ecosystems. River works are a particular issue because of the potential impacts they have on the sediments load or on organisms that live in the bed load. After commissioning, the transformation of a river environment into a lentic environment as well as the changes of water quality and sediments transport may be beneficial to certain life stages or species of fish and detrimental to others. Dams or reservoirs can also create a barrier for migratory fish species moving upstream, while penstocks, turbines and spillways can injure or kill fish moving downstream.

Fish population protection

Where appropriate, hydropower schemes should be designed and operated to minimise negative impacts on the existing fish populations, taking into account habitats associated with refugia, feeding, spawning, overwintering, and so on.

This can be achieved through a mix of structural measures (for example, fish passages/fish ladders, protection grids at intakes, low mortality turbines, fish diverters, and the enhancement or creation of instream habitats) and operational measures (minimum environmental flow, limitation of flow variations, river works or sediments flushing during spawning season, fish stocking programmes).

Regardless of the mitigation measures applied, each project should be designed on the basis of a robust aquatic biodiversity baseline, an assessment of the hydraulic and hydrological changes resulting from the hydropower development and an understanding of the fish ecology.

When required, fish passage and minimum environmental flow should be designed to meet the migration needs and the swimming capacity of the local fish populations. Wherever possible, fish passage that reproduces natural channels (naturalised fish path) should be the preferred option.

Adaptive management

The ecology of fish species is either insufficiently documented by available scientific information (in some cases); subject to geographic variability and therefore can be site specific; or can change as a result of adaptation or resilience of fish to the changes induced by the construction of a hydropower scheme.

Taking this into account, and wherever a priority or a sensitive biodiversity feature is potentially affected, a precautionary approach referred to as "adaptive management" is recommended. This approach includes the following:

- incorporating structural and operational mitigation measures in the design and construction works that are tailored for the fish population and meeting international good practices
- the appropriate maintenance of mitigation structures to ensure their functionality (for example, the attractiveness and navigability of fish ladders)
- the monitoring of fish populations throughout project development (before, during and after construction) in order to document residual impacts
- modifications of the structural components or of the operation of the hydropower scheme where deemed necessary, to mitigate significant unexpected impacts if any
- ensure no net loss and preferably a net gain of priority biodiversity features (or critical habitat) over the long term to achieve measurable conservation outcomes.

Terrestrial biodiversity

The loss of terrestrial biodiversity resulting from the construction of hydropower schemes should be mitigated or compensated through appropriate measures including:

- the capture and release of large mammals, protected terrestrial species and/or slow moving animals potentially affected by, or trapped on islands during reservoir impoundment
- the identification of risks of specific habitats losses and, if required, their mitigation following the mitigation hierarchy as defined in the EBRD's ESP
- reinstatement of temporary sites and project affected areas (construction sites, worker accommodation, laydown yards)
- reforestation to compensate for the loss of forested areas in terms of carbon content and biodiversity value.

Legally protected and internationally recognised areas

If HPPs are located in or close to protected areas (as defined in PR6 paragraph 19), the client must identify and assess potential project-related impacts and apply the mitigation hierarchy so that impacts from the project will not compromise the integrity, conservation objectives and/or biodiversity of such an area.

Specifically, the client must:

- demonstrate that any proposed development is legally permitted, which may have entailed that a specific assessment of the project-related impacts on the protected area has been carried out as required under national law

- act in a manner consistent with any government-recognised management plans for such areas
- consult protected area managers, relevant authorities, local communities and other stakeholders on the proposed project in accordance with PR10
- implement additional programmes, as appropriate, to promote and enhance the conservation objectives of the legally protected or internationally recognised area.

PR7 - Indigenous Peoples

Land use and environmental changes

When planning hydropower schemes, developers should identify whether the project's region is permanently, seasonally or occasionally used by indigenous peoples, and to what extent the project may affect this use of land or resources. Particular attention should be given to the following aspects:

- the loss of traditional land, livelihoods and subsistence
- the loss of access to resources or productive means
- the loss of sites having a cultural value
- changes in the cultural life of the indigenous peoples
- for pastoral or transhumant people, the loss of pastoral or transhumance routes and the risks associated with the use of fords downstream from hydropower schemes
- the early identification of benefit-sharing opportunities (PR7, paragraph 20).

