Overseas Private Investment Corporation
Environmental Guidance
Renewable Energy – Hydro Projects

September 24, 2012

Acknowledgements

These guidelines were developed with the technical support of:

Knight Piésold and Co.

1999 Broadway, Suite 600
Denver, Colorado 80202 USA
Telephone: (303) 629-8788
Facsimile: (303) 629-8789
E-mail: *denver@knightpiesold.com*

Overseas Private Investment Corporation
Environmental Guidance
Renewable Energy – Hydro Projects

Table of Contents

Page

Section 1.0 - Introduction 1-1
1.1 Project Definition 1-1
1.2 Summary of Significant Issues 1-1
1.3 Scope of the Guidelines 1-2

Section 2.0 - Standards and Guidelines 2-1

Section 3.0 - Screening 3-1
3.1 Categorically Prohibited 3-1
3.2 Category A or Category B 3-2

Section 4.0 - Significant Issues and Applicable Guidelines and Standards 4-1

Section 5.0 - Information Needed from Project Applicant 5-1

Section 6.0 - Monitoring Recommendations 6-1

Section 7.0 - Resources 7-1

Section 8.0 - Glossary of Terms - Hydro 8-1

Appendices

Appendix A Flowchart

Overseas Private Investment Corporation
Environmental Guidance
Renewable Energy – Hydroelectric Projects

Section 1.0 - Introduction

1.1 Project Definition

These guidelines apply to projects that generate hydroelectricity. Hydroelectric energy is energy recovered from the potential and kinetic energy associated with a water resource. The output of energy is determined by the available flow (discharge) and the vertical distance the water falls (head). In conventional hydroelectric facilities, water builds up behind a dam and creates a reservoir. The water accumulates potential energy in the reservoir. This is transformed into mechanical energy when the water is discharged through a pipe called a "penstock" or a sluice and strikes the blade of a water turbine. The turbine rotation spins electromagnets which generates current in stationary coils of wire. The current is then run through a transformer which steps up the voltage for long distance transmission. Water that is run through the turbine is discharged to the river though a pipe (or "tailrace") or a sluice.

In addition to hydroelectric projects that require the construction of a new large dam and storage reservoir, other types of hydroelectric projects include retrofits or upgrading of existing facilities, pumped storage, low-head hydropower (also called small- and mini- hydros) and "run-of-the-river" facilities.
Retrofits and upgrades on existing hydroelectric facilities typically involve modernizing and upgrading turbines and generators to increase their efficiency and/or electrical output. Other options include adding new generation units at an existing reservoir to increase power output.

Pumped storage facilities move water between reservoirs at different elevations. During periods of low electricity demand, excess electricity capacity is used to pump water from the reservoir at the lower elevation to the reservoir at the higher elevation. During periods of peak electricity demand, water from the higher elevation is used to drive the water turbine and generate electricity.

Low-head hydropower relies on a small elevation drop to generate a small amount of electricity.

"Run-of-the-River": electrical power stations are those with very small or no reservoirs. Water is transported through the penstock to the turbine, which is located at a lower elevation. A small dam or "weir" is required to divert the water to the penstock.

Inter-basin water transfers are man-made conveyance schemes which move water from one river basin where it is available, to another basin where water is less available or could be utilized better for human development. The purpose of such designed schemes can be to alleviate water shortages in the receiving basin, to generate electricity, or both.

Hydroelectric generation projects also include any associated infrastructure or ancillary facilities associated with the Project, including those that are not funded as part of the Project (funding may be provided separately), but whose viability and existence depend exclusively on the Project and whose goods and services are essential for the successful operation of the Project. These may include transmission lines, access roads, and temporary-worker housing.

1.2 Summary of Significant Issues

These guidelines discuss the evaluation features most significant to hydroelectric development projects and reflect many of the guidelines and procedures applied by other international financial institutions.

Although many of these international guidelines and procedures focus on projects that involve the construction of large dams and reservoirs the evaluation features are also relevant to other types of hydroelectric projects. These features include:

- Fragmentation and transformation of aquatic and terrestrial ecosystems as a result of creation of reservoirs, altered downstream flows and alteration of natural flood cycles that may affect biodiversity, habitats, migratory patterns, floodplain ecosystems, and downstream fisheries.
- Greenhouse gas emissions from newly created reservoirs.
- Social consequences including physical and economic displacement of affected communities including indigenous people, loss of livelihood of downstream communities and loss of access to natural resources and cultural heritage.
- Use of the existing water resources as relates to fisheries, water supply, and transportation.
- Safety factors, including: structural stability of the dam, the capacity of the spillway(s) to pass flood flows and potential effects on people downstream.
- Cumulative effects on natural resources, habitat quality, environmental sustainability and ecosystem integrity.

1.3 Scope of the Guidelines

These guidelines present potential environmental and social issues associated with hydroelectric energy projects; how OPIC may consider each of these issues when screening projects; applicable guidelines and standards; recommended measures to mitigate impacts; information needed to review a project; and monitoring recommendations.

These guidelines discuss the evaluation features that in general are most significant with respect to hydroelectric energy projects and therefore require more emphasis while conducting environmental and social due diligence. As each project is unique, these guidelines may not capture the complete set of environmental and social issues related to each hydroelectric project. Each project is distinct and therefore will have environmental and social issues that are associated exclusively with that particular project.

It should be noted that these guidelines do not discuss typical impacts from construction and civil works such as, erosion, impacts to water quality, solid waste disposal, and occupational health and safety but rather emphasize impacts that are unique to the construction of hydroelectric facilities, including dams, reservoirs and water diversion structures. For additional guidance on these generic construction impacts, please refer to IFC's General Environmental, Health and Safety Guidelines (2007) (Please refer to Section 2.0: Standards and Guidelines).

