Advancing Sustainable Hydropower: Biodiversity Assessment and Management webinar series

ROLE OF THE BIODIVERSITY MANAGEMENT AND ACTION PLANS FOR HYDROPOWER SUSTAINABILITY

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Presenters:

Leeanne E. Alonso, IFC

Dipesh Bista, Upper Trishuli-1 HPP, NWEDC

Welcome and Housekeeping

Moderator:

Kate Lazarus

Senior Asia ESG Advisory Lead

IFC

Agenda

Time	Event	Presenter
19:00-19:10	Welcome and Housekeeping	Kate Lazarus Senior Asia ESG Advisory Lead, IFC
19:10-20:00	Role of the Biodiversity Management and Action Plans for Hydropower Sustainability	Leeanne Alonso, IFC Dipesh Bista, Senior Manager E&S, NWEDC
20:00-20:30	Q & A and Conclusions	*Moderated by:* Leeanne Alonso, IFC

Role of the Biodiversity Management Plan (BMP) and Biodiversity Action Plan (BAP) for Hydropower Sustainability

Presenters:

Leeanne Alonso, Biodiversity Consultant, IFC

Dipesh Bista, Senior Manager, Environment and Social, Nepal Water and Energy Development Company (NWEDC)

Outline of the Presentation

1. Why and When is a BMP or BAP needed?
2. What are a BMP and BAP?
3. Contents of a BMP and BAP
4. Model BMP for the Trishuli River Basin
5. BMP for the Upper Trishuli-1 HPP

THANKS to the following people and organizations for providing material for this presentation:

- **Gina Walsh**, Model Biodiversity Management Plan for Trishuli River Basin, BMP slides
- **Hagler Bailly Pakistan**, Biodiversity Action Plan (BAP) for Gulpur HPP, Pakistan, BAP slides
- **Emma Hume**, The Biodiversity Consultancy, BMP/BAP slides
- **NWEDC**, BMP for the Upper Trishuli-1 HPP, ESIA and BMP

Why and When is a BMP or BAP needed?

To document the actions the project will take to Manage and Mitigate project impacts on Biodiversity

- **Development projects, such as hydropower projects, identify environmental and social impacts through the ESIA process.**
- **If the project will have significant impacts on biodiversity (terrestrial or aquatic, species and habitats), then specific mitigation actions must be developed according to the mitigation hierarchy to avoid and/or reduce the impacts, to restore where possible, and to offset if needed.**
- **The mitigation actions should be detailed and documented so that the project, contractors, lenders, government and partners all clearly understand how the project will mitigate and monitor its impacts.**
- **These mitigation actions should be documented in a specific biodiversity focused mitigation plan.**

Source: Hagler Bailly Pakistan

Biodiversity Management Documents

International Good Practice, including International Lenders' Standards such as IFC's Performance Standard 6 (Biodiversity Management), usually require one or more of the following documents **as part of the ESIA**:

- **Biodiversity Management Plan (BMP)**
- **Biodiversity Action Plan (BAP)**
- Biodiversity Monitoring and Evaluation Plan (BMEP)
- Contractor Management Plans (ESMMPs)
- Supplemental plans for specific purposes, such as for biodiversity offsets
- Not all of these documents are required for every project.

IFC's Performance Standard 6: Requirements for Biodiversity Management

For Projects located in Modified Habitat

- PS6 applies if significant biodiversity values found
- Minimize impacts
- Mitigate as appropriate

