Tools for Sustainable Hydropower Development

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Growth of Hydropower

- Hydropower represents about 16% of energy globally and 70% of renewable energy.
- In some Regions such as Latin America it is growing exponentially with over 800 approved projects.
- In many countries the share of hydropower is quite high as compared to other sources of energy

Share of Hydropower	Countries
≈100%	Albania, DR of Congo, Mozambique, Nepal, Paraguay, Tajikistan, Zambia
> 90%	Norway
> 80%	Brazil, Ethiopia, Georgia, Kyrgyzstan, Namibia
> 70%	Angola, Columbia, Costa Rica, Ghana, Myanmar, Venezuela
> 60%	Austria, Cameroon, Canada, Congo, Iceland, Latvia, Peru, Tanzania, Togo
> 50%	Croatia, Ecuador, Gabon, DPR of Korea, New Zealand, Switzerland, Uruguay, Zimbabwe

E & S Impacts of Hydropower

Hydropower Plant Type	Main Environmental Impacts
All	Barrier for fish migration and navigation, and sediment transport. Physical modification of riverbed and shorelines.
Run-of-river	Unchanged river flow when powerhouse is located at the toe of the dam; when powerhouse is localized further downstream, reduced flow between intake and powerhouse (dewatered zone).
Reservoir (storage)	Alteration of natural and human environment by impoundment resulting in impacts on ecosystems and biodiversity and communities. Modification of volume and seasonal patterns of river flow, changes in water temperature and quality, land use change related GHG emissions.
Multipurpose	As for reservoir HPP. Possible water use conflicts. Driver for regional development.
Pumped Storage	Impacts confined to a small area, often operated outside the river basin as a separate system that only exchanges the water from a nearby river from time to time

Cumulative Impacts and Climate change!

