Gulpur HPP: Poonch River, Kashmir[1]

The Poonch River originates in Indian-administered Kashmir, flows into Pakistan-administered Kashmir, and a further 85 km downstream enters Mangla Dam reservoir, which floods the confluence of the Poonch and Jhelum River. The entire 85-km length of the river within Pakistan-administered Kashmir is in the Poonch River Mahaseer National Park, recognised for its scenic beauty and high levels of fish endemism including the Critically Endangered Kashmir catfish, *Glyptothorax kashmirensis,* and the Endangered Mahaseer, *Tor putitora,* which is also a prized angling fish. Funding for maintaining the national park is scarce and sediment mining from the river, destructive fishing practices, nutrient enrichment from effluent discharges and removal of riparian vegetation all exert pressure on the system. Within the park, the 100-MW Gulpur Hydropower Project is being developed 50 km upstream of the Mangla Dam (Figure 1), by Mira Power Ltd. from South Korea.

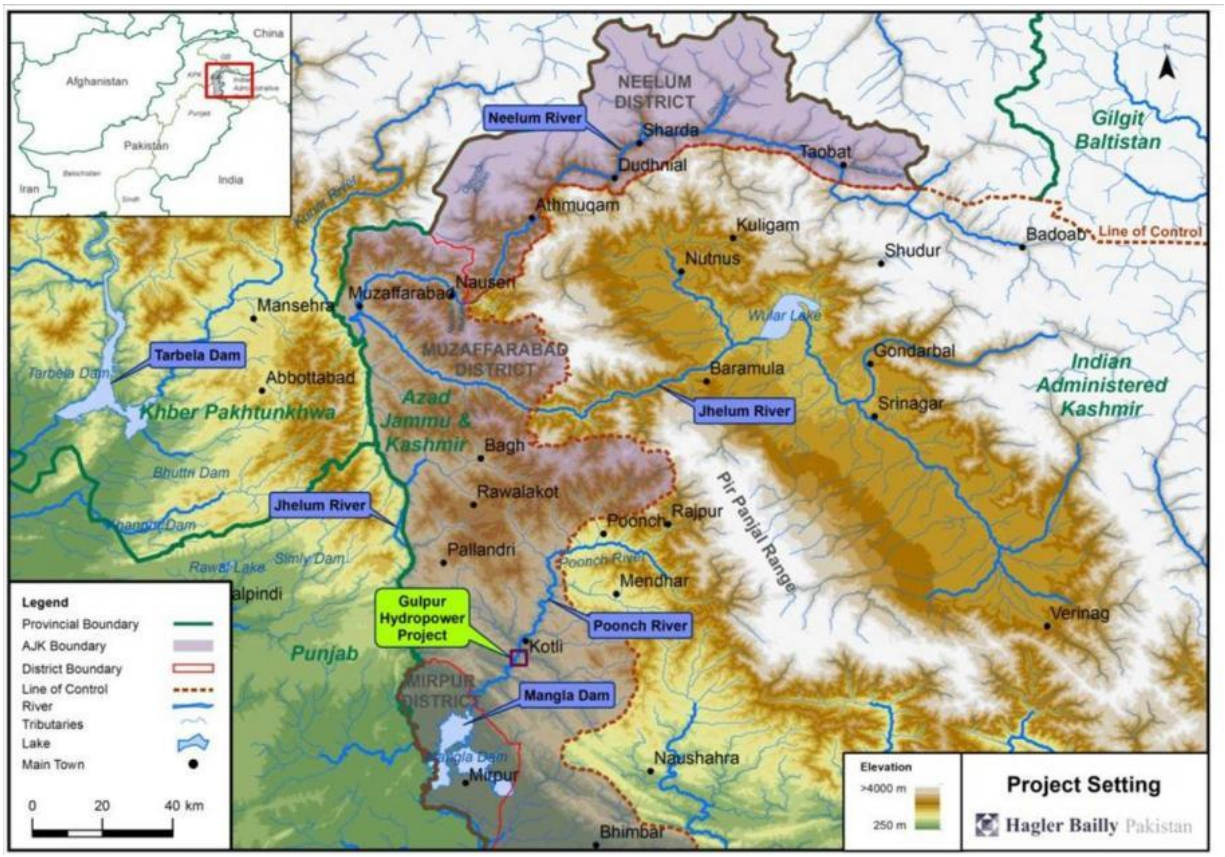

Figure 1 The Poonch River and Gulpur HPP setting

[1] From WBG (2016)