For Projects located in Natural Habitat

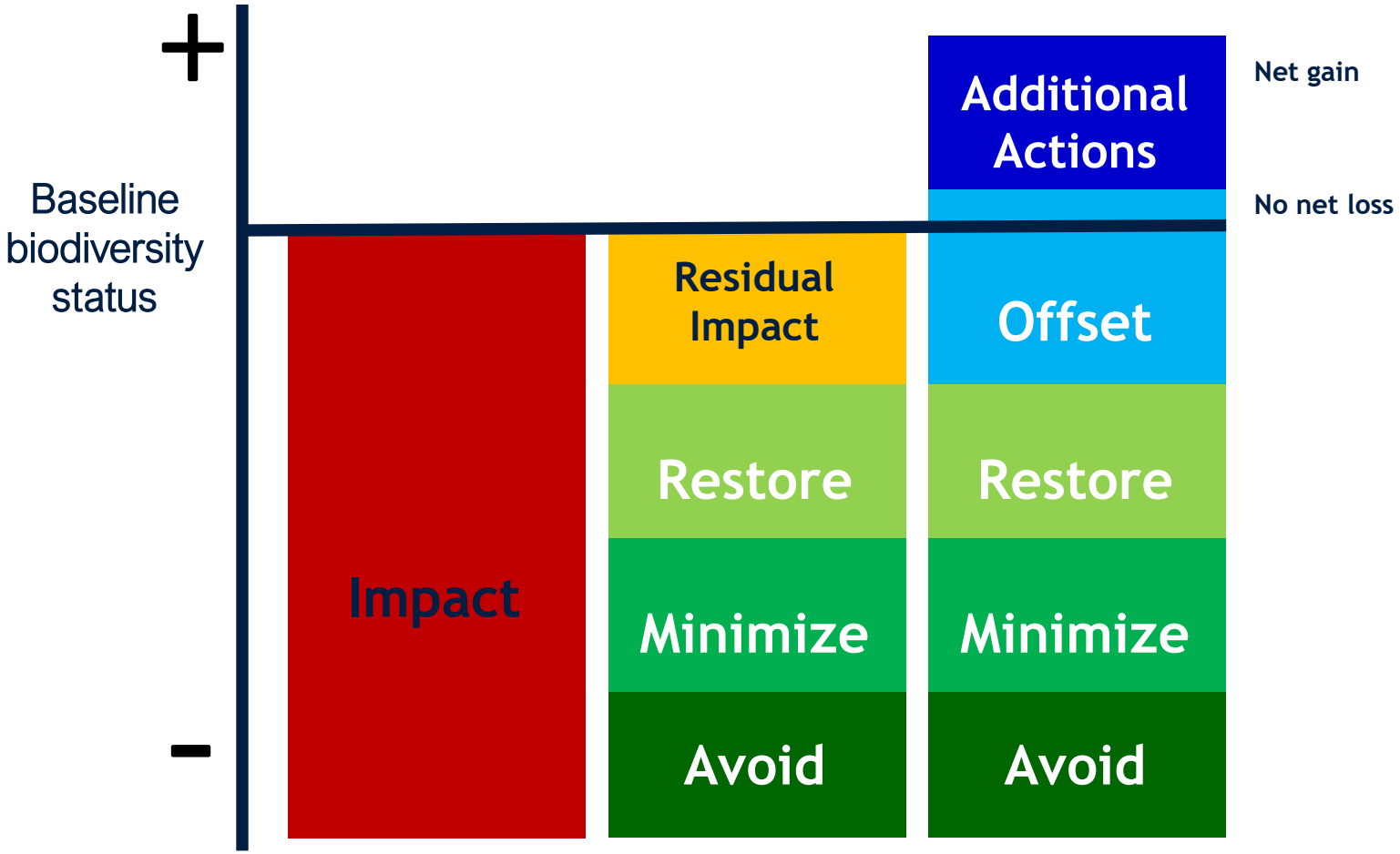
- No viable alternatives in Modified Habitat
- Views of stakeholders established about impacts
- Need to demonstrate No Net Loss of Biodiversity

For Projects located in Critical Habitat

- No viable alternatives in non-Critical Habitat
- No measurable adverse impacts on CH values or supporting processes
- No net reduction in CR or EN species population over reasonable time period
- Long-term monitoring and evaluation program
- Need to demonstrate Net gain for CH values
- If biodiversity offsets used, provide technical rationale

Mitigation Hierarchy

As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services.



What are a BMP and BAP?

Theme	Biodiversity Action Plan	Biodiversity Management Plan
Purpose	Strategic document	Operational document
Content	Establishes the biodiversity goals, residual impacts, rationale and actions that will enable a NNL/NG outcome	Details the onsite mitigation measures that will be implemented to avoid, minimise and restore impacts during construction and operations
Management	Live document: likely to require updates as the Project develops	Auditable: requires clear timelines, responsibilities and indicators to track each mitigation measure
Implementation	Typically Project developer, often requires external partnerships	Typically the Project developer, EPC and contractors

Source: Emma Hume, TBC

BMEP is the monitoring plan used to DEMONSTRATE NNL or NG for either plan

BMP or BAP?