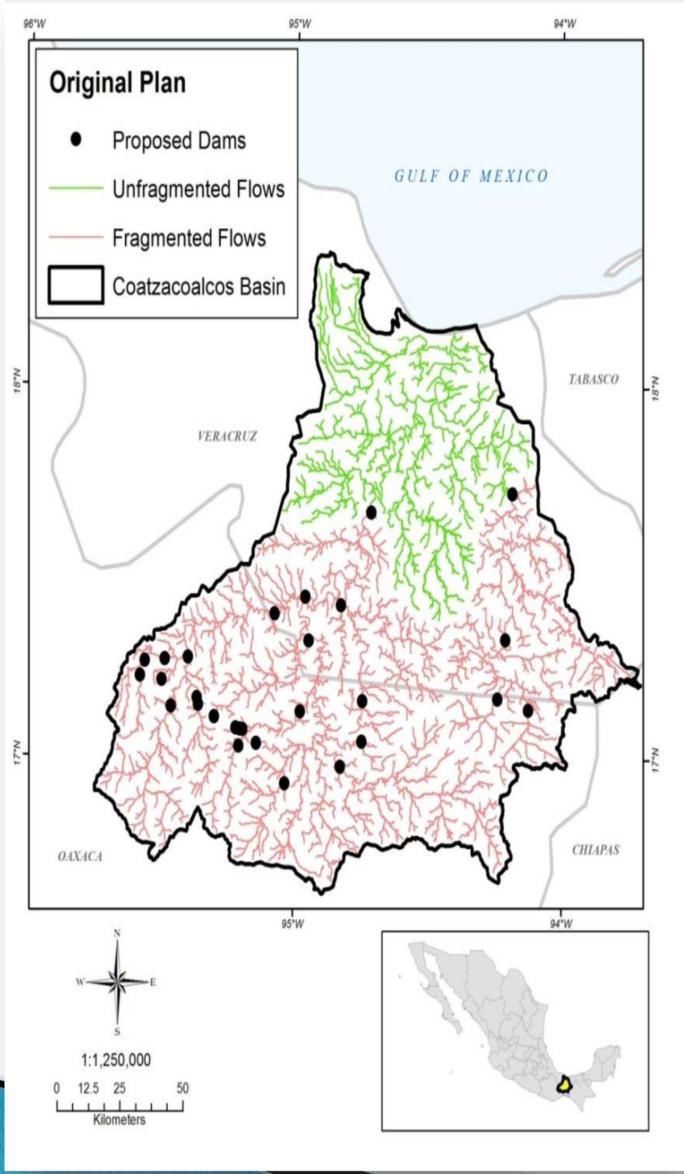
Good E&S Practices

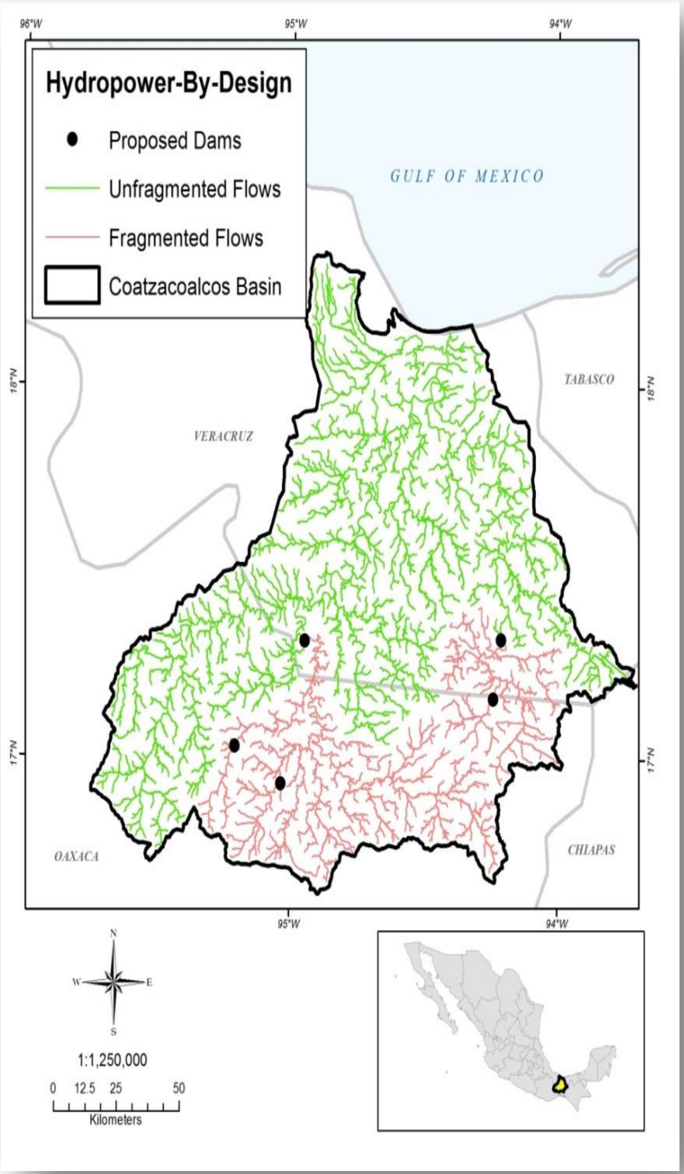
- A number of international criteria and guidelines
- Safeguards of IFIs
- There is a trend to meet standards that are additional to, and higher than national standards.
- Conducting SEAs, cumulative impact assessment, environmental and social impact assessment
- Including community consultations

Hydropower By Design

- Looks at an entire river basin and the impacts a dam will have both upstream and downstream.
- Meant to guide decision-making by looking beyond individual project locations to identify the cumulative impacts of development on natural areas across the landscape.
- Example: Upstream planning in Coatzacoalcos River basin, Mexico; Tapojas Basi, Brazil; Magdalena Basin, Colombia.