The initial design of the HPP included a 35-m weir[2], a 3.1-km headrace tunnel connecting the intake to the power house; and a tailrace that would discharge water back into the river about 6 km downstream of the weir. The power house would comprise three Francis 33.33-MW turbines with a minimum operational discharge of 33 m^3s^{-1}.[3] The design EFlows were planned as a minimum release of 4 m^3s^{-1} compared to the baseline minimum 5-day dry-season discharge of 20.4 m^3s^{-1}. The weir would not materially alter the wet-season flows, but would affect the dry-season onset, duration and discharge magnitude between the weir and the tailrace under base-power operation, and much of the remaining river under peaking-power operation.

The IFC rejected the EIA that was initially completed for the Gulpur HPP and, because the Poonch River is both a National Park and Critical Habitat (as per IFC definitions); they recommended a **high-resolution** EFlows Assessment.

The DRIFT EFlows Assessment method was used to evaluate over 20 scenarios comprising different permutations of **minimum releases** between 4 and 16 m^3s^{-1}; three future **levels of management** aimed at reducing the non-flow related pressures on the system;[4] **peaking versus baseflow operation**; options for reducing the **distance of the de-watered section of river between the weir and tailrace**; and options for **turbine selection**. All the scenarios considered the effects of **trapping bedload and suspended sediments** in the Gulpur reservoir, as well as the **barrier effect of the weir on fish** movement between downstream over-wintering areas and upstream breeding areas.

For each scenario, the outcome of the EFlows Assessment was expressed as an overall ecosystem condition in different river reaches using an integrity range from A to F (Figure 2; where A = natural and F = highly degraded); as semi-quantitative changes for 16 indicators of ecosystem condition, including fish (Table 1); and in terms of its implication for power generation (not shown here).

Figure 2 and Table 1 show that even without Gulpur weir the river ecosystem and biodiversity would continue to decline in the absence of focused management interventions. The findings include the following:

- With the weir, there would be a net positive effect on overall ecosystem condition upstream provided high-level conservation protection (funded by hydropower generation) was also implemented, largely due to some fish species colonizing the reservoir.

[2] A 35-m high wall, with release structures, is effectively a dam in terms of its effect on the river but we have retained the term 'weir' in line with other project literature.

[3] The minimum operational discharge is significant because, in the dry season, inflows to Gulpur reservoir can drop below 33 m^3/s and the turbines would have to be switched off until sufficient inflow was available to restart them. Thus, even in the absence of peaking power generation, the downstream river would experience short-term fluctuating flows.

[4] No protection = business as usual – do nothing and allow pressures to increase in line with 1976-2013 trends. Moderate protection = manage the system to ensure no increase in human-induced basin pressures over time relative to 2013; High protection = reduce 2013 pressures by 50%.