Biodiversity plans needed will depend on the Biodiversity Values of the area and the Project Impacts

Habitat and Biodiversity	Project Impacts on BD	Is NNL or NG required?	Mitigation focus	Documents
Modified	Low	No	Within project area	ESMMPs
Natural	Low	No	Within project area	BMP or ESMMPs
	High	No or Yes	Within project area	BMP, (BMEP)
	High	Yes	Within and outside project	BAP, BMEP
Critical	Low	Yes	Within project area	BAP*, BMEP
	High	Yes	Within and outside project	BAP*, BMEP

***IFC's PS6 requires a BAP for projects in Critical Habitat**

Biodiversity Management Plan (BMP)

BMP-equivalents can go by many names, for example:

Biodiversity Action Plan
Biodiversity Strategy
Ecological Management Plan
Conservation Management Plan
High Conservation Value Management Plan
Flora and Fauna Management Plan

They can be stand-alone plans or the actions integrated into one or more plans (e.g., noise, water, air quality). The approach depends on project capacity, management structures, corporate policies or lender/consultant/staff preferences!

The document names do not really matter.
What matters is that the Biodiversity Management Actions are clearly documented and detailed.

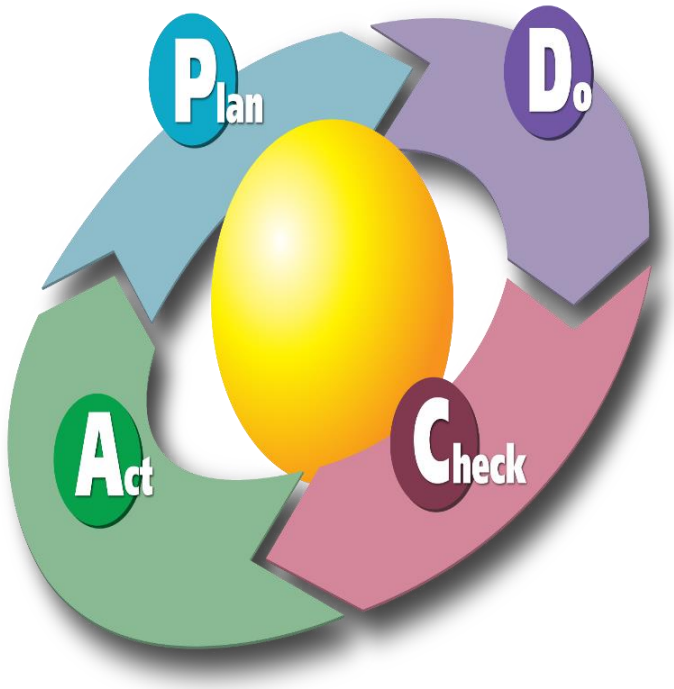
IFC Performance Standard 6: Guidance Note paragraph 50 (BMP)

GN50. Biodiversity-related commitments and mitigation and management actions should be captured in the client's ESMS. For all projects that have the potential to significantly convert or degrade natural habitats and for projects in critical habitats, these biodiversity actions should be captured in a single dedicated Biodiversity Management Plan (BMP) or integrated into one or more topic-specific management plans (for example, Invasive Species Management Plan, Induced Access Management Plan, Water Management Plan). The BMP or equivalents should be auditable management plans, integrated into a project's ESMS, which define parties responsible for an action, monitoring and/or verification requirements of an action, and an implementation schedule or frequency for an action. The BMP or equivalents are operational tools for' site managers and contractors, with focus on on-site mitigation measures. If biodiversity-related mitigation and management measures appear in other management plans, cross-references to the BMP or to the biodiversity-relevant section in the ESMS should be included. The corresponding monitoring/verification requirements should reflect the principal of adaptive management (see paragraph GN20 of this note), where relevant. Some projects in natural habitats may be required to develop a Biodiversity Action Plan to accompany these documents (see paragraph GN91 of this note).

Contents of a Biodiversity Management Plan (BMP)

To operationalize biodiversity-related management and monitoring as part of a broader Environmental and Social Management Plan (ESMP).

- Implementable & auditable?
- ESIA requirements fully integrated?
- Actions & responsibilities?
- Focus on site-specific mitigation measures?
- Monitoring implementation of site-specific mitigation measures?
- Adaptive management & responsive measures on regular basis?



