4 NAM THEUN 2 HYDROPOWER PROJECT AND ITS PREDICTED IMPACTS

4.1 Introduction

This chapter gives a brief summary of the basic features of the NT2 Project, the assumed project specific impacts, and the planned mitigation measures and preventive actions.

For more details about the Project development history, descriptions of the technical features of the project, and the project specific impacts and management plans, we refer to the Draft Environmental Assessment and Management Plan prepared by NTPC, October 2003. Map 2 shows the location of the project.

4.2 Technical features

4.2.1 The Reservoir

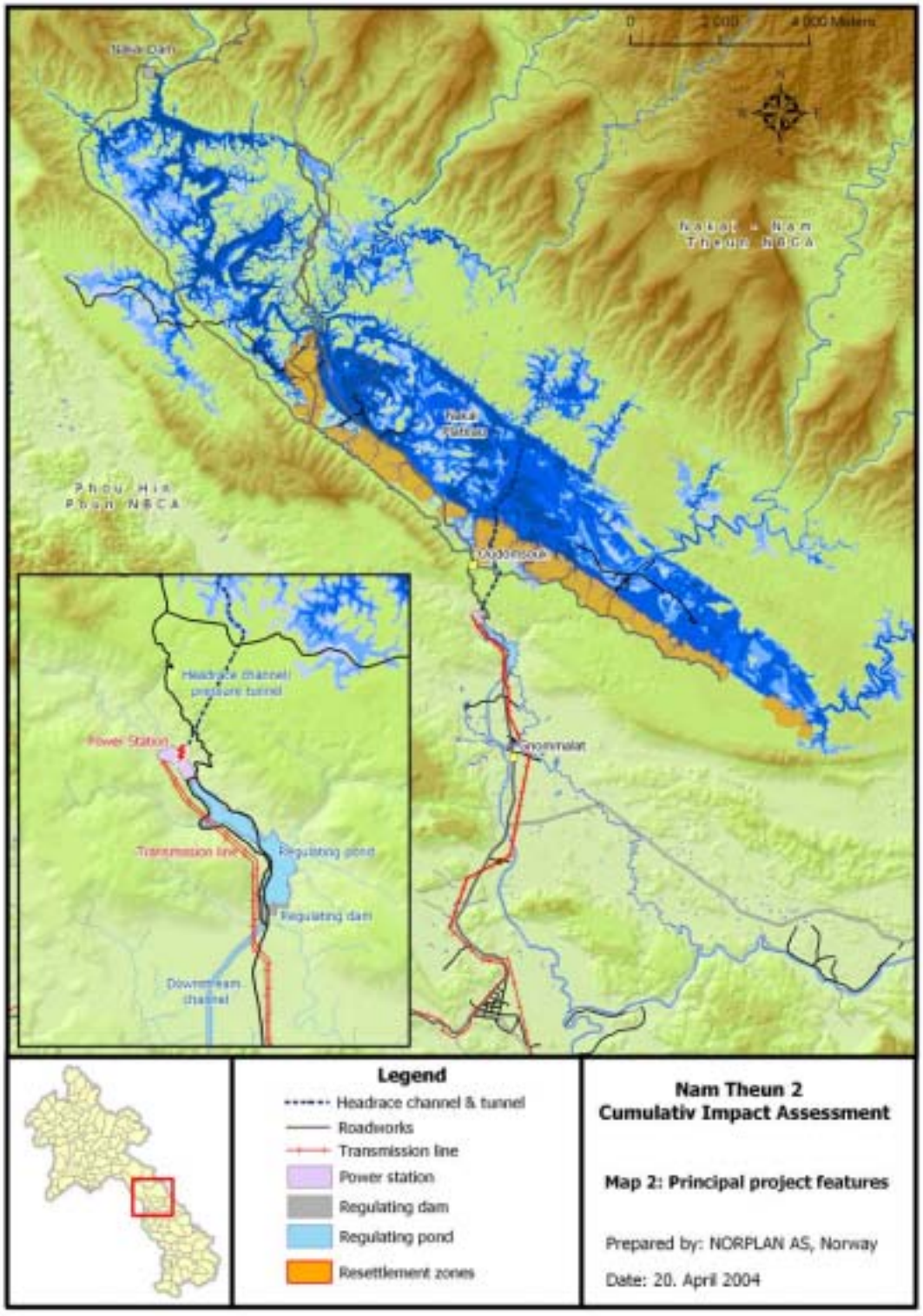
The Project reservoir will be formed by the construction of a 48 m high gravity dam with a crest length of 325 m across the Nam Theun, plus 13 small earthfill dams in saddles along the west bank of the reservoir. This will change the river and surrounding forestland into a lake that, at its highest level by the end of the wet season, will cover 450 km^2. In the dry season the surface area might be reduced to 82 km^2. The main features of reservoir are shown in Table1.