Basin Scale Planning

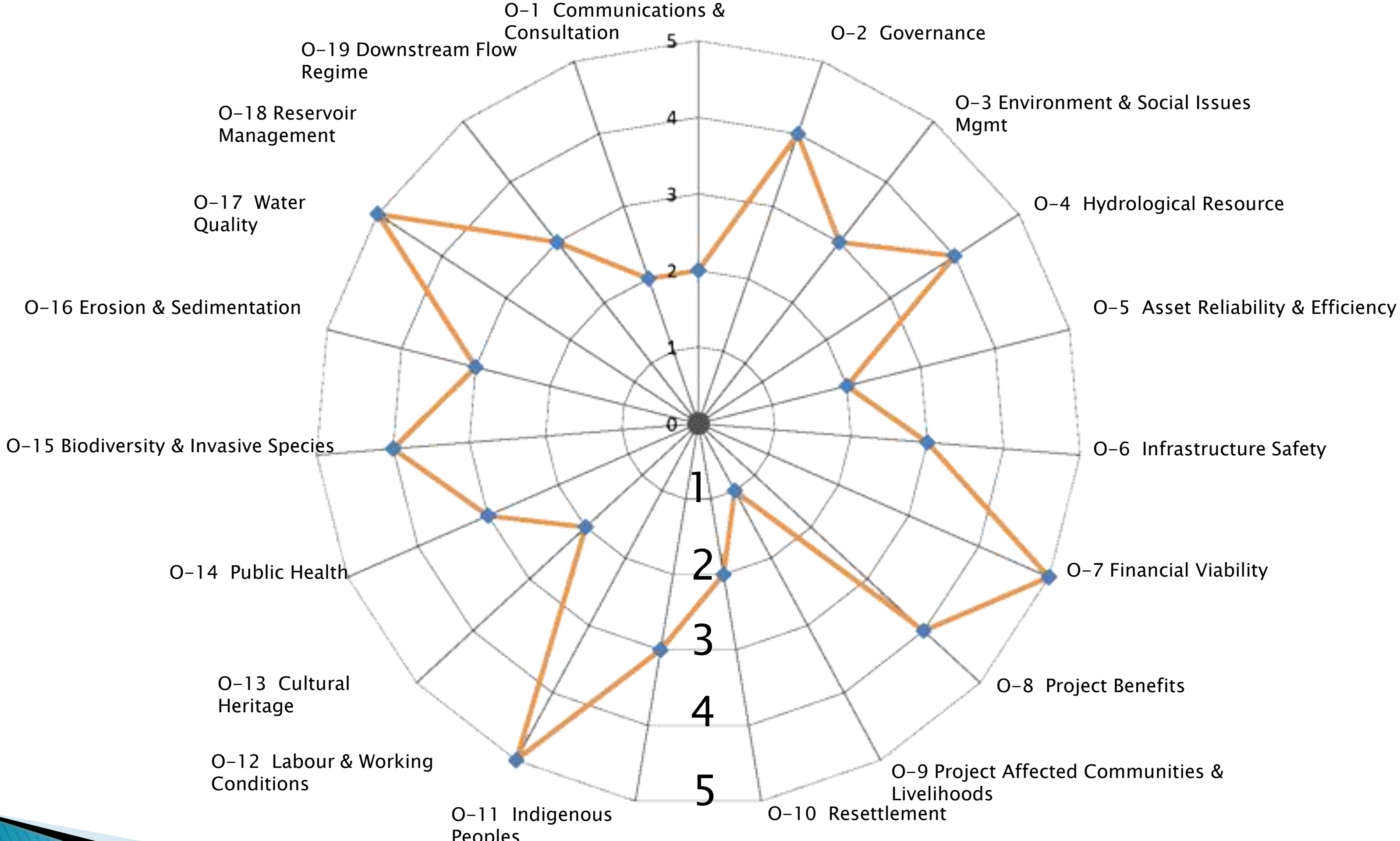




IHA Sustainability Assessment Protocol

- It is hydropower specific
- The Protocol encompasses all aspects of sustainability
- It measures the relative sustainability across 20+ topics
- Not a substitute for existing standards or regulations
- But can be a valuable complement to the standards or safeguards

Sustainability Profile: Presentation of results



Hydropower Sustainability Assessment Protocol

Rapid Basin-wide Hydropower Sustainability Assessment Tool (RSAT)

- To assess hydropower in a basin wide context based on integrated water resources management principles.
- Can be used to access a single hydropower project and its relationship to a sub-basin, existing or proposed cascades of hydropower projects within a sub-basin or multiple projects within a sub-basin.
- Has a framework of 10 topics and 27 sub-topics for basin wide hydropower sustainability

RSAT Topics and Subtopics

Topic 1. Institutional capacity	**Topic 6 Environmental management and ecosystem integrity**
Transboundary institutional capacity	Assessment and management of basin wide environmental impacts
National to local institutional capacity	Biodiversity conservation and ecosystem integrity
Water and energy sector integrated planning	**Topic 7 Flows and reservoir management**
Topic 2. Options assessment, siting and design	Multiple water use optimization and efficiency
Demonstrated need and options assessment	Reservoir planning and management
Siting and design for basin wide sustainable development	Co-ordinated hydropower operations
Topic 3 Economic contribution of hydropower	Downstream and environmental flows
National economic and financial analysis	Flood and drought management
Transboundary economic analysis	**Topic 8 Erosion, sediment transport and geomorphological impacts**
Topic 4 Equitable sharing of hydropower costs and benefits	Sediment baseline and impact assessment
Transboundary benefit sharing	Management of impacts and sediment resources
National to local benefit sharing	**Topic 9 Management of fisheries resources**
Financing ecosystem protection and other measures	Fisheries baseline and impact assessment
Topic 5 Social issues and stakeholder consultation	Management of impacts and fisheries resources
Stakeholder identification and consultation	**Topic 10 Dam and community safety**
Assessment and management of basin wide social impacts	Dam safety
Food security and poverty alleviation	Community safety and emergency response
Indigenous peoples and ethnic minorities	