Contents of a BMP Mitigation Table

Impact	Mitigation Measures	Responsible Party	Timeline	Frequency of implementation	Trigger for implementation	Means of Verification	UT-1 Staff	Responsible for Implementation	Relevant ESMMPs
Design									
Pre-Construction									
Construction									
Operations									

Role of BMP and BAP for Hydropower Sustainability

- To clearly document the actions to be implemented by a Hydropower Project (and partners) to Mitigate and Manage project impacts on Biodiversity

- For Hydropower, this includes impacts on both Aquatic Ecosystem and Terrestrial Ecosystem, including:

1. Fish passage and river connectivity	2. Changes in flow regimes	3. Habitat impacts
4. Fauna mortality	5. Stream morphology and sediment movement	6. Pollution

Sample mitigation actions in BMP for Hydropower

See also IFC webinar on January 26, 2021

	Possible Mitigation Actions per Project Phase		
Impact on Biodiversity	Design	Construction	Operations
River Flow	• Operating mode (Run-of-River, Peaking, etc.) • Amplitude/frequency/ ramping of peaking • Height of dam • Reservoir size • EFlows modeling • Include EFlows release mechanism • Intake position in reservoir • Impoundment management	• Release EFlows as needed • Maintain flow through diversion tunnels • Release EFlows during reservoir filling per plan (impoundment)	• Release EFlows • Monitor EFlows release • Follow peaking rules for ramping & flow • Monitor flow rate downstream
Aquatic Habitat	• Dam location • Length of diversion reach • Flushing plan • Quarry location • Model peaking flows and diversion reach to quantify impact on aquatic habitat • Regulating dam design	• Ensure quarry is not within river bed or sensitive areas • Maintain river flow through construction period • Monitor aquatic biodiversity	• Release EFlows • Adjust EFlows if too low in diversion • Enhancement of diversion reach • Enhancement of downstream reach (mitigate peaking) • Flushing per plan • Monitor aquatic biodiversity • Operate regulating dam
Upstream Fish Migration	• Dam location • Fish ladder design • Flow rate thru ladder • Attraction flow for Ffsh ladder • EFlows and attraction flows in diversion reach • Connectivity of river to tributaries • Model peaking flows and diversion reach to quantify impact on fish migration	• Monitor if fish congregate below coffer dam • Move fish upstream if deemed necessary	• Release EFlows • Maintain fish ladder • Release flow through fish ladder in migration season • Release attraction flow in migration season • Adjust EFlows if too low in diversion • Modify channel for better fish migration • Maintain connectivity to tributaries • Monitor fish
Downstream Fish Migration	• Dam location • Type of turbines • Trash racks bar spacing • Intake screens • Guiding screens • Spillway design • Plunge pool • Flushing gates and process • Fish ladder also for downstream migration	• Maintain flow through diversion tunnels • Ensure fish are not stranded within/below diversion tunnels	• Open gates in monsoon season to allow downstream fish passage • Release flow through fish ladder in migration season • Flushing per plan • Monitor fish

Model BMP for the Trishuli River Basin

- Developed with support of IFC as a Follow up to the “Cumulative Impact Assessment for the Trishuli River Basin” (see IFC Webinar January 19, 2021)
- Presents a model format and contents for a BMP for Hydropower projects in the Trishuli River Basin
- Can serve as a model for other basins in Nepal as well
- To be available in July 2021 as part of the Trishuli Assessment Tool Kit, on IFC Hydro Advisory website https://www.ifc.org/wps/wcm/connect/Industry_EXT_Content/IFC_External_Corporate_Site/Hydro+Advisory/
- See IFC Sustainability Webinar Series website: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/company-resources/ifc_sustainability_webinars
- Draft available upon request

Contents of a Biodiversity Action Plan (BAP)

BAPs may be separated from BMP but in some cases may be integrated.

BAP actions are usually off-site and/or include additional specialist studies that fill ESIA gaps, address compliance issues and once complete may inform or change BMP actions.

BAP actions more likely to include external partners.

Biodiversity Management Plan								
ID	Commitment/Action	Detail	Project Phase	Documentation	Cross-reference to other MPs	Frequency of action	Responsibility	Verification* indicator
	Discussions are needed to confirm whether this can be incorporated and included in a zone of controlled access.							
BIO3	Awareness training on the set-aside and other areas to be avoided will be provided to all relevant personnel and access to these areas will be prohibited.	To be part of site induction before any individual is allowed on site. Provide overview of sensitivities and constraints, including purpose of set-aside and restoration trials and prohibitions on access. Explain meaning of signs. Also include awareness of sensitive species and risks associated with any dangerous animals.	P, Const, Ops	Awareness training materials Site induction record		1. Before access to site. 2. Refreshers as needed afterwards.	1. Lydian 2. Contractor(s)	Fencing and signs in place Set-aside and restoration areas remains undisturbed
BIO4	An ecological risk assessment to evaluate the consequences of accidental spills during transport or storage of hazardous chemicals will be undertaken once transport routes are confirmed. This will focus particularly where routes run adjacent to sensitive water courses or water bodies.				BAP			
BIO5	Pre-construction checks (surveys) will be carried out immediately prior to ground disturbance in order to confirm that the biodiversity baseline as reported in this ESIA has not changed significantly, and that there are no additional features that should be avoided.	A formal procedure should be established such that NO ground breaking occurs until sign-off by environmental staff. See also BIO68, BIO69 and BIO73 for specific species of concern.	Const	Pre-construction check record Permit to dig		Prior to disturbance of a new area	Lydian	Sign-off of "Permit to Dig"

