

# PNPCA, LUANG PRABANG HPP



Ministry of Energy & Mines, Lao PDR  
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# CONTENTS

- Introduction
- General Overview
- Fish Migration
- Navigation
- Existing Infrastructure
- Sediment Management

## PROJECT OVERVIEW - LOCATION

- Located at Mekong km 2036 in Luang Prabang province, Lao PDR
- About 25 km upstream of the city of Luang Prabang
- Between Pak Beng HPP (upstream) and Xayaburi HEPP (downstream)





# Project Overview

## Salient Features

### Auxiliary Powerhouse

3 Kaplan turbines  
Total Capacity: 60 MW

### Spillway Structure

3 Low Level Outlets  
6 Surface Spillways  
Total Capacity: 41,400 m<sup>3</sup>/s

### Navigation Lock

2-Step Navigation Lock  
2 x 500 DWT  
Total Lifting Height: 35.50 m

### Powerhouse

7 Kaplan TG units (200 MW each)  
Design Discharge: 5,355 m<sup>3</sup>/s  
Total Capacity: 1,400 MW

### U/S Migration - Left Pier

Diversion wall during Construction  
Entrances along PH width  
2 Fish Locks at Left Pier

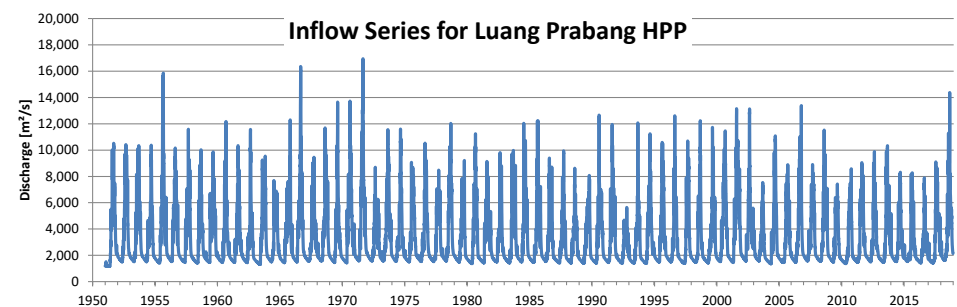
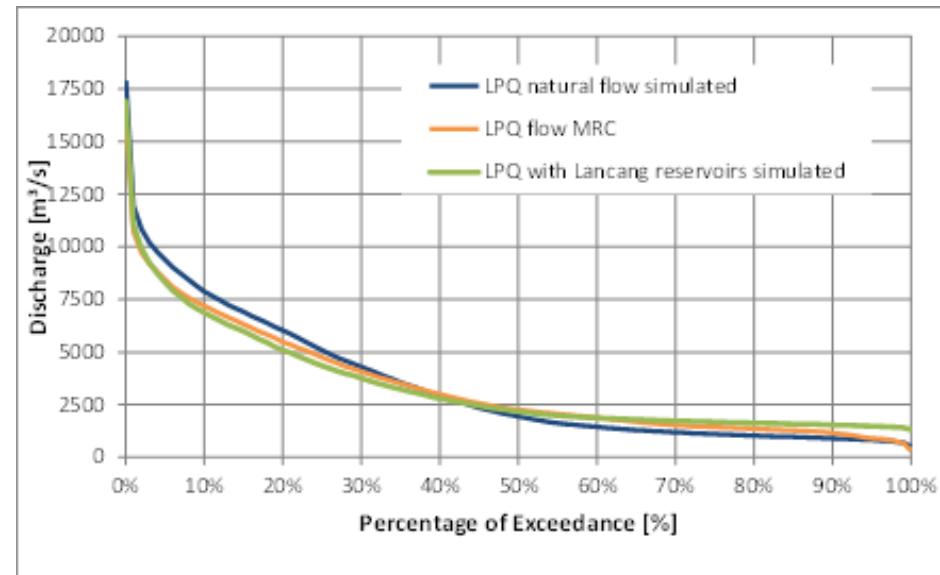
### D/S Migration - Right Pier