Source: RSAT 2013.

Greenhouse Gas Risk Screening Tool

- Estimates the likely level of total (gross) GHG emissions from a freshwater reservoir.
- Has been developed as an empirical model, making use of existing published data of gross GHG emissions from previous assessments on 169 reservoirs around the world.
- The model comprises of five stages of measurements: inundation area; reservoir; upstream watershed; reservoir outflow facilities; and downstream reach.

Integrating Environmental Flows

- The key objective is to maintain the existing in-stream values as closely as possible.

The minimum environmental flow (m^3) =total water required for downstream water users (m^3) + the minimum flow required to maintain ecosystem function (m^3)

- Example: The Yacyretá HPP includes an ecological flow of 1,500 m^3/s. This flow includes the quantity, timing, and quality of water flow required to sustain freshwater and estuarine ecosystems of the river and human livelihoods.

Compensation

Terrestrial Compensation

- Example: Yacyreta hydroelectric project established more than 170,000 hectares of protected areas
- Like-for-like habitat compensation criteria

Ecological Restoration

Reventazón Hydroelectric Project

- 305.5 MW hydroelectric power plant
- 130-m high dam
- Diversion tunnel
- Hydroelectric generation facilities
- 20 km of new internal access roads

Aquatic biodiversity impacts

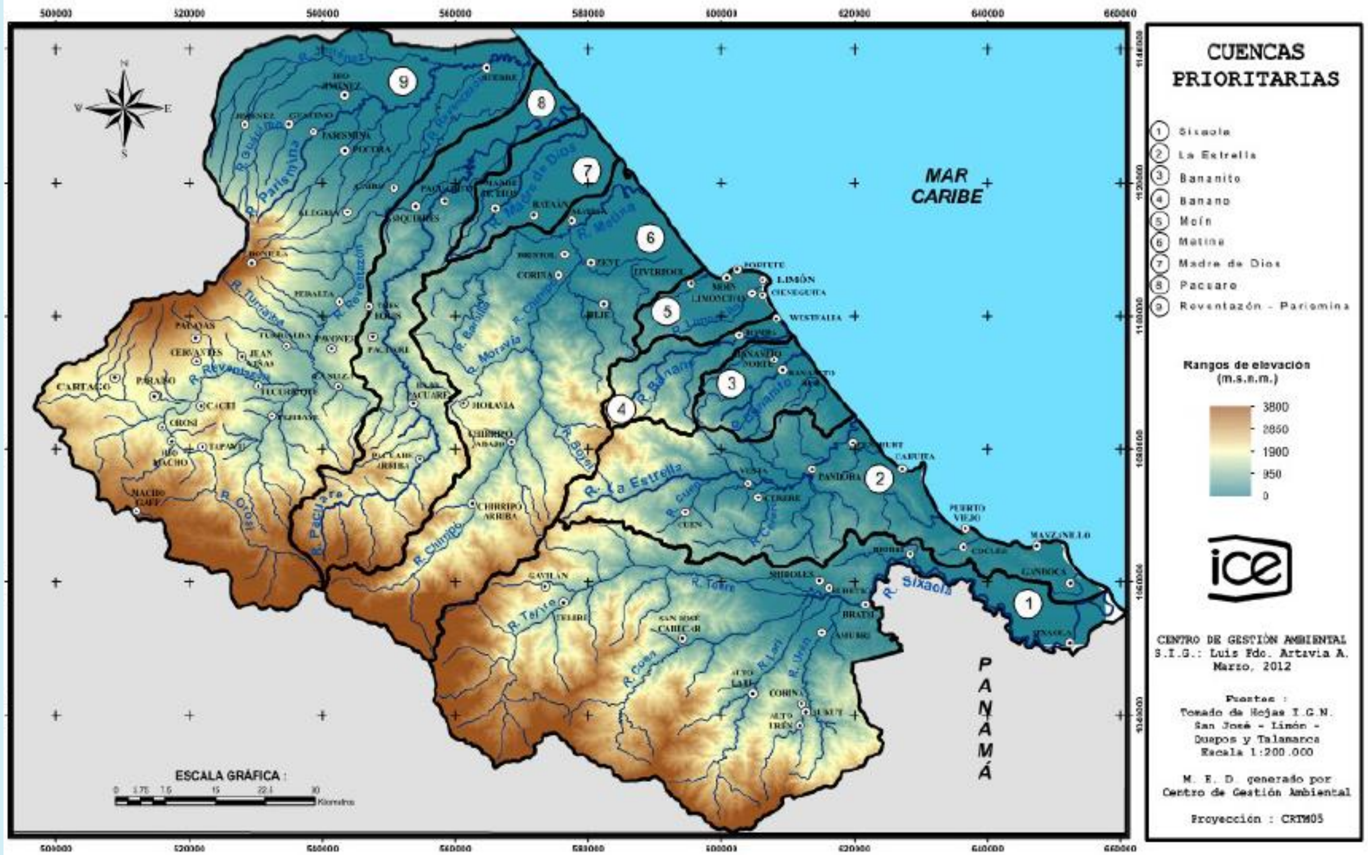
Direct and cumulative impacts of Reventazón HPP in addition to all the hydroelectric plants in the basin, on aquatic ecosystems are significant and substantially reduce the ability of the river to maintain viable populations of migratory fish and other aquatic organisms.