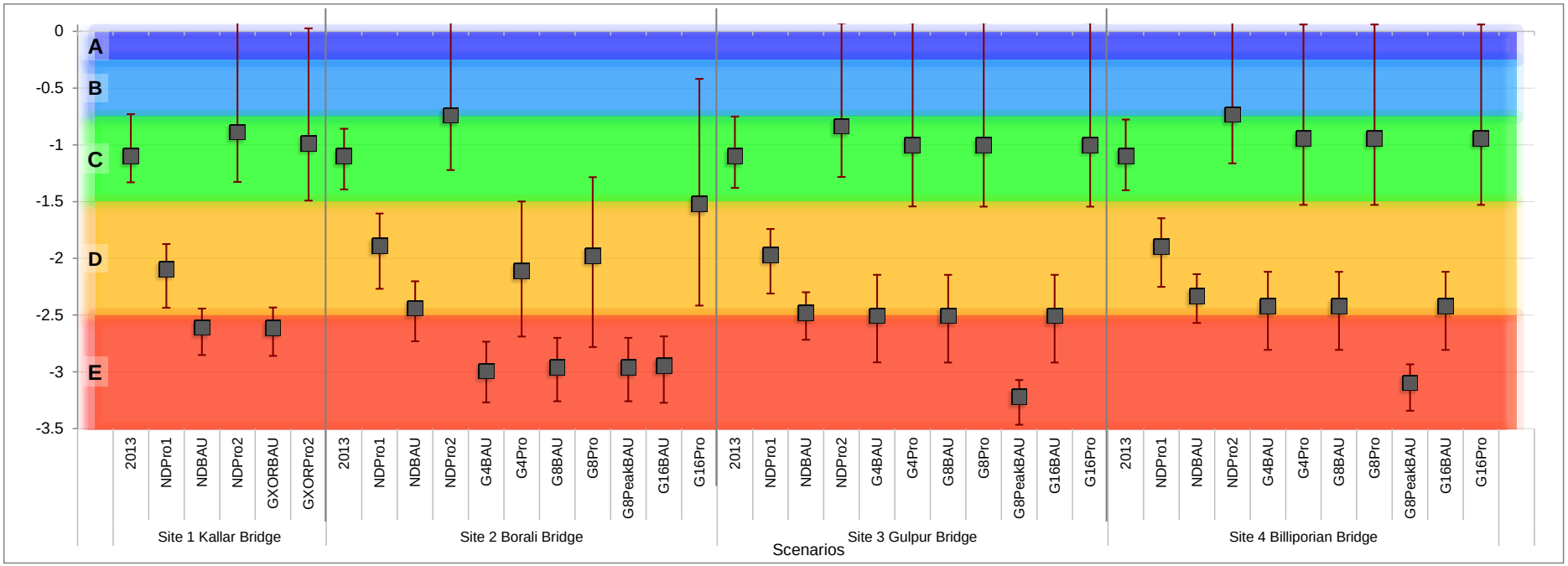

Figure 2 *Predicted overall ecosystem condition in the Poonch River upstream of Gulpur, between the weir and the tailrace, and downstream of the tailrace. Scenarios displayed include options for no dam, various release magnitudes (Gx – upstream so no releases, G4, G8, G16) and various basin protection (Pro) levels. Baseline (2013) river condition integrity is labelled 2013.*

Table 1 *The mean percentage changes in abundance (relative to 2012 Baseline) predicted for the fish indicators for the selection of scenarios shown in Figure 2. Blue and green are major changes that represent a move towards natural: green = 40-70%; blue = >70%. Orange and red are major changes that represent a move away from natural: orange = 40-70%; red = >70%. Baseline, by definition, equals 100%. The scenario coloured bright yellow was the one chosen.*

Location	Species	Baseload									Peaking
		No dam – moderate protection	No dam – low protection	No dam – high protection	4 m^3s^{-1} – no protection	4 m^3s^{-1} – high protection[5]	8 m^3s^{-1} – no protection	8 m^3s^{-1} – high protection	16 m^3s^{-1} – no protection	16 m^3s^{-1} – high protection	8 m^3s^{-1} – no protection
Upstream of weir[6]	Pakistani labeo	-64	-86	62	-79	69	-79	69	-79	69	-79
	Mahaseer	-60	-97	47	-82	80	-82	80	-82	80	-82
	Twin-banded loach	4	-70	34	-87	23	-87	23	-87	23	-87
	Kashmir catfish	-3	-67	31	-84	22	-84	22	-84	22	-84
	Garua bachwaa	-66	-100	73	-100	8	-100	8	-100	8	-100
	Snow trout	-50	-61	57	-30	88	-30	88	-30	88	-30
Weir to tailrace[7]	Pakistani labeo	-598	-77	58	-100	-26	-100	-5	-99	7	-99
	Mahaseer	-55	-92	51	-100	-93	-100	-87	-100	-41	-100
	Twin-banded loach	-1.4	-54	47	-100	-90	-100	-80	-93	-21	-100
	Kashmir catfish	-8	-62	15	-100	-91	-100	-88	-99	-54	-100
	Garua bachwaa	-60	-94	86	-95	-898	-95	-88	-95	-12	-95
Tailrace to Mangla reservoir[8]	Pakistani labeo	-59	-88	59	-88	63	-88	63	-88	63	-100
	Mahaseer	-58	-94	51	-100	-6	-100	-6	-100	-6	-100
	Twin-banded loach	-1	-53	48	16	93	16	93	16	93	-100
	Kashmir catfish	-8	-62	20	-20	76	-20	76	-20	76	-100
	Garua bachwaa	-60	-96	80	-99	67	-99	67	-99	67	-100