Entrances above Power Intakes  
Terminal Structure: Chute

# HYDROLOGY

In general good data basis  
Main focus was in impact of Lancang Cascade

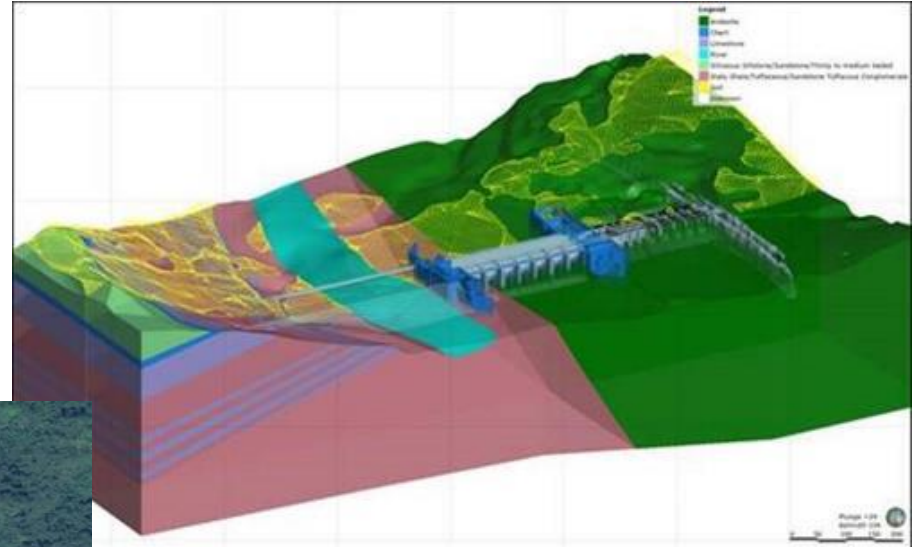
- Hydrological Rainfall-Runoff Model with 60 years of data, calibrated using first 4 years of full operation of Lancang Cascade
- Impact of Lancang Cascade
  - Significant higher than anticipated
  - Positive effects due to higher dry season floods
  - Sedimentation: Lancang cascade heavily impacts sediment regime in Lower Mekong





# GEOLOGY

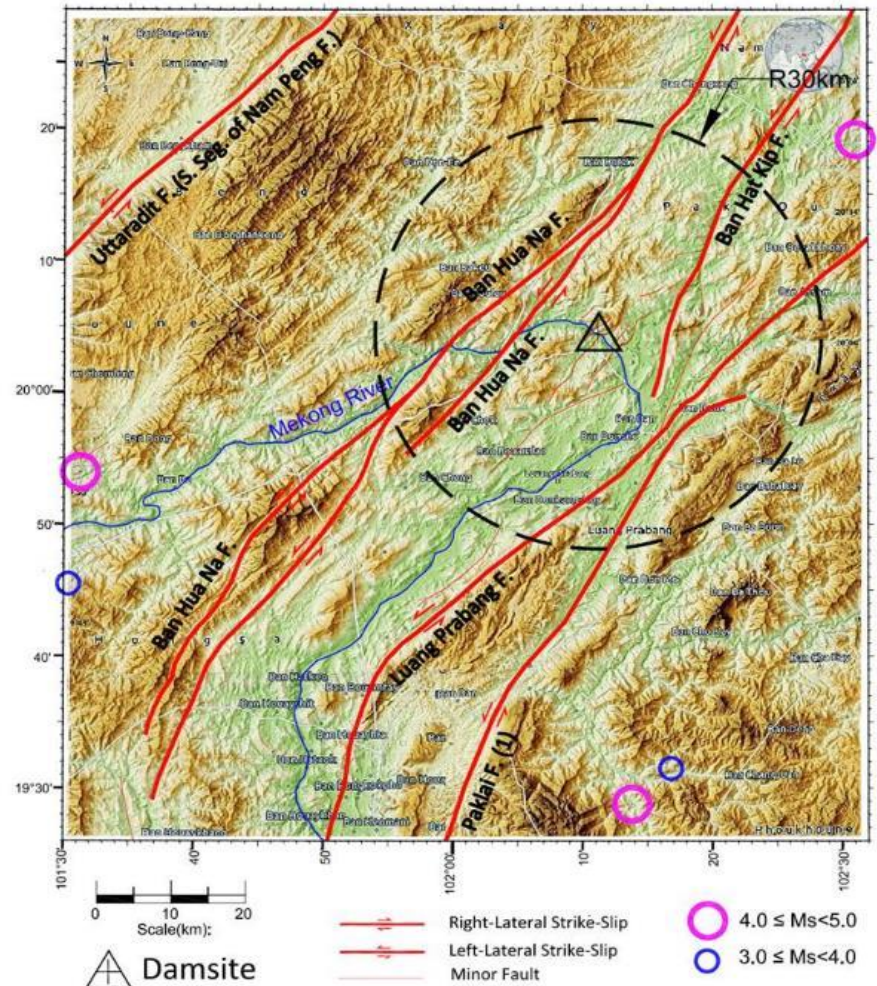
- Site investigation and laboratory testing carried out
- Geology:
  - Volcanic rocks and
  - Limestone
- Additional investigations ongoing