Section 2.0 - Standards and Guidelines

In addition to applicable host country requirements, hydroelectric projects are assessed against:

- OPIC's Environmental and Social Policy Statement (2010).
  http://www.opic.gov/sites/default/files/consolidated_esps.pdf

- International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability (2012).
  http://www.ifc.org/ifcext/policyreview.nsf/Content/2012-Edition#PerformanceStandards

- Applicable provisions of IFC's General Environmental Health and Safety Guidelines, including the following:

  1. **Environment**
     Section 1.1 Air Emissions and Ambient Air Quality
     Mobile Sources - Land-based
     Section 1.3 Wastewater and Ambient Water Quality
     Section 1.6 Waste Management
     Section 1.7 Noise
  2. **Occupational Health and Safety**
     Section 2.1 General Facility Design and Operation
     Section 2.2 Communication and Training
     Section 2.3 Physical Hazards
     Section 2.7 Personal Protective Equipment
     Section 2.9 Monitoring
  3. **Community Health and Safety**
  4. **Section 3.1 Water Quality and Availability**
     Section 3.2 Structural Safety of Project Infrastructure
     Section 3.4 Traffic Safety
     Section 3.6 Disease Prevention
     Section 3.7 Emergency Preparedness and Response
  5. **Construction and Decommissioning**
     Section 4.1 Environment
     Section 4.2 Occupational Health and Safety
     Section 4.3 Community Health and Safety

  http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS/$FILE/Final+-+General+EHS+Guidelines.pdf

Other guidelines relevant to ancillary infrastructure include applicable provisions of:

- IFCs Environmental, Health and Safety Guidelines for Electrical Power Transmission and Distribution.
  http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_ElectricTransmission/$FILE/Final+-+Electric+Transmission+and+Distribution.pdf

- IFCs Environmental Health and Safety Guidelines for Toll Roads.

http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_TollRoads/$FILE/Final+-+Toll+Roads.pdf

- Workers' Accommodation: Processes and Standards: A Guidance Note by IFC and the EBRD.
  http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_WorkersAccommodation/$FILE/workers_accomodation.pdf

IFC has not issued sector-specific environmental, health and safety guidelines for hydroelectric power projects. Other sources of information that are used to inform decision-making, but not used as strict standards include:

- U.S Federal Energy Regulatory Commission 18 CFR Subchapter B.
- Dams and Development. The Report of the World Commission on Dams (WCD) (http://www.unep.org/dams/WCD/).
- Technical publications of the International Commission on Large Dams (http://icold-cigb.net/)
- World Bank Operational Policy 4.37: Safety of Dams (2001) (http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTOPMANUAL/0,,contentMDK:20064653~menuPK:64701637~pagePK:64709096~piPK:64709108~theSitePK:502184,00.html)
- World Bank Procedures 4.37: Safety of Dams (2001) (http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTOPMANUAL/0,,contentMDK:20064589~menuPK:64701637~pagePK:64709096~piPK:64709108~theSitePK:502184,00.html)
- World Bank Procedures 4.37, Annex A, Dam Safety Reports: Content and Timing (2001)(http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTOPMANUAL/0,,contentMDK:20066577~menuPK:64701637~pagePK:64709096~piPK:64709108~theSitePK:502184,00.html)
- "Dams and Development", The Report of the World Commission on Dams (November 2000)

Note: International organizations, the United States Government and Industry Groups periodically revise guidelines and standards to reflect technological advances and improved understanding of environmental, health, safety and social risks. Complete applications that are received before the effective date of a new guideline or standard will be assessed against the guideline or standard in effect on the date of application, provided OPIC commitment to provide support is achieved within one year of the effective date of the new guideline or standard. If commitment is not achieved within one year after the effective date of the new guideline, the project will be subject to the new guideline.

Section 3.0 - Screening

Based on information received from the project applicant for the purposes of environmental, health and safety review, OPIC screens projects in the hydroelectric power sector into 1 of 3 categories: Categorically Prohibited, Category A, and Category B. For projects involving the construction and operation of dams, OPIC applies screening and environmental assessment criteria that incorporate core values and strategic priorities identified in the Report of the World Commission on Dams (WCD) (2007) http://www.unep.org/dams/WCD/. OPIC has adopted and implemented those elements of the WCD policy that inform good public policy and that are within OPIC's capacity to implement.

3.1 Categorically Prohibited

Hydroelectric power projects can result in adverse impacts that may preclude OPIC support. Specifically, OPIC will not support projects involving the construction of dams that significantly and irreversibly:

- Disrupt natural ecosystems upstream or downstream of the dam;
- Alter natural hydrology;
- Inundate large land areas;
- Impact biodiversity;
- Displace large numbers of inhabitants (5,000 persons or more); or
- Impacts local inhabitants' ability to earn a livelihood.

In determining whether a project involving the construction of a dam is categorically prohibited OPIC considers the following factors:

- *Disrupt Natural Ecosystems.* Disruption of natural ecosystems may result from barring passage of anadromous (migratory) fish, restricting the mobility of terrestrial species, modifying the timing and concentration of nutrient releases downstream, reducing or eliminating downstream flow, or reducing or permanently inundating critical or sensitive terrestrial habitat. Additional guidance may be found in WCD Guideline 14 (Baseline Ecosystem Surveys) and Guideline 16 (Maintaining Productive Fisheries).
- *Alter Natural Hydrology.* Alteration of natural hydrology may result from the elimination of, or significant reduction or increase in, stream flow, significant alteration of diurnal or annual stream flow, modification of groundwater levels, or induced seismicity. Additional guidance may be found in WCD Guideline 4 (Strategic Impact Assessment) and WCD Guideline 12 (Operating Rules).
- *Inundate Large Land Areas.* A simplified cost-benefit analysis is used to assess whether an unreasonably large land area is inundated relative to the power generated. Additional guidance may be found in WCD Strategic Priority 2 (Comprehensive Options Assessment).
- *Impact Biodiversity.* Impacts on biodiversity may result from ecosystem and habitat impacts elimination or reduction of habitat due to land-take, or the increased potential for species exploitation due to improved access to the site. Additional guidance may be found in WCD Policy Principle 4.4 (Avoiding Significant Impacts on Threatened and Endangered Species).
- *Displace Inhabitants.* Evaluation of this impact is based on a quantitative threshold (5000 person displacement). Additional guidance may be found in WCD Guideline 19 (Mitigation, Resettlement and Development Action Plan).
- *Impact on Local Inhabitants' Livelihoods.* Impacts on livelihoods may result from impairment or elimination of traditional hunting or fishing methods, elimination of scarce agricultural lands, elimination of access to drinking or irrigation water, or Project-related increases in endemic diseases. Additional guidance may be found in WCD Strategic Priority 1 (Gaining Public Acceptance), Strategic Priority 2 (Comprehensive Options Assessment), Strategic Priority 4 (Sustaining Rivers and Livelihoods), Policy

Principle 4.1 (Basin-Wide Understanding of Ecosystem and Livelihood Issues), Policy Principle 4.2 (Precautionary Approach), and Policy Principle 4.5 (Release of Environmental Flows).