Interaction with the workforce

The influx of workers for the construction of a hydropower scheme presents a number of risks for indigenous peoples that should be anticipated at the project preparation stage and might require specific measures. This includes in particular:

- the risk of exploitation of the vulnerabilities of indigenous peoples
- identification of cultural significance or sites associated with the water body or bodies that will be affected by the project
- increased use of natural resources by project workers
- any language or technical literacy issues that should be accommodated in order to provide meaningful comments on the project and how they may be impacted
- exposure to diseases carried by the influx of people to the area (workforce, increased economic activity or opportunists)
- risks of conflicts and grievances and how they will be handled in a culturally appropriate way
- psychosocial stress factors of significant temporary or permanent changes to the environment or population.

PR8 - Cultural Heritage

Systematic search

A particular feature of hydropower scheme is that the reservoir footprint can be significantly larger than the worksite footprint. In this context, a “chance find” procedure should be prepared for all construction activities that involve earthworks. In addition, if the area is known to be associated with cultural heritage, the assessment should include a systematic identification for cultural sites in the reservoir area:

- in liaison with the competent authorities and project affected communities for the identification of sites that are being used, were recently or traditionally used, or are known to exist
- through a systematic search directed by experienced specialists for the identification of potential archaeological sites and vestiges.

It should be noted that cultural heritage can be intangible, as well as tangible, and this can be particularly true for the significance of water to a culture or population, including indigenous peoples.

Culturally sensitive sites

Graves, cemeteries, places of worship, sacred sites and other culturally sensitive assets located in the reservoir area of a hydropower project can be either relocated (in order to avoid their inundation) or left in place. This question should be discussed and agreed with the affected families or communities and with the religious and administrative authorities, taking into account the cultural context. Whatever approach is selected, specific ceremonies may need to be organised with the involvement of affected stakeholders and authorised representatives, which should be anticipated and carefully planned and communicated.

Cultural significance of river systems

Where a new hydropower project is planned, the developer should as a result of the baseline studies get an understanding of the cultural significance for the population of the river systems. In case the river has a significant cultural importance for a local community, early engagement with this community should be organised in order to understand the project's potential impacts and agree mitigation measures.

Visual impacts

Visual impacts of hydropower schemes and their associated facilities have to be considered during the siting and designing stages, in consultation with local communities and users of the water body where possible. This issue should be addressed taking into account the importance of landscapes for both occasional visitors (tourists, pilgrims) and the people who live in the project area and may have a spiritual link to the landscape where the project is being developed.

PR9 - Financial Intermediaries

The EBRD provides specific credit lines for renewable energy projects through financial intermediaries (FI) such as local banks and investment funds.

This guidance note is also intended to be applied by FIs and their clients. For FIs financed by the EBRD, specific questionnaires that have been developed by the EBRD for small hydropower projects should be used in addition to this guidance note. Under the 2014 ESP, Category A hydropower sub-projects financed by FIs should be referred to the EBRD and will need to meet PRs 1 to 8 and 10.

PR10 - Information Disclosure and Stakeholder Engagement

Stakeholder identification and engagement

The identification of stakeholders potentially affected by or interested in a hydropower scheme development should take into account the different project stages:

- planning and design
- construction or rehabilitation period
- operation
- emergency situations.

There may be different stakeholder groups at different stages of the project. It should also be understood that the stakeholders affected by the project may not all be proximal to the project, and this should be included in the assessment and stakeholder mapping. Users of the water body affected may include tourists or recreational users (for fishing, swimming, boating) who live remotely. The Stakeholder Engagement Plan (SEP) should identify relevant stakeholder groups and clarify how communication will be undertaken.

Construction period

The construction of a hydropower scheme typically requires all the information disclosure and stakeholder engagement activities that apply to large worksites. Consultation is essential in the planning and construction phase, particularly if resettlement is required. A good SEP for a hydropower construction period should ensure, before construction starts, that:

- stakeholders and their information needs are clearly identified and addressed, taking into account the entire construction schedule and both temporary and permanent sites
- affected population and vulnerable persons/groups are identified on the basis of a good understanding of the project's impacts (not limited to people living in the reservoir area)
- people receive objective information about the potential negative impacts and benefits/opportunities associated with the hydropower scheme in terms of livelihood or employment and environmental and social impacts
- the risks and disturbances associated with the construction period are communicated to affected stakeholders
- a readily accessible grievance mechanism is put in place and communicated.