Compensation

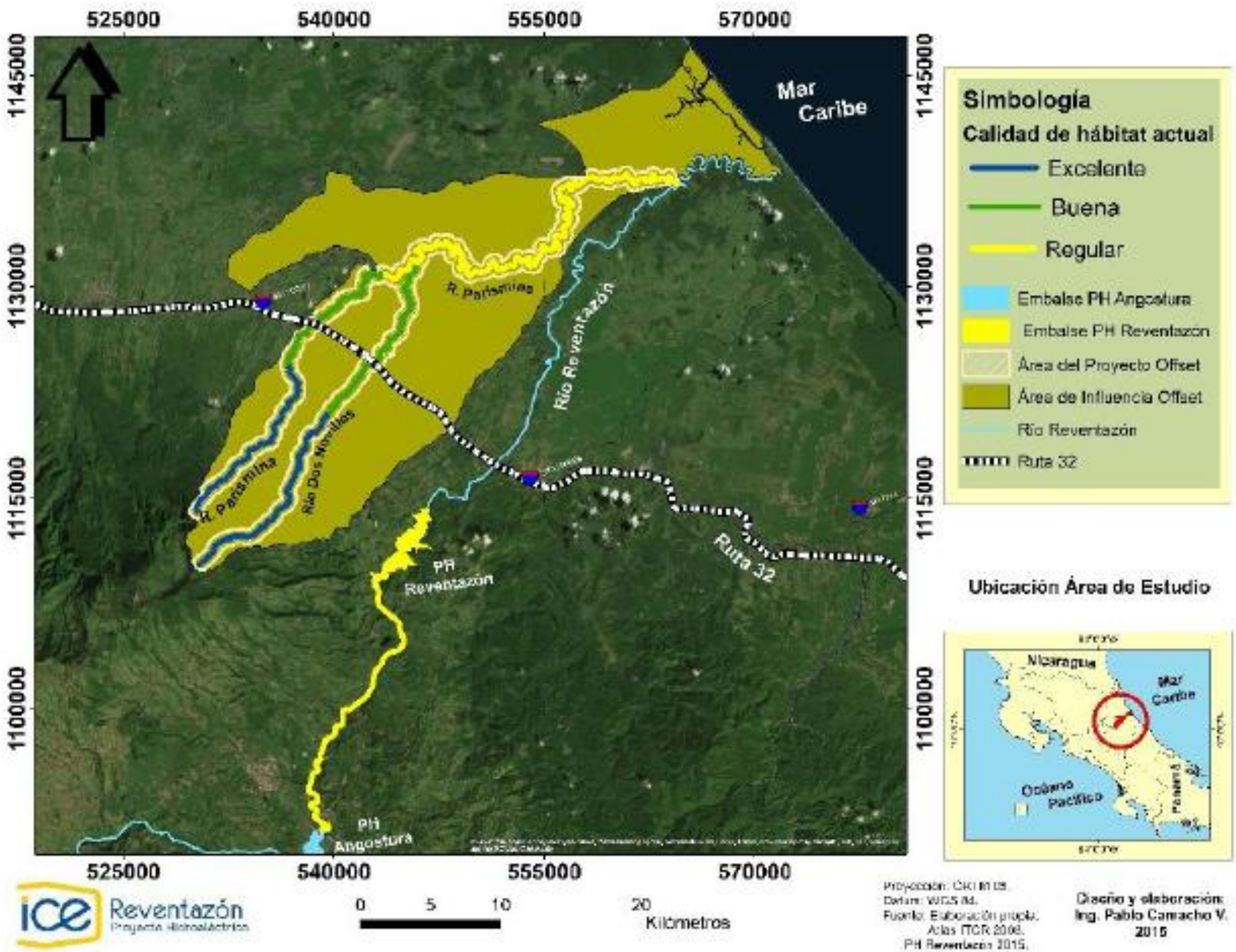
Aquatic Compensation – Fluvial Offset

Selection criteria

- Presence of Protected areas
- Connectivity to sea Caribbean
- Topography
  - Slope
- Ecological conditions
  - Habitat
  - Aquatic biodiversity
    - Micro invertebrates
    - Migratory fish
  - Life zones
- Climatic conditions
- Environmental services
  - Tourism