Table1: NT2 Reservoir Features.

Catchment Area	4,013 km^2
Total storage	3,900 million m^3
Live storage	3,530 million m^3
Full Supply Level (FSL)	El. 538.0 m
Minimum Operating Level (MOL)	El. 525.5 m
Surface Area at FSL	450 km^2
Surface Area at MOL	82 km^2

4.2.2 Power Plant and Water Diversion

The water in the reservoir will be diverted by a 3 km headrace tunnel, pressure shaft and pressure tunnel from the intake structure at Oudomsouk (Nakai) to the power station at the foot of the escarpment 10 km north of Gnommalath. This will create a gross head of 348 m. The power station will contain four Francis turbines for export production (EGAT) and two Pelton turbines for delivery to the local EdL distribution network. The total installed capacity will be 1074 MW.


Nakai Dam
Nakai - Nam Theun NBCA
Nakai Plateau
Phou Hin Poun NBCA
Thakhek
Headrace channel pressure tunnel
Power Station
Transmission line
Regulating pond
Regulating dam
Downstream channel
Legend
Headrace channel & tunnel
Roadworks
Transmission line
Power station
Regulating dam
Regulating pond
Resettlement zones
Nam Theun 2
Cumulativ Impact Assessment
Map 2: Principal project features
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The discharge from the power plant will be conveyed through a short tailrace channel into a regulating pond, which will allow for buffering of fluctuations in the water release created by daily peaking operations of the plant. From the regulating pond the water will be lead trough a 27 km long channel discharging into Xe Bangfai upstream of Mahaxai. An aeration weir will be built to reduce the content of methane and hydrogen sulphide and to improve the oxygen concentration in the water. Several outtakes for irrigation purposes will be constructed along the channel.

4.2.3 Hydrology and Planned Operations

The catchment area of the reservoir is 4,013 km^2, most of it located in the Nakai-Nam Theun Biodiversity Conservation Area (NNT NBCA). Due to this relatively undisturbed catchment, the water quality is good with high transparency. The average annual runoff is 7,487 million m^3. With live storage capacity of 3,530 million m^3 the reservoir will easily be filled in the wet season. Based on the statistics available, the yearly water flow of the Nam Theun was greater than the reservoir's total capacity in 49 out of the 50 years since records began.

The environmental flow requirement (riparian release) in Nam Theun downstream of the dam site is set to 2 m^3/s (approximately 5.2 million m^3 per month) + 5 million m^3/year to be used for flexible release. The unregulated flow is today about 20 m^3/s in the dry season and 1500 m^3/s in the wet season.

The main volume of water will be transferred from the reservoir through a tunnel to the power plant and discharged into the river basin of Xe Bangfai. The power plant will operate on a daily peaking mode. The discharged water from the power plant will increase the water flow in Xe Bangfai with an average of 250 m^3/s. This will double the dry season flow and add about 10% to the natural wet season flow in Xe Bangfai.