IFC Performance Standard 6: Guidance Note paragraph 91 (BAP)

GN91. A Biodiversity Action Plan (BAP) is required for projects located in critical habitat and is recommended for high-risk projects in natural habitats. The BAP describes (i) the composite of actions and a rationale for how the project's mitigation strategy will achieve net gain (or no net loss), (ii) the approach for how the mitigation hierarchy will be followed, and (iii) the roles and responsibilities for internal staff and external partners. BAPs are living documents that should include agreed-on timelines for regular review and update as new information arises, project implementation progresses, and conservation context changes over time. Where project mitigation measures are included in the project ESMS/BMP (paragraph GN50 of this note), this should be referenced in the BAP. A BAP differs from a BMP in that the latter is an operational document developed largely for site managers and contractors (see paragraph GN50); whereas the BAP will almost always include actions for off-site areas (for example, offsets and additional actions) and involve external partners (for example, implementing partners, reviewers, or advisors). The BAP may also be accompanied by documents that would be developed at a later timeframe, such as an Offset Management Plan or a Biodiversity Evaluation and Monitoring Plan. In these cases, the BAP would be updated to reference these critical documents when they are developed. Depending on the nature and scale of the project, an initial BAP may describe a strategy and timeline for identifying actions to deliver net gain (or no net loss).

BAP Example: Gulpur Hydropower Project, Pakistan

(see also IFC Webinar January 26, 2021)

BAP focuses on achieving Net Gain for Critical Habitat Biodiversity Values:

- Golden Mahseer (*Tor putitora*) – Endangered migratory fish species
- Kashmir Catfish (*Glyptothorax kashmirensis*) – Critically Endangered fish species
- Poonch River Mahseer National Park

BAP Actions will focus on reducing External threats to these biodiversity values:

- Illegal over-fishing
- Illegal sand, gravel and boulder mining

BAP Actions include:

Gulpur HPP Biodiversity Action Plan (BAP)

Watch and Ward program
Sediment Mining Plan
Community fishing program
Mahseer hatchery
Kashmir catfish hatchery
Community outreach and education
Government capacity building
Biodiversity Monitoring and Evaluation

Biodiversity Monitoring and Evaluation Plan (BMEP)

Required to monitor habitats and species over life of project in Critical Habitats. Recommended in Natural Habitats.

- In-field monitoring of high biodiversity values
- Monitoring implementation & effectiveness of mitigation
- Monitoring external threats to high biodiversity values

Usually designed in consultation with & undertaken by third-parties with biodiversity monitoring experiences e.g. credible conservation organization or university

Establish acceptable thresholds of variability for biodiversity values

Measurable results outside thresholds for set time periods indicate non-compliance with PS6 and require Adaptive Management

Demonstrate No Net Loss or Net Gain for selected important biodiversity values (all Critical Habitat values)

BMP for the Upper Trishuli-1 Hydropower Project (HPP)

Developer:
Nepal Water and Energy Development Company (NWEDC)

216 MW

32 m high weir

10.7 km diversion reach
between dam and power house

Location at 1300 m elevation


Photo: Leanne Farrell, World Bank

Trishuli River Temperature Zones

Upper Trishuli-1 HPP
Located in Cold Water Zone

Fish Studies for Upper Trishuli-1 HPP

- NESS (2012, 2013, and 2014-2016) – cast nets
- SWECO (2016) – electrofishing and drift nets
- 8 fish species recorded in the area (cold water region)
- Sampling for Cumulative Impact Assessment at 7 sites in the basin (2018), including eDNA

  25 species recorded by eDNA
- 
  
  

Common Snow Trout, *Schizothorax richardsonii*

Most abundance species – >90% of catch but considered low population size, possibly due to overfishing