# SEISMICITY

The Seismic conditions have been checked and the following conclusions have been made:

- Active faults about 10-20 km away from dam site
- Medium seismicity
- Probabilistic and Deterministic Seismic Hazard Assessment carried out
- No risk of reservoir triggered seismicity

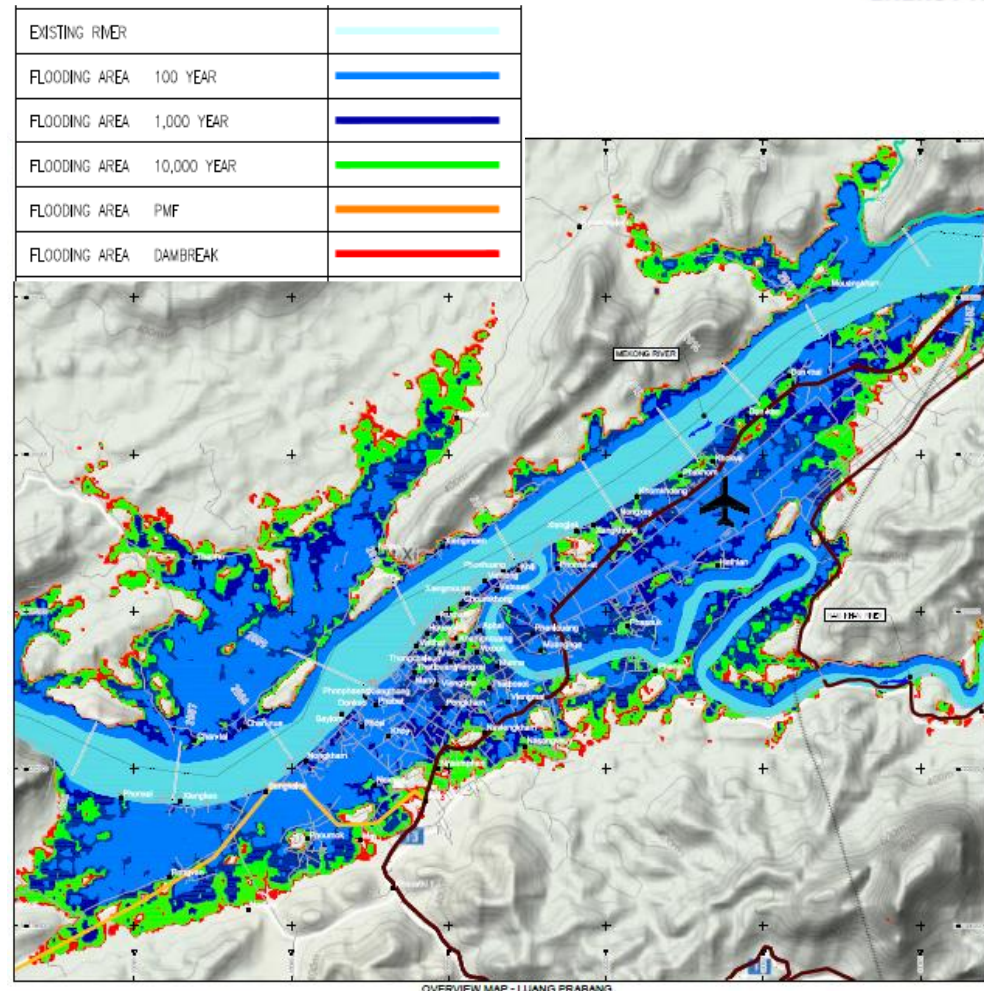




# DAM SAFETY

The dam break analysis are based on the following scenarios:

- The failure modes for Concrete Gravity Dams are given in ICOLD Bulletin 99 and 111
- Dam break based on a 100-year flood
- The peak of the dam break flood will be in range the PMF flood.