In addition to the factors above related to the construction of dams other adverse impacts may preclude OPIC support. Project location is the primary determinant of eligibility. OPIC will not support the following types of projects:

- Projects that involve conversion or degradation of Critical Forest Areas or forest-related Critical Natural Habitats.
- Projects that require resettlement of 5,000 or more persons.
- Projects in or impacting natural World Heritage Siteshttp://whc.unesco.org/en/listunless it can be demonstrated through an environmental assessment that the project (i) will not result in the degradation of the protected area and (ii) will produce positive environmental and social benefits.
- Projects in or impacting areas on the United Nations List of National Parks and Protected Areas http://www.unep-wcmc.org/un-list-of-protected-areas_269.html

  unless it can be demonstrated through an environmental assessment that the project (i) will not result in the degradation of the protected area and (ii) will produce positive environmental and social benefits.
- Extraction or infrastructure projects in or impacting: protected area Categories I, II, III, and IV (Strict Nature Reserve / Wilderness Areas and National Parks, Natural Monuments and Habitat / Species Management Areas), as defined by the International Union for the Conservation of Nature (IUCN). Projects in IUCN Categories V (Protected Landscape / Seascape) and VI (Managed Resource Protected Area) must be consistent with IUCN management objectives

  http://www.iucn.org/about/work/programmes/pa/pa_products/wcpa_categories/

  http://www.iucn.org/about/work/programmes/species/red_list/

  unless it can be demonstrated through an environmental assessment that the project (i) will not result in the degradation of the protected area and (ii) will produce positive environmental and social benefits.

If not prohibited, then the hydroelectric project is further screened and categorized in either Category A or Category B.

3.2 Category A or Category B

Category A hydroelectric projects are likely to have significant adverse environmental and social impacts that are irreversible, sensitive, diverse or unprecedented. Category A projects require submission of an Environmental and Social Impacts Assessment (ESIA) developed in accordance with IFC P.S. 1, an on-site due diligence visit by an OPIC environmental analyst or a third party consultant approved by OPIC and development and implementation of an Environmental and Social Action Plan (ESAP). Within three years of the execution of the contract with OPIC, Category A projects are required to conduct a third party audit.

Issues that require careful consideration in determining whether a project is Category A or B for hydroelectric projects include the following:

- Potential for significant socio-cultural impacts including economic or physical displacement and impacts on cultural heritage that cannot easily be mitigated.
- Potential for impacts on lands and natural resources subject to traditional ownership or customary use by Indigenous People.
- Potential for trans-boundary impacts.

- Potential for impacts on threatened, endangered or endemic species habitats.
- Potential for significant reductions or increase in river flow that result in adverse impacts on downstream water access or habitats.
- Potential for induced seismicity.
- Significant public opposition as a result of lack of participatory consultation or transparency.
- Significant adverse cumulative impacts.
- Significant adverse impacts from the construction of associated infrastructure (e.g., roads, transmission lines).

If a project originally screened as a Category A project is subsequently found to result in major or unreasonable adverse impacts on the environment, health, or safety, OPIC may decline support.

Modifications of project design, advanced planning in siting, and operation mode may be used to avoid or significantly reduce adverse impacts of hydroelectric projects. A hydroelectric project may be screened as Category B if potential impacts are avoided or, adequately mitigated and sufficient information is provided to assess such impacts, and there is no significant opposition to the Project by local stakeholders.

Hydroelectric projects may be screened as Category B include: retro-fitting or upgrading of existing facilities; small additions to capacity at existing facilities; and low head hydropower facilities.

Note: For all eligible hydroelectric projects that involve the construction of a new dam, OPIC requires that experienced and competent professionals design and supervise construction and that the project adopt and implement dam safety measures throughout the project life cycle. In projects involving existing dams, OPIC may require a third-party dam safety assessment prior to and/or following construction.

Section 4.0 - Significant Issues and Mitigation Measures

This section describes environmental and social evaluation features associated with hydroelectric projects, how each of these features may affect screening determinations, and measures to mitigate impacts as provided in applicable guidelines and standards.).

4.1 Presence of Critical or Sensitive Habitat on, adjacent to or downstream from the site

Description of Impact. Impacts to habitat due to the siting of hydropower projects will vary greatly depending on location, but hydropower projects represent the potential for fragmentation and transformation of aquatic and terrestrial ecosystems as a result of creation of reservoirs, altered downstream flows and alteration of natural flood cycles that may affect biodiversity, habitats, migratory patterns, floodplain ecosystems, and downstream fisheries. The construction of storage dams and the subsequent inundation of the reservoir area eliminate terrestrial plants and forests and displace animals that are dependent on those plants. Large scale impoundments often eliminate unique valley bottom habitat, which may represent critical habitat for endangered species. Population numbers may also be reduced when animals become trapped and drowned during reservoir filling.

The extent of impacts on aquatic habitat depends on the change in flow rate, the quantity and character of sediment in motion in the channel, and whether water is extracted or diverted for consumption or left in-stream. Varying frequencies and volumes of releases may result in fluctuations in downstream water levels and surges that are not well tolerated by river species. The natural variability of most river systems sustains complex biological communities that may be very different from those adapted to the stable or intermittent flows of a regulated river. As a physical barrier, a dam may disrupt the movement of aquatic species, including anadromous fish, leading to changes in upstream and downstream species composition and possible species loss.

Screening. OPIC cannot support hydroelectric projects that disrupt natural ecosystems upstream or downstream of a dam; alter natural hydrology; or inundate large land areas. In addition, OPIC cannot support projects that convert or degrade Critical Forest Areas or forest-related Critical Natural Habitats. Projects that have the potential to result in significant (non-critical) habitat alteration may be classified as Category A. The extent of impact and species located in or near the habitat are considered in determining the classification of the Project.