Operation related risks

The operation of hydropower schemes can present a number or risks (see PR4 Downstream risks) which can be addressed through effective engagement and information disclosure with stakeholders through implementation of the project's stakeholder engagement plan. A wide variety of guidance exists on stakeholder engagement and planning. For hydropower plant operation, the routine communication and education of potentially affected stakeholders is critical to protect the public against the risks associated with the hydropower plant operation (as identified under PR4).

These communications may include a variety of methods such as:

- informative documents disclosure (brochures, videos, leaflets) in public buildings and through the web
- regular open days for the HPP, including school visits
- presentations at local schools and community organisations, particularly in advance of seasonal changes in water levels and to remind people of warning signs and alarms (as relevant) prior to sudden changes in levels
- information of the public about planned operations presenting a risk through local media, a website or a hotline
- proactive and regular identification and engagement with potentially impacted downstream users in order to provide them with relevant information through appropriate means
- communication for users of the waterbody who do not live locally through appropriate channels (such as regional or commercial tourism information)
- regular visits of the river to identify new or unexpected river uses
- review and communication of emergency plans following any incident or drill
- signs at all access points to the dangerous reaches of the river
- informative outdoor posters at key locations such as touristic or recreational sites, crossings for people on foot or with livestock or vehicles.

Disclosure of environmental parameters

In application of good international practices and in order to meet the objectives of both the EU water framework directive and the UNECE Aarhus Convention, the environmental data monitored by hydropower schemes should be disclosed in an appropriate format to the public through, for example, a dedicated page on the client's website.

This requirement includes in particular the disclosure of:

- inflow, outflow and reservoir level data
- meteorological parameters measured at the site
- physical and chemical quality parameters monitored in the operator
- planned dam releases.

Emergency related information

The operator of a hydropower scheme is expected to prepare an emergency prevention and response plan (see PR4 – Emergency Plan and Response) and share key information such as flooding maps with the authorities in charge of civil security.

A summary of emergency related information (action plans, early warning, alarm sounds, and so on) should be shared with the public regarding public safety, as agreed with the relevant authorities.

Grievance mechanism

The developer or operator of a hydropower project should establish and maintain effective grievance mechanisms, one for all workers, including contractors, and one for external stakeholders (such as populations, water body users, civil society organisations) as early as possible but certainly before construction activities start.

This is particularly important for people who access the river or where exclusion zones around the impoundment area are set. The grievance mechanism for the public should remain readily accessible by external stakeholders during the entire project lifetime. It should routinely be included in information about the project and the operation of the HPP.

Monitoring information and reporting

For projects requiring environmental and social impact assessments, routine information should be made available to the public, including an annual report on environmental and social performance, implementation of commitments in action plans. The stakeholder engagement plan for the construction phase will likely be considerably different than the one for operations. While the first SEP will go out for consultation, later SEP updates may go out for information only, or for consultation if public input is desired.

Annex I: Example of source material in the public domain

The 2014 EBRD ESP refers to a range of industry, trade or other widely accepted standards and guidelines, defined as good international practices (GIP). Regarding the hydropower sector, the following are examples of documents available in the public domain and contain recommendations that can be referred to as examples of GIP.

- The Sustainability Guidelines of the International Hydropower Association (http://www.sustainablehydropower.org/site/info/aboutsustainability.html)
- The Sustainability Assessment Protocol of the International Hydropower Association (https://www.hydropower.org/topics/featured/hydropower-sustainability-assessment-protocol)
- The Hydropower Good Practices of the International Energy Agency (Annex VIII of the Hydropower Implementing Agreement (http://www.ieahydro.org/publications/iea-hydro-reports)
- The bulletins of the International Commission On Large Dams (http://www.icold-cigb.org/GB/Publications/bulletin.asp)
- The EU guidance document no.31 "Ecological flows in the implementation of the Water Framework Directive" (http://ec.europa.eu/environment/water/water-framework/facts_figures/guidance_docs_en.ht)
- The Good Practices for the collection of Biodiversity Baseline Data, as well as the Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning prepared by the Multilateral Financing Institutions Biodiversity Working Group and Cross-Sector Biodiversity Initiative (http://www.ebrd.com/who-we-are/our-values/environmental-and-social-policy/implementation.html%20)
- The Fishbase website: http://fishbase.org