Reventazon HPP: A protected area in an ecologically equivalent river system with no existing barriers to connectivity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PH Angostura
Simbología
Calidad de hábitat actual
Excelente
Buena
Regular
Embalse PH Angostura
Embalse PH Reventazon
Área del Proyecto Offset
Área de Influencia Offset
Río Reventazón
Ruta 32
Ubicación Área de Estudio
Nicaragua
Mar Caribe
Océano Pacífico
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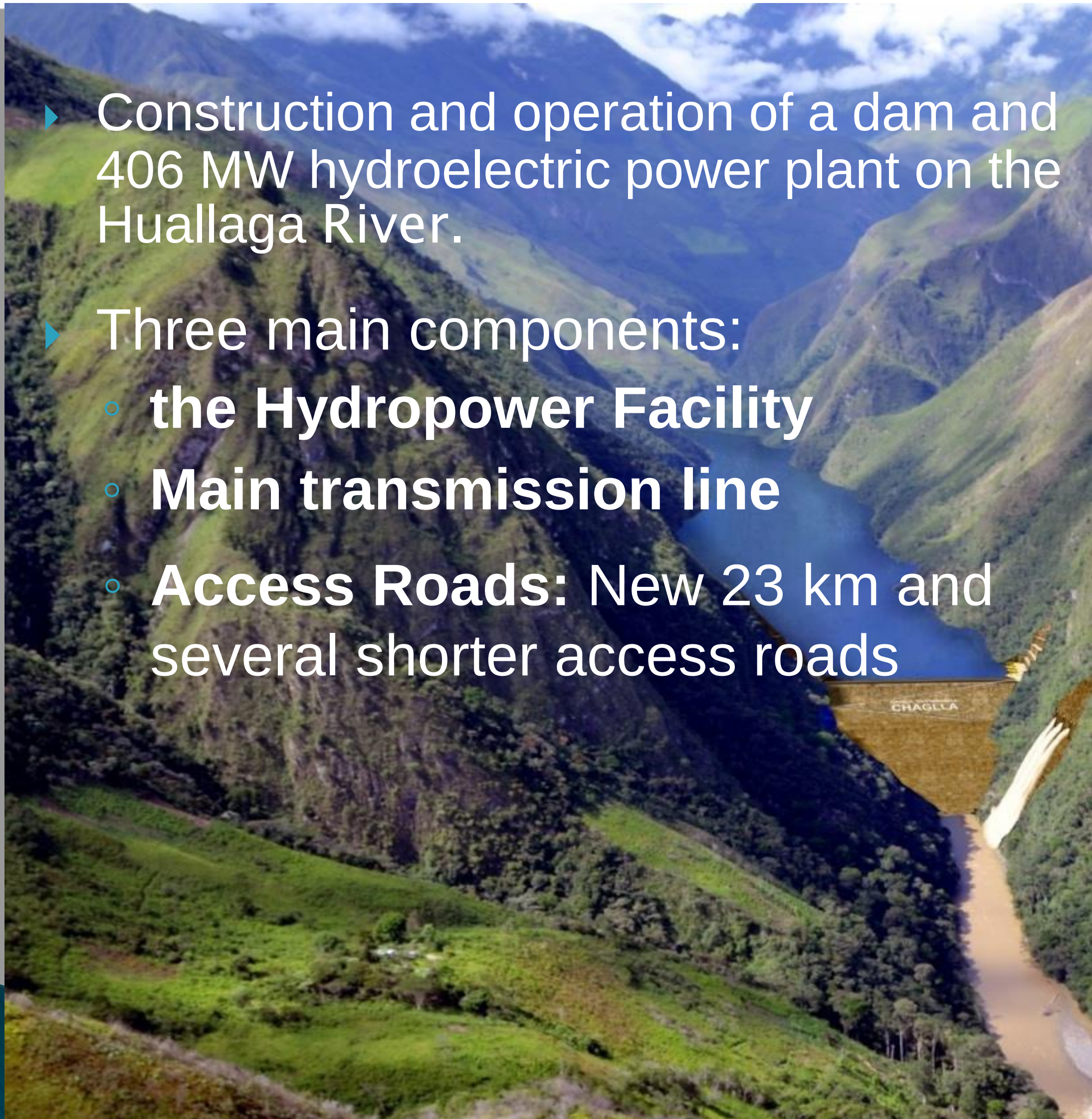
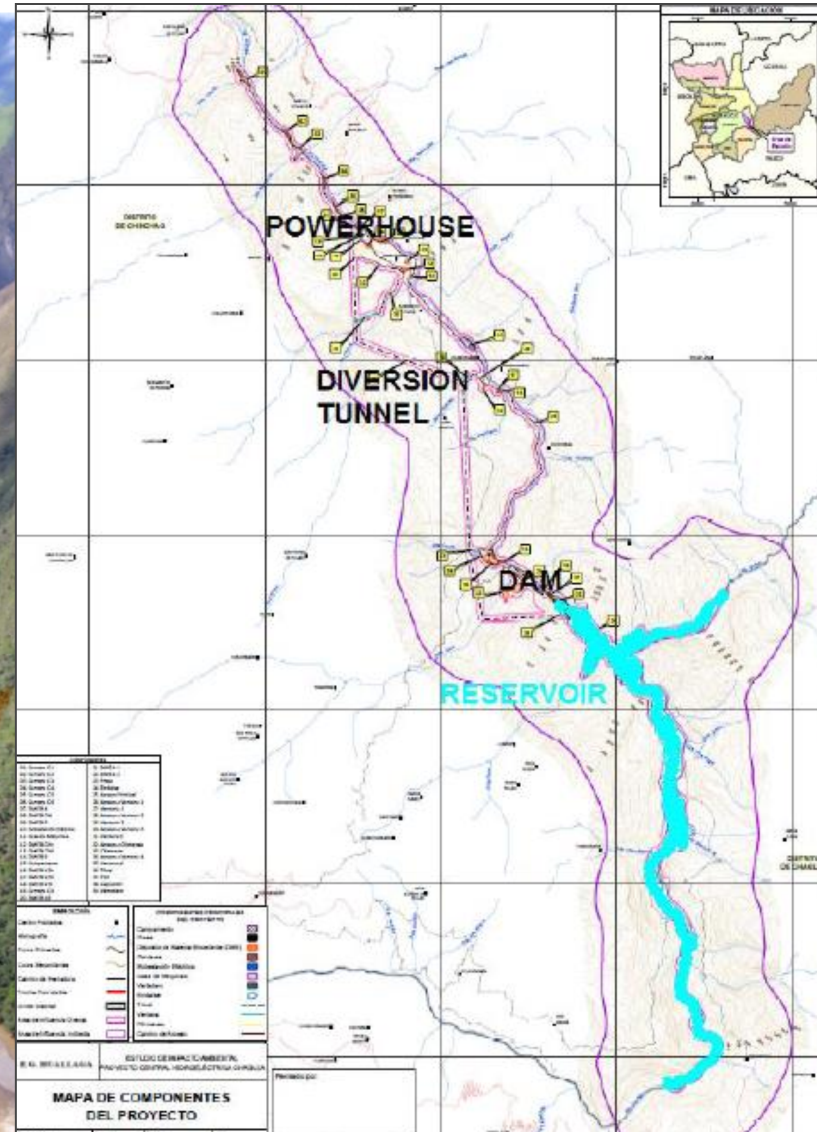
Kilómetros
Diseño y elaboración:
Ing. Pablo Camacho V.
2015