[5] Scenario selected for implementation
[6] ~ 20 km upstream of the reservoir
[7] ~ 1 km
[8] ~ 40 km

- Increasing the EFlows releases from 4 to 8 m^3s^{-1} would not significantly improve the outcome for the river section between the weir and the tailrace.
- Downstream of the tailrace to the Mangla reservoir, peaking power operations would significantly adversely affect both overall condition and biodiversity.

The full range of scenarios was presented to the stakeholders, comprising local communities, government officials, the developer, Pakistan Power Authority, and representatives from the lending organisations including the Asian Development Bank and the IFC.

The results of the EFlows Assessment underpinned the following decision:

- forgo peaking power generation;
- relocate the weir closer to the power house to, *inter alia*, reduce the dewatered section form about 6 km to about 1 km;
- release an EFlows of 4 $m^3 s^{-1}$ for the (shortened) section of river between the weir and tailrace;
- select different turbines that would allow greater operating flexibility under low-flow conditions;
- implement a management and finance structure for high levels of protection in the Poonch River National Park;
- establish a fish hatchery and use it to stock the reach downstream of Gulpur tailrace with the fish Mahaseer.

These last two bullets also contributed to biodiversity offsets that offer better overall biodiversity protection than increasing the EFlows release above 4 $m^3 s^{-1}$.

The EFlows Assessment was subjected to an intensive review by the environmental regulator, the Department of Fisheries and Wildlife, the Himalayan Wildlife Foundation and WWF–Pakistan, and approved by the environmental regulator and Wildlife Department on condition of adoption of a Biodiversity Action Plan (BAP) that would ensure a 'net gain' in the key fish species. The BAP includes institutional commitments by the government to implement conservation measures, arrangements for and participation of environmental groups and communities in implementation, independent monitoring, and definition of the financial commitments to be made by the project owner.

1.1.1 A message from Mira Power

"*With the project located in a National Park, the presence of Endangered and Critically Endangered fish species, and the Poonch River classified as Critical Habitat, the Gulpur Project faced a very serious challenge in project development as the project had to prove 'net gain' in key biodiversity values, the fish species in this case. This requirement was mandated by both IFC Performance Standards as well as the local environmental regulations. Given the need for a*

credible assessment of impacts of the project on aquatic biodiversity, the DRIFT model was selected for impact assessment as it adopted an holistic approach and provided for an indicator- and scenario-based approach for design of a project that meets the requirements of IFC and conforms to the principles of sustainable development. Drawing on the results of DRIFT modeling, the design of the project was first modified to reduce the low flow and highly impacted section downstream of the outlet of the power generation tunnel. Subsequently, a non-peaking turbine design and operation combined with an Enhanced Protection management scenario incorporated in DRIFT model was selected to achieve the net gain. The use of the holistic environmental flow modelling was instrumental in proving our ability to achieve net gain to the lenders as well as local authorities, and in making the project an example of creating a win-win situation for the economic development and environment.

The financial costs of the study and subsequent negotiations were negligible relative to other development costs; the costs of the protection measures were incorporated into the power purchase agreements; and the redesign of the diversion tunnel resulted in a considerable reduction in construction costs."