4.2.4 Associated Infrastructure

Roads

A number of roads will be constructed or improved as part of the planned project:

- The existing roads 12 and 8B between Thakhek and Ban Gnommalath will be upgraded and bridges reinforced where necessary.
- Between Gnommalath and Ban Oudomsouk, on the Plateau, the existing road (8B) will need significant upgrading.
- A new road will be constructed to replace the sections of 8B that will be inundated by the planned reservoir.
- A new access road will be constructed to enable transport to the Nakai dam site at Nam Theun.
- In addition a number of existing smaller roads will be improved to enable access to the resettlement villages and farm plots on the plateau.

Camps and Residence

Four areas have been identified for construction work camps:

- Nakai Dam Area Construction Camp to accommodate about 800 workers,
- Oudomsouk Work Camp for intake structure and upper tunnel workers, with capacity for about 800 workers,

- Power Station Work Camp for lower tunnel, power station, regulating pond works, catering for about 2200 workers, and
- Downstream Work Camp for channel, quarry sites, etc. catering for about 400 workers.

In addition to the formal camp areas additional zones have been identified in the vicinity of camps that can accommodate businesses, families and other "followers" that normally will be attracted to the areas of new activity.

The project will establish an operator's village close to the de-regulating pond area. This village will be the residence of about 150 permanent employees. This new village will have a post office, a telecom centre, shops, recreational facilities, a school, etc.

Resettlement Areas

The construction of the reservoir will require resettlement of about 5000 people in 21 villages and hamlets. The resettlement area is planed in about 208 km^2 in the forested land between the western shore of the reservoir and the escarpment. The Nakai District capital is also located in this area. The relocation distances vary between 5 and 0.5 km and the land is within familiar territory for most communities.

Transmission Lines

Adjacent to the power station a 500/115 kV substation and a 115/22 kV substation will be constructed. Electricity to EGAT will be delivered at the Thailand border north of Savannakhet via a 138 km long double circuit 500 kV transmission line. From the border a similar 160 km long line will connect to a new substation at Roi Et in Northeast Thailand. Energy to EdL will be transferred from the project substation via a 115 kV transmission line to a substation transformer in Thakhek. The detailed alignment of these transmission lines is yet to be decided.

Table 2: Summary of Identified Project Impacts and their Mitigation

Sectors	Direct and Indirect NT2 Impacts	Proposed Mitigation
Hydrology and water resources	Á Impoundment of 195 km of Nam Theun. Á Significant reduction in water flow in Nam Theun and Nam Kading. Á Significant increase in water flow in Xe Bangfai Á 3% reduction (in average) in water flow in Mekong from Nam Kading to Xe Bangfai. Á Reduced risk of flooding along Nam Theun and Mekong, increased risk along Xe Bangfai.	Á Minimum bypass flow of 2 m^3/s. below the Nakai dam. Á Construction of a regulating pond for a more constant release of water into Xe Bangfai. Á Restrictions on outflow from the reservoir in periods of floods in Xe Bangfai.
Water quality	Á Periodic episodes of low concentration of dissolved oxygen in parts of the reservoir (anoxic conditions) and downstream rivers. Á Increased nutrient concentrations during the initial years. Á Waste water discharges from construction sites and camps.	Á Reduction of biomass in the inundation area (reservoir). Á Discharges into Nam Theun from the epilimnion of the reservoir. Á Construction of an degasification and aeration weir downstream of the regulating pond. Á Solid waste and wastewater management. Á Effective catchment management.
Erosion and sedimentation	Á Increased sedimentation in the inundation area (reservoir) and reduced sedimentation in Nam Theun downstream of the dam. Á Reduced riverbank erosion in Nam Theun downstream of the dam. Á Increased riverbank erosion in Xe Bangfai below the confluence with the downstream channel. Á Potential for erosion in downstream channel.	Á Implement soil protection measures. Á Riverbank protection / stabilisation Á Lining of exposed sections of the channel. Á Asset and livelihood compensation.
Climate	Á Minor microclimatic changes (air temperature and relative humidity) around the reservoir.	Á No mitigation measures.
Physical cultural resources	Á Several sites and physical structures of cultural significance are found within the inundation area. No sites on the Nakai Plateau have been classified as important with regards to historical and cultural values.	Á Further studies of the affected sites on the Nakai Plateau will be conducted. Á Develop a management strategy / plan for sites and structures of archaeological, cultural or religious significance.
Terrestrial biodiversity	Á 1170 km^2 will be affected by the project (construction phase). Areas of mixed broadleaved and coniferous forests, swamps and gallery forests are most affected. Á 450 km^2 of forest, woodlands and other land will be lost in the inundation area. Á Habitats for a wide range of animals, including endangered/threatened species like Tiger, Elephant, Macaques, Dhole, Gaur, Banteng, White winged duck, etc. will be reduced. Increased access to certain areas (NNT NBCA) and increased human population on the Nakai plateau will lead to increased hunting pressure and trade in wildlife.	Á Designation of Nakai – Nam Theun NBCA. Management / protection funded by NTPC. Á Alternative livelihood systems combined with conservation for inhabitants of the NBCA Á Management plans for five species of mammals and ten species of birds. Á Conservation programmes for Asian elephant and White winged duck. Á Ban on hunting among workers.

