Dhara" (or "Continuous Flow"), "Nirmal Dhara" (or "Unpolluted Flow"), Geologic Entity, and Ecological Entity. To plan the recovery of a wholesome National River Ganga, the task of analyzing the basin status was broken up from the whole to its parts into eight Thematic Groups, namely: *Environmental Quality and Pollution*; *Water Resources Management*; *Fluvial Geomorphology*; *Ecology and Biodiversity*; *Socio-economic and Socio-Cultural*; *Policy, Law and Governance*; *Geo-Spatial Database Management*; and *Communication*. Each thematic study is conducted by select groups of IIT faculty members and allied experts, and seven important missions were identified for focused interventions: *"Aviral Dhara"*, *"Nirmal Dhara"*, *"Ecological Restoration"*, *"Geological Safeguarding"*, *"Disaster Management"*, *"Sustainable Agriculture"*, and *"Environmental Knowledge-Building and Sensitization"*. Based on the findings, action plans are formulated to counter harmful anthropogenic activities in NRGB and promote helpful activities.

Mission *Aviral Dhara*: For a given geological-climatic setting, alluvial rivers achieve stability through long-term balance between various parameters such as water and sediment flow rates, temporal variations of flow, terrain gradient, and seepage flow rates. *"Aviral Dhara"* emanates from this long-term balance of rivers. A direct violation of *Aviral Dhara* is due to dams and barrages, which snap the longitudinal connectivity in rivers and alter river water and sediment flows. However, since NRGB is hydraulically connected by ground water flow, water withdrawals/recharges from different regions of the basin also affect the river. Thus, while longitudinal connectivity in rivers is a prerequisite for *Aviral Dhara*, maintaining Environmental Flows (or E-flows) needed for the sustenance of rivers also depends on judicious management of the basin's waters. Available data indicate that human water use has been increasing rapidly of late, and probably increasing beyond the renewal capacity of the basin. Hence, either (i) water availability in the basin must be increased through *increased storage*, preferably by "distributed storage" in locally manageable and eco-friendly water bodies and aquifers, and/or (ii) water demands must be reduced through more *efficient water use*. These issues call for both technical interventions and changes in government policies on NRGB's water resources. For dams and other structures that disrupt or change river flows, the maintenance of E-flows in the river network is essential, besides fulfilling other safety criteria. The estimated E-Flows for select locations in the Upper Ganga reach – which has many existing and potential hydropower sites – have been presented to enable their inclusion in the design and operation of these dams and barrages.

Mission *Nirmal Dhara*: The Ganga river's present-day water quality is abysmal due to anthropogenic wastes polluting the river network in various ways. The main approach in GRBMP has been to identify the types of pollutants, their sources of generation, and the feasibility of collecting and treating them to the degree needed for reuse and/or safe environmental disposal. Urban and industrial wastewaters are major point sources of pollution that need immediate remediation. For municipal wastewaters it was found that it is economically feasible to treat them to the point where they can be re-used for non-contact purposes, the cost of such additional treatment being only about 1 paisa per litre at

Table 4.2: Criteria for Permissibility of Dams and Other Projects on Rivers

Category	Environmental Impact	Environmental Clearance
I	**MAJOR LONG-TERM, IRREVERSIBLE IMPACTS:** Break in Longitudinal River Connectivity, leading to: (i) loss of habitat of rare or endangered species in river; and/or (ii) disruption in movement of biota along the river length; and/or (iii) disruption in sediment transport in the river. Critical Flow Reductions, leading to: inadequate Environmental Flows needed to maintain river stability and ecological balance. Land Inundation: causing loss of habitat of endangered/ rare terrestrial species living in the areas inundated.	**DEFINITELY "NO"** [*Such a project should be summarily rejected, except in critical national interest and after reviewing at the highest political level.*]
II	**LONG-TERM, IRREVERSIBLE IMPACTS OF LESS IMPORT:** Land Inundation, leading to: (i) loss of terrestrial biodiversity and other ecological changes; and/or (ii) loss of historical, religious and cultural heritage sites. Geological Hazards, such as: (i) seismic hazards; and/or (ii) landslides, land subsidence, etc.	**GENERALLY "NO",** [*But permissible in exceptional cases after thorough study and review by domain experts*]
III	**POTENTIALLY REVERSIBLE LONG-TERM IMPACTS:** Land Acquisition and Inundation, leading to human dislocation, loss of livelihood, marginalization, etc. Construction Activities, leading to: ecological damage, disruption of local hydrology, human dislocation, loss of livelihood, etc. Inadequate water downstream of project area, leading to: adverse effects on livelihood, tourism (including religious tourism) and recreational activities. Adverse socio-economic impacts: Demographic changes, changes in livelihood patterns, unplanned "developmental activities", tourism and other recreational activities, etc.	**"CONDITIONALLY PERMISSIBLE"** [*subject to:* *(i) a comprehensive socio-economic and environmental impact assessment of the project by an independent agency;* *and* *(ii) formulation of a Rehabilitation/ Resettlement Plan and an Environmental Management Plan acceptable to all stakeholders.*]
IV	**POTENTIALLY REVERSIBLE SHORT-TERM IMPACTS:** Construction Activities that cause: noise, explosions, degradation of forests and agricultural land, pollution from debris, influx of outsiders, despoiling of nature, etc. Potentially adverse socio-economic impacts: Increase in crime and other social vices, tensions between native population and outsiders, etc.	

The second option of "*distributed water storage*" can be of great advantage in NRGB (see Figure 4.2). NRGB has a vast groundwater storage capacity which can be annually replenished by capturing runoff (during monsoons and other rainfall periods) and letting it percolate down to the water table through recharge pits, trenches, etc. In addition, distributed surface storages (ponds and tanks) also need to be adopted for their environmental and socio-economic usefulness. Taken up at the level of small or micro-watersheds, these measures have the advantage of decentralized and better management by local government bodies and end-users (rural and urban communities), besides boosting