Impact Mitigation. Examples of recommended mitigation measures include the following:

- Siting to avoid critical habitat and avoidance of placing large dams on the main-stem of a river system.
- Rescue and replanting of protected plant species from terrestrial habitat eliminated by reservoir creation.
- Establishment and maintenance of minimum flows in the river to meet downstream needs of the environment and people.
- Consider the efficacy of fish passes to reduce impacts on migratory fish.
- Consider restoring downstream ecosystems through managed floods.
- Compensate for terrestrial habitat eliminated by reservoir creation by establishing managed habitat elsewhere. (Note: OPIC does not consider offsets as acceptable mitigation for critical habitat elimination).

Physically rescuing animals from the area to be flooded or by anticipating that mobile species will move to neighboring areas have generally not proven to be effective mitigation strategies.

4.2 Greenhouse Gas Emissions from Newly Created Reservoirs

Description of Impact. Reservoirs emit greenhouse gases due to rotting vegetation and carbon in-flows from catchment areas. Decomposition and gas generation rates are dependent on many factors, including reservoir and catchment characteristics. All large reservoirs and natural lakes in boreal and tropical areas emit some greenhouse gases, although emissions are greatest from large, shallow tropical impoundments where vegetation has not been removed prior to filling. Emissions from these reservoirs have been recorded as exceeding 1 million tons CO_{2eq}/year.

Screening. Projects that result in Direct Greenhouse Gas Emissions of more than 100,000 (short) tons (91,000 metric tonnes) of CO_{2eq}/year are classified as Category A.

Impact Mitigation. Pre-inundation removal of vegetation is a required mitigation measure.

4.3 Social Consequences

Description of Impact. Social consequences of hydroelectric projects include physical and economic displacement of affected communities, including Indigenous Peoples, loss of livelihood of downstream communities and loss of access to natural resources and cultural heritage.

Physical displacement (the need for resettlement) may result from the need to inundate land for reservoirs, but also from the installation of project facilities and associated infrastructure, such as transmission lines. The inundation of land and alteration of river ecosystems – whether upstream or downstream – may affect the resources available for land- and river-based productive activities and often results in loss of access to traditional means of livelihood. These traditional forms of livelihood include agricultural production, fishing, livestock grazing, fuel wood gathering and collection of forest products. Not only does this loss of access to livelihoods disrupt local economies but may indirectly displace people because of the need to access natural resources and other traditional inputs to their livelihoods. Indigenous Peoples are particularly vulnerable.

Potential health impacts on affected communities include increased exposure to vector-borne diseases associated with reservoir development in tropical areas including Schistosomiasis (Bilharzias), Rift Valley Fever, malaria and Japanese encephalitis. Cases of mercury accumulation have also been documented in some reservoir fish. Other health concerns are related to potential transmission of HIV/AIDS in construction and resettlement areas.

Screening. OPIC will not support hydroelectric projects that displace large numbers of inhabitants (5,000 persons or more) or impact local inhabitants' ability to earn a livelihood. Land acquisition procedures, physical or economic displacement and changes in land use are factors considered in screening projects as Category A or B. Information regarding land ownership, and in some cases past ownership, as well as existing and adjacent land use, can assist in determining if effects in the area would result in a Category A or B classification.

Impact Mitigation. The principle mitigation strategy is to minimize land take that results in physical or economic displacement through changes in design and siting. Land should be acquired on a voluntary basis and at market rates through negotiated settlements with current land owners and tenants. For projects that involve involuntary physical or economic displacement or result in expropriation, land must be acquired and compensation provided in accordance with IFCs Performance Standard 5 (Land Acquisition and Involuntary Resettlement) and where Indigenous Peoples are affected, IFCs Performance Standard 7 (Indigenous Peoples). The resettlement, compensation and community consultation processes and agreements must be clearly documented.

Mitigation strategies for managing the health impacts of reservoirs include minimizing vector habitat through reservoir level management, locating settlements far from vector habitat, provision of health screening and management services and vector eradication strategies.

4.4 Water Use

Description of Impact. Large storage reservoirs and river basin diversion projects reduce the volume of water available to downstream users of the resource, including use for irrigation and drinking water. Flow reductions may also result in degraded water quality – both due to increased sediment and decreased ability of the receiving stream to effectively absorb pre-existing waste discharges such as sewage. Substantial losses in downstream fisheries may occur due to blockage of sediments and nutrients, re-regulation of flow and elimination of natural flood cycles. Sufficient in-stream flows must be maintained to support downstream water transport use.

Hydropower storage projects also can alter groundwater levels. Large impoundments may result in depression of the groundwater table downstream of the dam due to reduced aquifer recharge from the river. Depressed water tables, particularly during the dry season, may result in elimination of drinking water sources, Depending on the geology of the area, a depressed water table also may result in subsidence-related property damage.

Screening. OPIC cannot support hydroelectric projects that adversely impact local inhabitants' ability to earn a livelihood, including downstream users that depend on the water resource for fishing and agriculture. The ability to mitigate downstream water use impacts can affect a project's classification as Category A or Category B.

Impact Mitigation. Sufficient in-stream minimum flows must be maintained to support existing downstream water users. Periodic releases from large reservoirs may be useful in increasing the sediment and nutrient flows to downstream fisheries. It may be necessary to consider compensatory measures, including providing monetary support for downstream hatcheries and stacking programs and waste treatment facilities.

Minimum downstream flows partially may mitigate depressed water levels downstream. In some cases it may be necessary to compensate well owners to dig deeper wells.

4.5 Safety and Structural Stability

Description of Impact. Dams pose an implicit downstream flood hazard in the event of catastrophic failure. Downstream flooding also may occur if releases from hydropower projects coincide with seasonal heavy rains or snow melt. Upstream flooding may occur as a result of rapid increases in reservoir backwater due to excess rain or snow melt. Flooding may result in damage to property, crops, livestock and potentially loss of life.