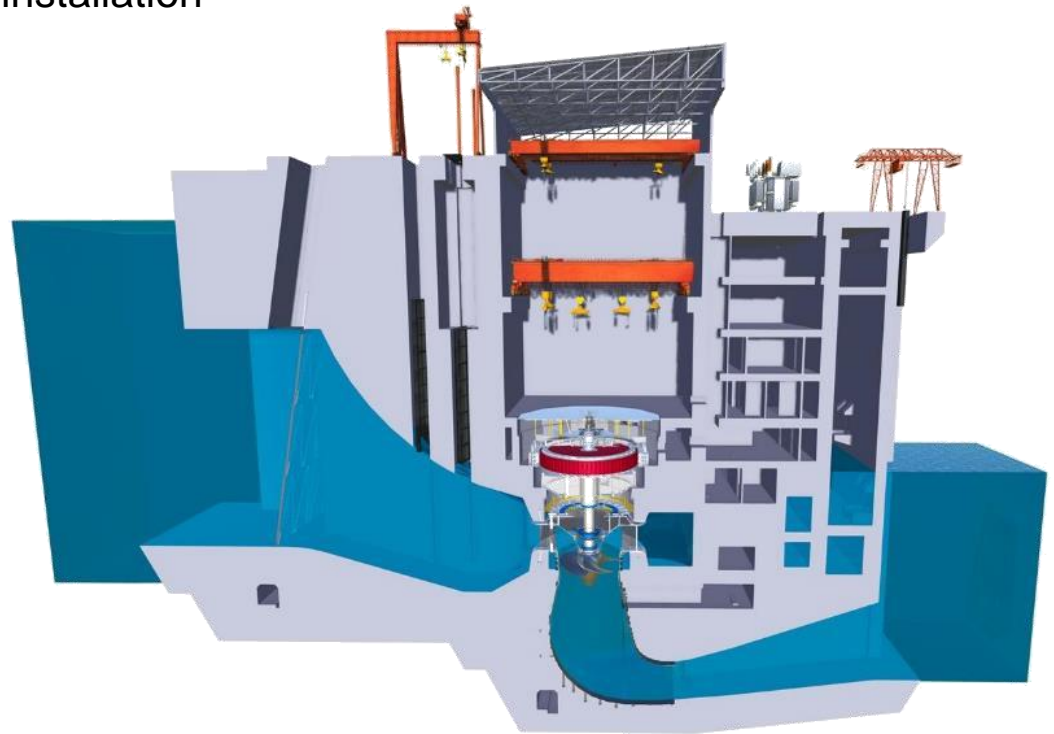
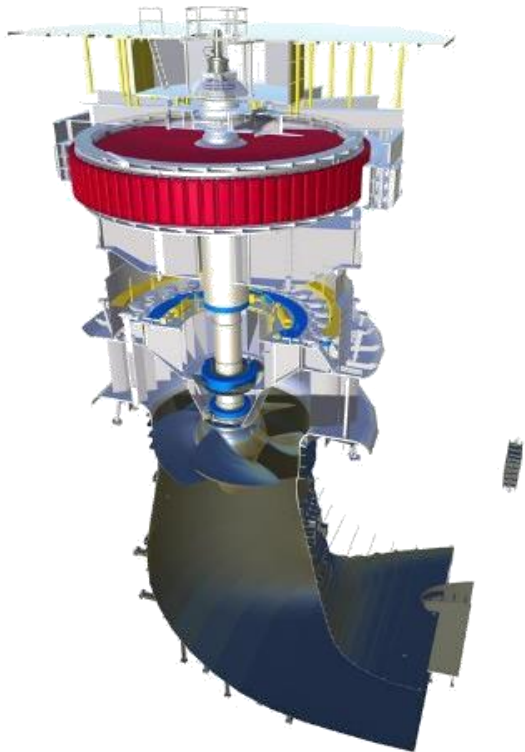
Natural Flood Map of Luang Prabang