Compensation – Chaglla Aquatic Offset

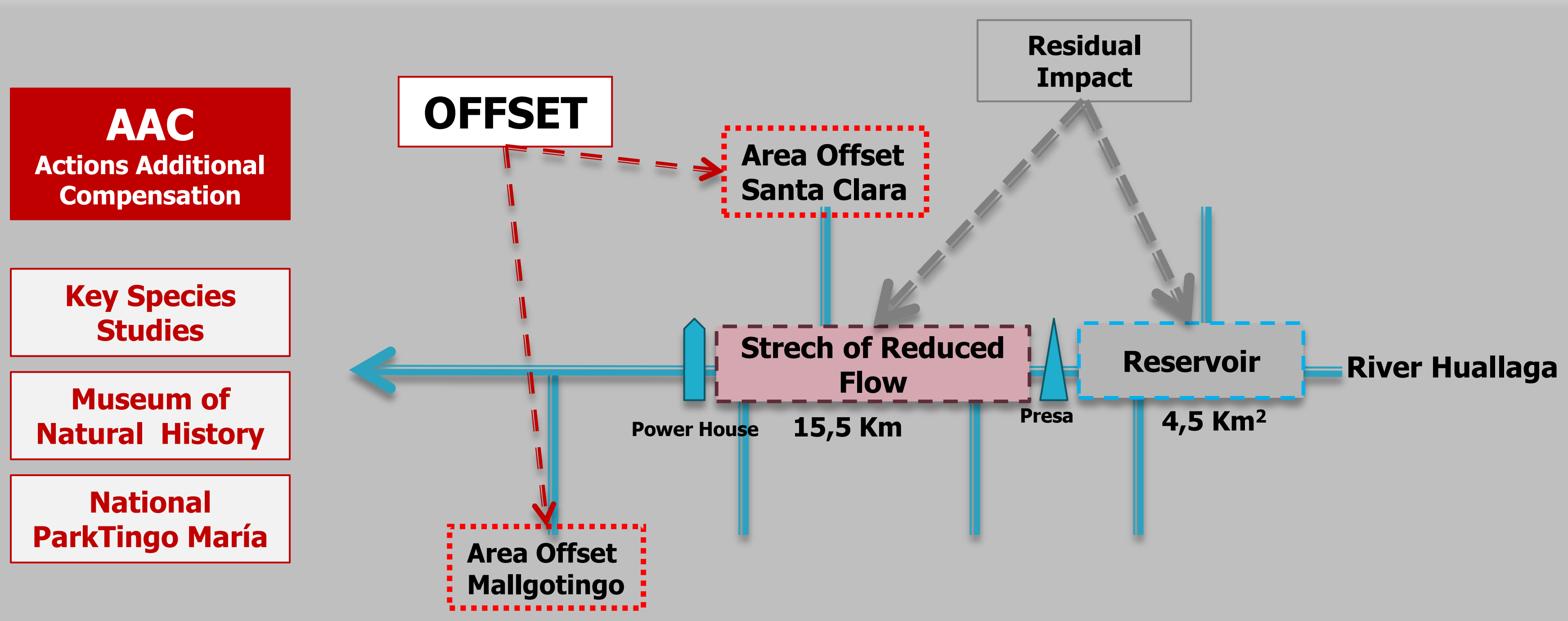


- Construction and operation of a dam and 406 MW hydroelectric power plant on the Huallaga River.
- Three main components:
  - **the Hydropower Facility**
  - **Main transmission line**
  - **Access Roads:** New 23 km and several shorter access roads



Fluvial Compensation

Aquatic compensation



Restoration and Compensation

Restoration of damaged habitat

Conservation and restoration of Riparian forest

Adaptive Management

Specie specific studies

Rapid ecological and social assessment

Riparian habitat improvement

Fluvial offset monitoring

Environmental Awareness program

Conclusion

- Investment in hydropower is intensifying and sustainability is proving to be a critical component of the boom.
- Without upstream planning and integrated water resources management, environmental mitigation measures at the project level are limiting
- There is a need to utilize the tools to ensure that Hydropower develops in a manner that is compatible with the environment and local communities.

Thank You!