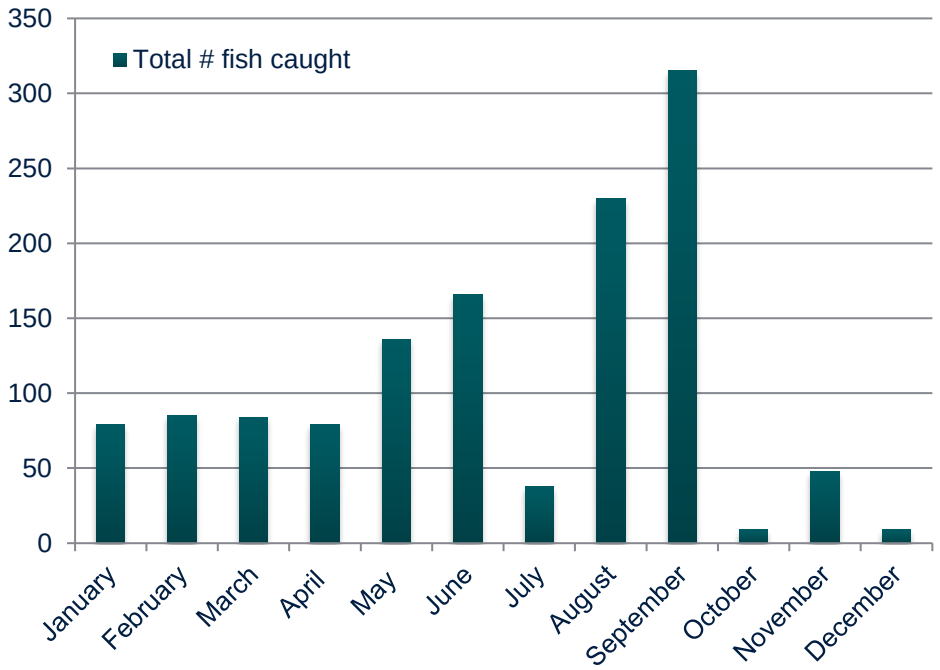
Other fish species from the Trishuli River Basin

Fish Species documented in UT-1 Area

Common Name	Scientific Name	Above Dam Site		Diversion Reach		Downstream of Powerhouse	
		Found	Expected*	Found	Expected*	Found	Expected*
Common snowtrout	*Schizothorax richardsonii*	X		X		X	
Dinnawah snowtrout	*Schizothorax progastus*	X		X		X	
Suckerthroat catfish	*Pseudecheneis sulcata*		x	X		X	
Torrent catfish	*Euchiloglanis hodgarti*	X		X		X	
Pharping catfish	*Glyptosternum (Myersglanis) blythi*	X			x	X	
Banded loach	*Schistura savona*					X	
Mottled loach	*Nemacheilus botia*					X	
Rainbox trout (non-native species)	*Onchorhyncus mykiss*		x	X			
# of species found	8	4	2	5	1	7	

Common Snow Trout Migration through UT-1 HPP Project Area

Month/Area	Feb-May	May-July	Aug-Oct	Nov-Jan
Upstream of proposed UT-1 dam	Adults migrate to spawning areas in tributaries upstream of the confluence of the Bhote Khosi and the Langtang Khola	Mix of adults and some young-of-year fish, Spawning in tributaries	Some adults and mostly young-of-year fish moving downstream as river temperatures begin to cool	A few adults, possibly a small resident population, at least during comparatively warmer winters.
Diversion reach	Adults migrate upstream through the diversion reach to upstream tributaries (none in in this reach)	Mix of adults and some young-of-year fish moving upstream	Some adults and mostly young-of-year fish moving downstream as river temperatures begin to cool	A small resident population during comparatively warmer winters.
Downstream of Powerhouse	Adults and juveniles present, feeding and growing	Adults and juveniles present, feeding and growing	Adults, juveniles, and young-of-year fish present, feeding and growing	Adults, juveniles, and young-of-year fish, water temperatures appear to be warm enough to support them through the winter



Source: NESS 2014

Upper Trishuli-1 HPP BMP

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Upper Trishuli-1 HPP BMP Main Project Impacts and Mitigation

Impact	Mitigation
Flow Reduced flow in 11 km Diversion Reach during dry Season	EFlows Assessment, 10% of mean monthly flow
Aquatic Habitat Changes to fish habitat Connectivity to allow fish to move through Diversion reach	Connectivity Assessment to evaluate fish movement Channel modification if needed
Upstream Fish Migration	Fish Ladder
Downstream Fish Migration	Curved spillway and deep pool Trash racks and guidance Fish ladder, located on other side of dam from intake
Terrestrial Habitat Loss	Reforestation at 2:1, and 25:1 where required Offset of 2.61 ha to add to Langtang NP