Large reservoirs have been linked to an increased occurrence of seismic tremors. Changes in effective stresses in underlying rock or transmission of hydrostatic pressure through seams of limestone or other porous bedrock may induce seismic activity. Landslides also may occur around the rims of reservoirs resulting in wave surges. Landslides pose a hazard to property along the rim of the reservoir.

Screening. The potential for loss of life or property damage in the area downstream of the dam in the event of failure or incorrect operation is a factor in determining whether a hydropower project is classified as a Category A or Category B. Projects with a high probability of inducing seismicity are classified as Category A.

Impact Mitigation. Flood prevention measures that are determined to be reasonable and prudent are dependent on the level of failure risk selected by project proponents and regulatory authorities in the host country. In general, project design considerations should include prevention of hydrological failure, overtopping by a large inflow flood, piping failure, damage due to seismic activity, reservoir slope instability, structural weakness or a combination of these factors. An independent panel of experts should be employed to verify design standards for high hazard dams.

4.6 Cumulative Impacts

Description of Impact. Many of the major catchments of the world contain multiple dams. Within a basin, the greater the number of dams, the greater the fragmentation of the ecosystem. Multiple dams magnify the changes to flow regimes, water quality and the productivity and species composition of rivers. Upstream dams also impact the risk profile of downstream dams. Major structure failure of upstream dams may damage structural integrity of downstream dams and this must be taken into account in developing flood estimates.

Screening. The additive effects of land use conversion or significant changes to river hydraulics, which may require further study, can result in a project being classified as Category A rather than B.

Impact Mitigation. Cumulative effects on land use may be reduced by the sharing of access roads and transmission lines. Some risks to downstream dams may be reduced by coordinated emergency response actions to more effectively manage extreme floods.

Section 5.0 - Information Needed from Project Applicant

Information that can be supplied by a developer that would assist OPIC in the screening and review of any proposed hydro project includes:

- Physical information relating to the location of the Project.
- Existing hydraulic conditions at the site.
- Available flow duration curves and head.
- The size, type, configuration, and number of hydro generation units, penstocks, spillways, canals, tailraces or other project structures.
- The existing or proposed storage capacity.
- The location of the closest substation or transmission line that can handle the Project.
- Any diversions or disruption of flows anticipated.
- Proposed operation of the Project (plant factor, minimum flows, filling schedule, daily or seasonal storage, ramping rates, flood control etc.).
- Changes during construction and any reservoir filling should be described separately from changes during operations.
- Identification of other dams and flow diversions located within the same river basin.
- Existing land and water use patterns in the Project and adjacent areas, including existing roads, settlements, land uses, fishing, irrigation, agricultural activities, transportation and any other specific uses that could be impacted by the development of a reservoir or hydro facility.
- For landownership, it is important to identify if any land purchases are needed, and if these purchases have been negotiated with existing landowners.
- The results of any community or local landowner communication by the Project sponsor should also be supplied.
- The occurrence of any water-borne diseases that occur in the area or could occur as a result of Project development or operations.
- Biological information related to the proximity of any sensitive, rare, or endangered species, any fish migration requirements, important wildlife habitat areas including Special Protected Areas (SPAs), Important Bird Areas (IBAs) and statutorily designated or qualifying International or National sites for nature conservation including Natura 2000 sites.
- Cultural resources including cultural sites and indigenous peoples.

Section 6.0 - Monitoring Recommendations

- Sponsors must provide a complete record of the process by which facilities were sited, as well as a record of consultation that occurred with stakeholders.
- Review the results of monitoring of inflows, outflows, and water levels.
- Review the results of monitoring and effects on any nearby aquifers or water supply facilities.
- Review the results of any fish population or migration monitoring.
- Review the results of any programs developed to assist people in adapting to the new lacustrine environment.
- Review the results of any dam safety-monitoring program.
- Review the results of any resettlement program established as part of the Project.
- Review of Emergency Action Plan, reporting of any incidents, and identification of responsible staff.
- Confirm that an Occupational Health and Safety Plan has been established and review the results on any self-monitoring.
- Review the Company's environmental management plan, grievance mechanism, monitoring requirements and responsible parties, to ensure monitoring has occurred and records are in place.

Section 7.0 - Resources

Critical habitat on or adjacent to the site. Changes in the hydraulics of the river in the project area and downstream. Land ownership and land use in the project area. Use of the existing water. Socio-cultural issues. Safety factors. Project acceptability. Cumulative effects.	<u>Large Scale Hydro</u> (WCD) World Commission on Dams (2000): Dams and Development: A New Framework for Decision-Making. November 2000. *http://hqweb.unep.org/dams/WCD/report/WCD_DAMS report.pdf* Vovk-Korže A, Korže D, Goltara A, Conte G, Tununni N, Smolar-Žvanut N. (2009): Review of Best Practices/Guidelines for Compensation Measures for Hydropower Generation facilities. http://www.ch2oice.eu/download/public/CH2OICE_D2-2.pdf COFACE (2003): Environmental Guidelines: Hydroelectric power stations and large dams. July 2003. http://www.adb.org/water/topics/dams/pdf/barragesgb.pdf (IEA) International Energy Agency (2000): Implementing Agreement for Hydropower Technologies and Programmes, Annex III: Hydropower and the Environment: Present Context and Guidelines for Future Action. Subtask 5 Report Volume II. May 2000. http://www.ieahydro.org/reports/HyA3S5V2.pdf Government of Canada and the Government of Newfoundland and Labrador (2008): Environmental Impact Statement Guidelines: Lower Churchill Hydroelectric Generation Project, Newfoundland and Labrador Hydro. July 2008. http://www.env.gov.nl.ca/env/env_assessment/projects/Y2010/1305/lower_churchill_final_guidelines_en.pdf (EEPC) Ethiopian Electric Power Corporation (2009): GIBE III Hydroelectric Project: Environmental and Social Management Plan. January 2009. http://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/GIII ESMP.pdf Ledec G, and Quintero J.D. (2003): World Bank: Latin America and the Caribbean Region Sustainable Development Working Paper No. 16: Good Dams and Bad Dams: Environmental Criteria for Site Selection of Hydroelectric Projects. November 2003. http://siteresources.worldbank.org/LACEXT/Resources/258553-1123250606139/Good_and_Bad_Dams_WP16.pdf Locher H. (2004): Hydro Tasmania: Sustainable Hydropower – Information and Communication on Good Practice. October 2004. http://www.un.org/esa/sustdev/sdissues/energy/op/hydro_lochergoodpracticepaper.pdf Ball J, Elston J, Sullivan M, Walker A. (2005): Review of Nam Theun 2 Hydroelectric Dam, Lao PDR: FINAL REPORT TO AUSAID. February 2005. http://www.ausaid.gov.au/publications/pdf/nt2_hydro_report.pdf