Aquatic habitats and fish diversity	Á Transformation of a river (Nam Theun) into standing water (the reservoir) will disfavour species adapted to fast flowing conditions. Á The dam will represent a barrier for species migrating from lower Nam Theun to its headwaters. Á Large seasonal fluctuations in water level in the reservoir, and changes in water quality (anoxic conditions), are likely to lead to unfavourable conditions for some fish and other aquatic species. Á Changes in water flow and temperature in Xe Bangfai might alter the species composition and the productivity of the river. Á Work in or along rivers might increase the sediment load. This can cause damage to fish (gills), destroy spawning areas and reduce the productivity of the river. Á Potential for pollution from domestic wastewater and chemicals from workplaces and camps.	Á Clearing of vegetation in the inundation area (reducing biomass). Á Diversion of the river away from the dam site during construction. Á Stabilisation of road sides and other affected areas in order to reduce erosion. Á Construction of retention tanks around areas where liquid and solid fuels and chemicals are stored.
Social impacts	Á Resettlement of approximately 5000 ethnic minorities on the Nakai Plateau. Á Potential in-migration that could lead to reduced capacity of local authorities and marginalisation of ethnic minorities. Á Influx of population could create inflation and shortages of essential goods due to increased demand. Á Increased competition for natural resources. Á Health impacts including the inability of existing services to cope with demand, increased STIs and the threat of the spread of HIV/AIDs, poor sanitation and spread of other communicable diseases. Á Direct impacts on downstream communities due to landtake for camps and project sites. Á Changes in water quality and water flow may result in the introduction or elimination of water-borne diseases.	Á Livelihood packages for agricultural, fisheries and forestry development for resettlement communities. Á Improved institutional capacity for local, regional and national institutions for implementing resettlement and livelihood development plan. Á Exclusive rights for resettlers in relation to natural resource management. Á Health, education and community development initiatives for resettlers. Á Specific measures to ensure benefits for women. Á Culturally sensitive consultations and mitigation for ethnic minorities. Á Mitigation framework for monitoring and implementation of measures to enhance project benefits in the Xe Bangfai and other downstream areas (e.g. irrigation potential and capacity building). Á Support for local and regional capacity building for implementation of mitigation measures for GoL.

4.2.5 Regional and Cumulative Impacts and Implications

The reports listed in 4.3.1 briefly discuss some of the regional and cumulative aspects and potential impacts of the Project. Among others the following issues has been addressed:

- Changes in hydrology, water quality and flow along the Nam Theun/Nam Kading, the Xe Bangfai basins and to some extent the Greater Mekong River,

- Regional health development and health service in Bolikhamxai and Khammouane Provinces,
- Improved infrastructure, including upgrading of existing roads, new roads, electrification and water supply to resettler villages,
- Threats to the Nakai-Nam Theun NBCA caused by improved transportation and market access and population increase in the area surrounding the NBCA,
- Institutional capacity situation and the potential for improvements through training and management of the project at all government levels.