Upper Trishuli-1 HPP BMP Actions to Achieve NNL of Priority Biodiversity Values

Priority feature	Project biodiversity goals	Mitigation hierarchy		Significant residual impact?	Offsite offset	Key features of mitigation
		Avoidance / Minimization	Restoration/ Rehabilitation			
Trishuli River (Natural Habitat)	NNL	✓				EFlow management for diversion reach, Fish ladder for connectivity, Fish monitoring using indicator species (Common Snowtrout)
Langtang National Park (Natural Habitat)	NNL	✓	✓	✓	X	Onsite mitigation, replanting of trees 2:1, Offset for LNP buffer zone

Upper Trishuli-1 HPP BMP Responsible Parties for Mitigation Actions

- The Owner (NWEDC)
- The Engineering, Procurement, Construction (EPC) Contractor
- The Operation and Management (O&M) Contractor
- The Aquatic Monitoring Team (BMEP)
- The Terrestrial Monitoring Team (BMEP)

Upper Trishuli-1 HPP BMP Sample from Mitigation Table – Owner (NWEDC)

Impact	Mitigation Measures	Responsible Party	Timeline	Frequency of implementation	Trigger for implementation	Means of Verification	UT-1 Staff	Responsible for Implementation	Relevant MPs
Design									
Change to flow regimes (water and sediments) due to water diversion	• Design dam to release a minimum environmental flow (EFlows) during the dry months (Jan-April) • Dam operation run-of-river (no peaking) • Develop an EFlows Management Plan	NWEDC	Prior to the commencement of construction activities for project lifespan	Pre-construction throughout operation.	Upon confirmation of construction phase onset	Development of EFlow adaptive management plan	E&S Manager Environmental Manager	Senior Civil Engineer Hydrologist	Biodiversity MP Sediment MP EFlows MP
Blockage of aquatic fauna migration up and downstream	• Design fish ladder for Common snow trout (*Schizothorax richardsonii*) for upstream passage • Design spillway for downstream fish passage • Design adequate sediment flushing mechanism and schedule for minimum environmental damage downstream	NWEDC	Prior to the commencement of construction activities for project lifespan	Pre-construction throughout operation.	Upon confirmation of construction phase onset	Provision of fish ladder plans and incorporation into project design	E&S Manager Environmental Manager	Senior Civil Engineer	Biodiversity MP EFlows MP Fish ladder design document
Pre-construction									
Changes to flow regimes	• Installation of flow measuring gauges (meter with recording provisions) both electronic and manual measurement basis to measure EFlows	**NWEDC**	Prior to the commencement of construction activities	Preconstruction period throughout operation	Upon confirmation of construction phase onset	EFlow monitoring data and appropriate analysis	E&S Manager	Senior Civil Engineer	EFlows MP
Changes to aquatic habitat and fish migration	• Hire expert fish monitoring advisor to guide mitigation and long-term monitoring program to show NNL • Create an aquatic monitoring team	**NWEDC**	Prior to the commencement of construction activities	Preconstruction to operation period to collect baseline and monitoring data	At least 9 months before instream construction begins	Contracts of staff and responsibility, provision of structure of research team/consortium	Environmental Manager Fish Monitoring Advisor	Environmental Officer	Biodiversity MP Biodiversity Evaluation and Monitoring Program