	New Energy Foundation, Japan (2001): Hydroelectric Power Development Center. http://www.nef.or.jp/english/info/pdf/ar13.pdf (IHA) International Hydropower Association (2011): Summary of the International Hydropower Association World Congress on Advancing Sustainable Hydropower. June 2011. http://www.iisd.ca/ymb/hydro/iha2011/html/ymbvol139num7e.html Survival International (2010): Serious Damage: Tribal Peoples and Large Dams, A Survival International Report. London, EC1M 7ET, UK. http://assets.survivalinternational.org/documents/373/Serious_Damage_final.pdf USAID Latin America and Caribbean Bureau: Environmental Guidelines, Chapter 6: Environmental Issues and Best Practices for Renewable Energy Systems. Washington, D.C. 20523-1000. http://www.usaid.gov/locations/latin_america_caribbean/environment/docs/epiq/chap6/lac-guidelines-6-renewable-energy.pdf Bratrich C, Truffer B, Jorde K, Markard J, Meier W, Peter A, Schneider M and Wehrli B (2004): Green Hydropower: A New Assessment Procedure for River Management. River Research and Applications 20: 865–882, 2004. http://homepages.eawag.ch/~wehrli/papers/Bratrich_GreenHydro_RiverRes_04.pdf Canadian Energy Research Institute and Environment Canada (2004): Environmental Impacts of Hydro Power. Continental Energy Sector Issues, pg. 28, March 2004. http://www.ec.gc.ca/energie-energy/default.asp?lang=En&n=79B18E90-1 International Bank for Reconstruction and Development / World Bank Group (2009): Directions in Hydropower: The World Bank Group. http://siteresources.worldbank.org/INTWAT/Resources/Directions_in_Hydropower_FINAL.pdf PSI Media (2010): 2011 INDIA Energy Handbook: Demand Driven, Supply Chained. August 2010. http://www.psimedia.info/handbook/India_Energy_Handbook.pdf Ibenholt K (2011): Report 2011/08 from Vista Analysis: International Standards and Principles for the Environmental and social management of renewable energy projects in developing countries. March 2011 http://vista-analyse.no/themes/site_themes/vista/images/uploads/VA_Report_2011-08_International_Standards_RE.pdf

	Rew A, Fisher E, Pandey B. (2000): Addressing Policy Constraints and Improving Outcomes in Development-Induced Displacement and Resettlement Projects: A review prepared for ESCOR and the Research Programme on Development-Induced Displacement and Resettlement. Refugee Studies Centre, University of Oxford. January 2000. http://law.wustl.edu/Library/cdroms/refugee/data/RSC Reports%5CAddressing Policy Constraints.pdf (INFORSE) International Network for Sustainable Energy (2011): Distance Internet Education on Renewable Energy Technology: Hydropower. Gl. Kirkevej 82 DK-8530 Hjortshøj Denmark. http://www.inforse.dk/europe/dieret/Hydro/hydro.html Sangroula D. P. (2009): HYDROPOWER DEVELOPMENT AND ITS SUSTAINABILITY WITH RESPECT TO SEDIMENTATION IN NEPAL. Journal of the Institute of Engineering, Vol. 7, No. 1, pp. 1-9. 2009. http://www.nepjol.info/index.php/JIE/article/download/2063/1892 GHIMIRE, S. (2011): Assessing the Role of Land Tenure in Hydropower Development for Social and Environmental Effects. Geo-Information Science and Earth Observation of the University of Twente, Enschede, The Netherlands, February, 2011. http://www.itc.nl/library/papers_2011/msc/la/ghimire.pdf
Critical habitat on or adjacent to the site. Changes in the hydraulics of the river in the project area and downstream. Land ownership and land use in the project area. Use of the existing water. Socio-cultural issues. Safety factors. Project acceptability. Cumulative effects.	<u>Small Scale Hydro</u> Department of Communications, Energy and Natural Resources: Ireland (2007): Guidelines on the Planning, Design, Construction & Operation of Small-Scale Hydro-Electric Schemes and Fisheries. CFB, Swords Business Campus, Swords Co. Dublin, IE. October 2007. http://www.seai.ie/Renewables/Hydro_Energy/Guidelines_Planning,_design,_construction_operation_of_SS_Hydro.pdf Department of Communications, Energy and Natural Resources: Ireland (2005): Guidelines on the Construction & Operation of Small- Scale Hydro-Electric Schemes and Fisheries: Consultation Document. CFB, Swords Business Campus, Swords Co. Dublin, IE. June 2005. http://www.google.com/url?sa=t&rct=j&q=hydroelectric guidelines&source=web&cd=21&ved=0CBsQFjAAOBQ&url=http%3A%2F%2Fwww.fisheriesireland.ie%2FDownload-document%2F13-Guidelines-on-the-Planning-Design-Construction-Operation-of-Small-Scale-Hydro-Electric-Sc Permanent Secretariat of the Alpine Convention (2011): Alpine Convention: Platform Water Management In the Alps: Common Guidelines for the Use of Small Hydropower In the Alpine Region. http://www.alpconv.org/documents/Permanent_Secretariat/web/ACXI/AC11_B8_2_Guidelines_SHP_en+annexes.pdf

	Kumar A and Verma H. K. (2007): Indian Initiative to Develop Standards, Guidelines and Manuals for Small Hydropower. International Conference on Small Hydropower - Hydro Sri Lanka, October 2007. http://ahec.org.in/links/International conference on SHP Kandy Srilanka All Details%5CPapers%5CPolicy, Investor & Operational Aspects-C%5CC12.pdf Schmitz D. (2006): Developing a methodology for assessing the Sustainable Development impact of Small Scale CDM hydropower projects. HWWA-Report: Hamburg Institute of International Economics, 2006. http://www.econstor.eu/dspace/bitstream/10419/32918/1/521362091.pdf

Section 8.0 - Glossary of Terms - Hydro

Anadromous - Term used to describe fish that ascend rivers returning from the sea for breeding.

Canal - An artificial waterway.

Catchment Area - The area drained by a river that is upstream of a specific point in the river.

Categorically Prohibited Project - A Project where potential adverse environmental or social impacts of the Project preclude OPIC support.

Category A - Category for projects likely to have significant adverse environmental impacts that are sensitive (i.e. irreversible, affect sensitive ecosystems, involve involuntary resettlement, etc.), diverse, or unprecedented. These projects can be readily identified on the basis of industry sector or site sensitivity and require a full-scale EIA or IEAU, as well as an EMMP or ENR.

Category B - Category for projects less-likely to have adverse environmental impacts than Category A projects, where few, if any, of the impacts are likely to be irreversible, site-specific, and mitigation measures can be designed more readily than for Category A projects. Limited environmental review, mitigation, action plans, audits, and hazard assessment need to be incorporated into the Project.

Critical Forest Areas - A type of **Natural Forest** that qualifies as **Critical Natural Habitat**. **Critical Forest Areas** include, but are not limited to, primary **Forests** and old growth **Forests** that may serve as critical carbon sinks.

Critical Natural Habitats - (i) Existing internationally-recognized protected areas, areas initially recognized as protected by traditional local communities (i.e. sacred groves), and sites that maintain conditions vital to the viability of protected areas (as determined by the environmental assessment procedure); and (ii) Sites identified on supplementary lists by authoritative sources identified by OPIC. Such sites may include areas recognized by traditional local communities (i.e. sacred groves), areas with known high suitability for biodiversity conservation and sites that are critical for vulnerable, migratory or endangered species. Listings are based on systematic evaluations of such factors as species richness, the degree of endemism, rarity, and vulnerability of component species, representativeness and the integrity of ecosystem processes.

Cultural Heritage - Tangible property or sites having archaeological (prehistoric), paleontological, ***historical***, cultural, artistic and religious value, as well as unique environmental features that embody cultural values, such as sacred groves. **Cultural Heritage** also includes intangible forms of culture, such as cultural knowledge, innovations and practices of communities embodying traditional lifestyles.

Economic Displacement - Loss of assets or access to assets that leads to loss of income sources or means of livelihood.

Environmental and Social Action Plan (ESAP) - A systematic program designed to prevent, mitigate and monitor anticipated environmental and related human impacts of prospective and ongoing activities. Required on all ***Category*** A projects.

Environmental and Social Impact Assessment (ESIA) - A comprehensive analytical body of work designed to evaluate environmental impacts of major projects having the potential to have significant, diverse and irreversible impacts on the natural environment and on humans dependent on that ***environment***. Required for all Category A projects involving new ("greenfield") developments or significant expansion of existing facilities.

Environmental and Social Management System (ESMS) - Part of a Project's overall management system that includes the organizational structure, responsibilities, practices and resources necessary for implementing ***the*** Project-specific management program developed through the environmental and social assessment of the Project.

Flow - The volume of water passing a point in a given amount of time.

Flow Duration Curve - The measured flows, expressed on a graph, as the percentage of time these flows are exceeded.

Forest - An area of land not less than 1.0 hectare with a tree crown cover (or equivalent stocking level) of more than 10 percent that has trees with the potential to reach a minimum height of 2m at maturity *in situ*. A **Forest** may consist of either closed forest formations, where trees of various stories and undergrowth cover a high proportion of the ground, or open **Forest**. Young natural stands and all plantations that have yet to reach a crown ***density*** of 10 percent or tree height of 2m are included under **Forest**, as are areas normally forming part of the forest area that are temporarily destocked as a result of human intervention such as harvesting or natural causes, but are expected to revert to **Forest**. The definition includes **Forests** dedicated to forest production, protection, multiple uses, or conservation, whether formally recognized or not. The definition excludes areas where other land uses not dependent on tree cover predominate, such as agriculture, grazing or settlements. In countries with low forest cover, the definition may be expanded to include areas covered by trees that fall below the 10 percent threshold for canopy density, but are considered **Forest** under local conditions.

Fragmentation of Habitat - The emergence of discontinuities (fragmentation) in an organism's preferred environment (habitat), causing population fragmentation. Geological processes that slowly alter the layout of the physical environment can cause habitat fragmentation. Sahney, S, Benton, M.J. & Falcon-Lang, H.J. (2010). "Rainforest collapse triggered Pennsylvanian tetrapod diversification in Euramerica" (PDF). Geology 38 (12): 1079–1082. doi:10.1130/G31182.1.

High Hazard Potential Dams- Dams whose failure or mis-operation will probably cause loss of human life, economic loss, environmental damage and disruption of lifeline facilities.

Hydraulic Head - The difference in elevation, and the resulting pressure between two points in a water system; often the difference in elevation between the upstream water body and the tailrace.

Hydro - Harnessing of power from moving water.

Induced seismicity - Earthquake activity that is the result of human activity, which causes a rate of energy release, or seismicity, which would be expected beyond the normal level of historical seismic activity.
http://esd.lbl.gov/research/projects/induced_seismicity/primer.html

Industry Sector Guidelines - Technical reference documents issued by the **International Finance Corporation** with general and industry specific performance levels and measures.

Intake - An opening through which the water enters for subsequent discharge through the powerhouse.

Lacustrine - Relating to, or resembling a lake.

Minimum flow - Traditionally thought of, as the lowest stream flow required protecting some specified aquatic function as established by agreement, rule, or permit.
http://www.dnr.state.mn.us/watershed_tool/glossary.html#m

Natural Forests - Forest lands and associated waterways where the ecosystem's biological communities are formed largely by native plant and animal species and where human activity has not essentially modified the area's primary ecological functions.

Plant factor - The ratio of actual power to be produced compared to the amount of power that would be produced if the facility operated full time at its design capacity.