+ Oversight of all EPC and O&M mitigation activities

Upper Trishuli-1 HPP BMP Sample from Mitigation Table – EPC

Impact	Mitigation Measures	Responsible Party	Timeline	Frequency of implementation	Trigger for implementation	Means of Verification	UT-1 & EPC Staff	Responsible for Implementation	Relevant MPs
Construction									
Construction impacts on river ecosystem and water quality	• No spoil will be dumped in river or tributaries • No quarry within 500 m of river and tributaries	**EPC with NWEDC**	During construction	Monitor and log daily in construction phase	Onset of construction phase and storage of sediment	Records by Environmental Officer in register Photographic records	Environmental Manager	Environmental Officer	Biodiversity MP Construction MP Spoil Handling MP Waste Management MP Water Quality MP Sediment and Erosion MP
Impacts of workers on aquatic biodiversity	• Prohibit fishing and hunting • Prohibit dumping of waste into river • Develop Biodiversity codes of conduct for employees to outline the rules, procedures, and prohibitions • Implement appropriate penalties for staff and contractors who disregard the codes of conduct	**EPC with NWEDC**	Start as early as pre-construction and continue into construction phase	Training and induction of staff as required and on arrival of new staff. Refresher training 6 monthly	Start of pre-construction workers camp establishment and throughout construction	Records of induction and signed codes of conduct of all new staff Monthly property inspections and written reports	Environmental Manager	Induction and compliance officer	Biodiversity MP Construction Worker MP Operation Worker MP
Noise and vibration associated with construction activities	• Monitor noise and vibration in the study area • Machinery operation to occur only during designated hours • Work to be carried out in daylight	**EPC**	During construction	Continuously in the construction phase	At onset of construction phase and use of noise generating machinery weekly.	Noise monitoring comparison with ambient standards	Environmental Manager	Environmental Control Officer (EPC)	Noise and Vibration MP
Increased utilization of roads by traffic associated with construction activities.	• Signage and speed humps to be used in areas where wildlife crossing is likely • Wetting of roads to reduce dust during the dry season, and as necessary	**EPC**	During construction	Once off in construction phase (signage and driver training), and review of driver training at monthly intervals	Pre-construction phase for driver training and construction of roads for implementation of road safety features	Records of incidents and disciplinary action, and records of codes of conduct	Construction Manager and SEO Access Road Manager	Induction and compliance officer	Traffic MP Air MP

Upper Trishuli-1 HPP BMP Sample from Mitigation Table – O&M Contractor

Impact	Mitigation Measures	Responsible Party	Timeline	Frequency of implementation	Trigger for implementation	Means of Verification	Staff	Responsible for Implementation	Relevant MPs
Operation									
Change to flow regimes (water and sediments) due to water diversion	• Ensure release of minimum EFlows according to EFlows MP year round • Monitor and report EFlows	**O&M contractor**	During Operations	Continually	At all times	EFlows reporting	Operator	Environmental Officer	EFlows MP
Impacts to fish migration from dam blockage	• Operate fish ladder to ensure effective fish passage • Ensure the channel in the diversion segment just below the dam is clear so fish may reach fish ladder entrance • Establish a flow and temperature monitoring program to optimize fish ladder performance	**O&M contractor**	Before and during operations.	Monitoring plan to be developed prior to construction monitored weekly during construction.	Operation Phase	Fish monitoring data at fish ladder EFlow monitoring data and appropriate analysis	Environmental Manager	Environmental Officer	Biodiversity MP EFlows MP Biodiversity Evaluation and Monitoring Program
Impacts on reservoir water quality	• Removal of dead vegetation or debris on regular basis • Regular monitoring of reservoir water quality	**O&M contractor**	Regularly during operations.	At the beginning of instream construction activities and throughout operations. Monthly for 5 years	Onset of instream construction activities and into operations	Water quality monitoring data and appropriate analysis	Environmental Manager	Environmental Officer Fish monitors (remove debris in diversion reach)	Water Quality MP
Increased utilization of roads by traffic associated with operation activities	• Signage and speed humps shall be used in areas where wildlife crossing is likely • Training shall be provided to vehicle drivers regarding the driving risks through biodiversity sensitive areas and along remote roads.	NWEDC and **O&M contractor**	During operations.			Record of traffic violations Records of signed codes of conduct			Traffic MP

Upper Trishuli-1 HPP
Biodiversity Monitoring and Evaluation Plan (BMEP)

To be developed by NWEDC Environmental Team with Fish Monitoring Advisor

NWEDC will develop an Aquatic Monitoring Team and a Terrestrial Monitoring Team

BMEP will implement the Trishuli Assessment Tool for the aquatic ecosystem (see IFC Webinar February 2, 2021)

Metrics for demonstrating No Net Loss of Biodiversity will focus on:

- Aquatic: Snow Trout and Macroinvertebrates
- Terrestrial: Habitat restoration, selected metrics

Photo: Gina Walsh

Next up in the IFC Webinar Series

- **May 11: Freshwater Ecosystem Assessment Handbook**
  Dr. Deep Narayan Shah, *Central Department of Environmental Science, Tribhuvan University, Nepal*
  Dr. Ram Devi Tachamo Shah, *Aquatic Ecology Centre, Kathmandu University, Nepal*
  Dr. Sunita Chaudhary, *ICIMOD, Nepal*

- **May 25: Sustainable Sediment Mining and Management during Hydropower Development**
  Dr. Lois Koehnken, *Sediment Specialist and Consultant*
  Dr. Cate Brown, *Freshwater Ecologist, Southern Waters, South Africa*
  Mr. Vaqar Zakaria, *Hagler Bailly Pakistan*

Thank you!