Penstock - A closed conduit that conducts water to the powerhouse.

Performance Standards - Technical reference documents issued by the **International Finance Corporation** with environmental and social impact management performance criteria.

Physical Displacement - Relocation or loss of shelter.

Project - All facilities owned or controlled within a physical project boundary that constitute a commercially viable business unit eligible for OPIC support.

Project Affected People - Individuals, workers, groups or local communities, which are or could be affected by the project, directly or indirectly, including through cumulative impacts. Emphasis should be placed on those who are directly and adversely affected, disadvantaged or vulnerable.

Ramping rates - The rate of change in discharge downstream of a hydro facility.

Renewable Energy - Energy supplied from renewable energy sources, such as wind and solar power, geothermal, hydropower and Renewable Biomass, not otherwise categorically prohibited, but does not include nuclear power.

Riverine - Relating to, or resembling a river.

Run-of-River - Discharge equals inflow.

Spillway - A passage for surplus water to run over or around a dam.

Storage - Water artificially impounded, on a daily or seasonal basis, for future use.

Storage capacity - The amount of water that can be stored in the reservoir for future use.

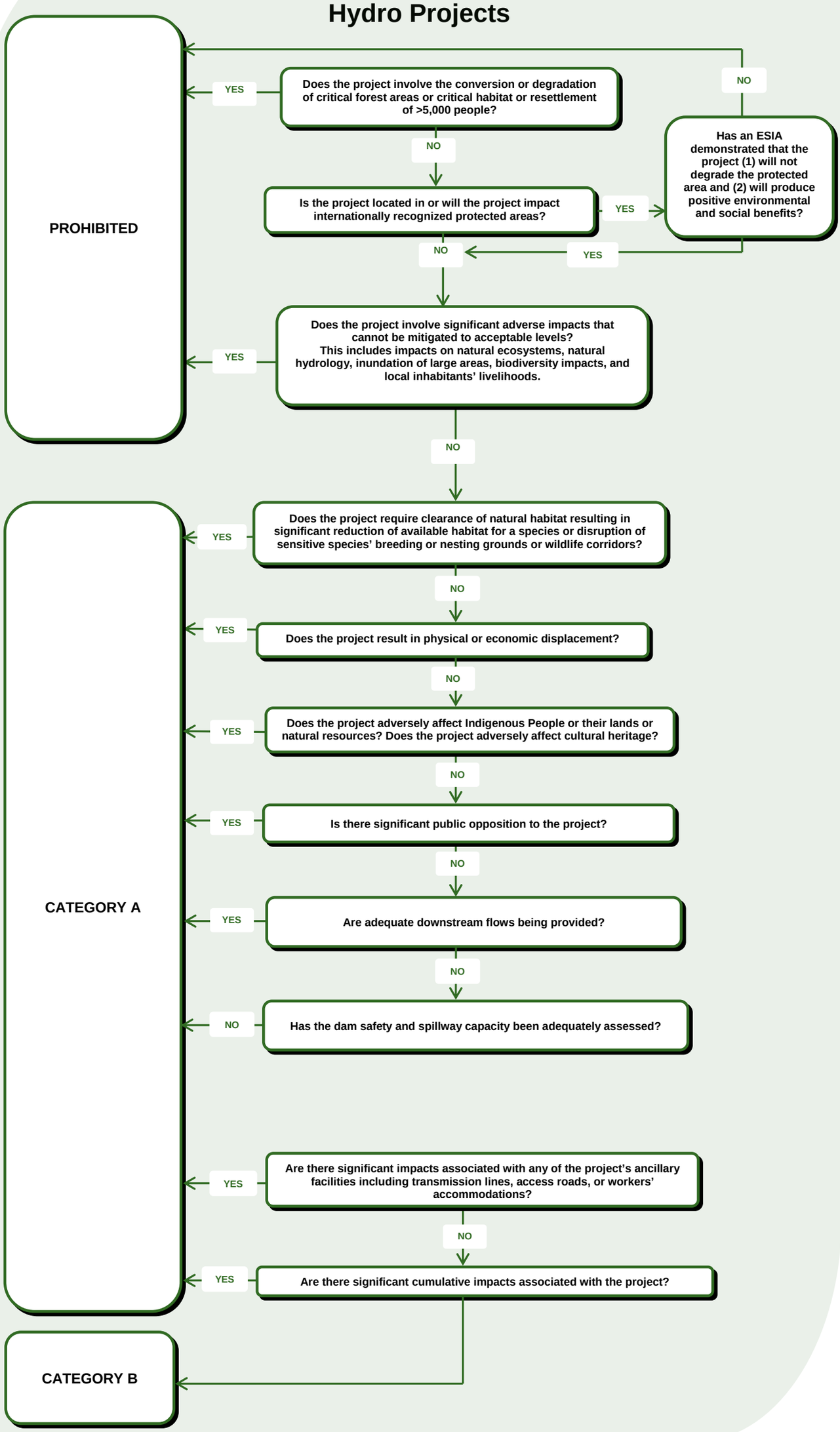
Tailrace - The channel that carries water away from the powerhouse.

Water borne diseases - Major health disorders caused through ingestion or contact with unsafe water.

World Commission on Dams (WCD) Guidelines - The World Bank and the World Conservation Union (IUCN) brokered the world Commission on Dams (WCD) Guidelines. It was established in May 1998 in response to the escalating local and international controversies over large dams. It was mandated to: review the development effectiveness of large dams and assessed alternatives for water resources and energy development and develop internationally acceptable criteria, guidelines and standards for the planning, design, appraisal, construction, operation, monitoring and decommissioning of dams. The World Commission on Dams published its final report, entitled *Dams and Development: A New Framework for Decision-Making,* in November 2000. With the publication of the report, the Commission was disbanded. The WCD Secretariat in its previous form was closed on 31 March 2001. http://www.unep.org/dams/WCD/.

Renewable Energy - Energy supplied from renewable energy sources, such as wind and solar power, geothermal, hydropower, and Renewable Biofuels / Biomass not otherwise categorically prohibited, not including nuclear power.

Appendix A

Flowchart

Screening Flow Chart
Hydro Projects