# MAIN POWERHOUSE

## Barrage Type Powerhouse

- 7 main units a 200 MW
- Total Installed Capacity: 1400 MW (main Units only)
- 2 Erection bays – advantages for installation



# SPILLWAY

## Surface Spillway

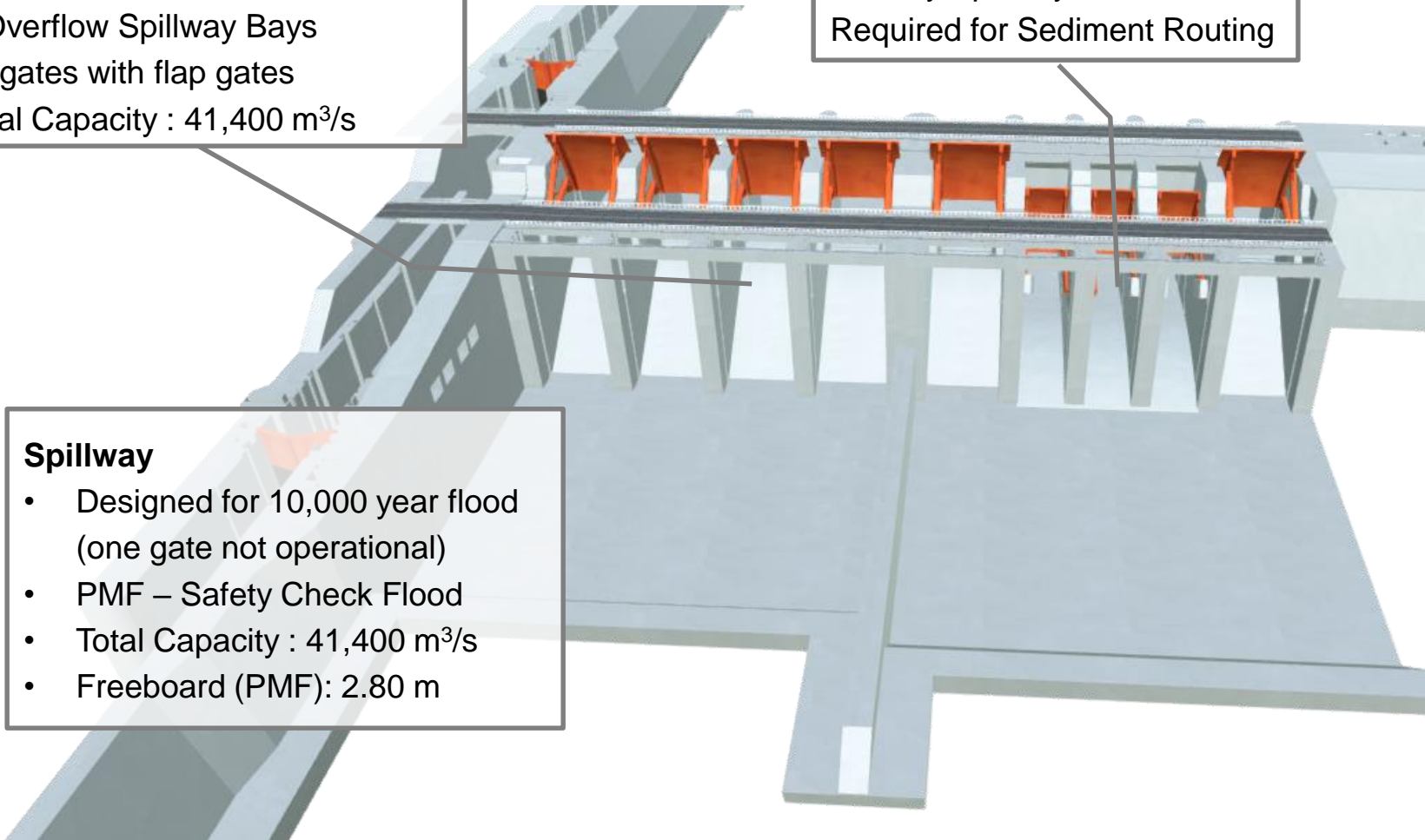
6 Overflow Spillway Bays  
All gates with flap gates  
Total Capacity : 41,400 m<sup>3</sup>/s

## Low Level Outlets

3 Bays  
Primary Spillway Devices  
Required for Sediment Routing

## Spillway

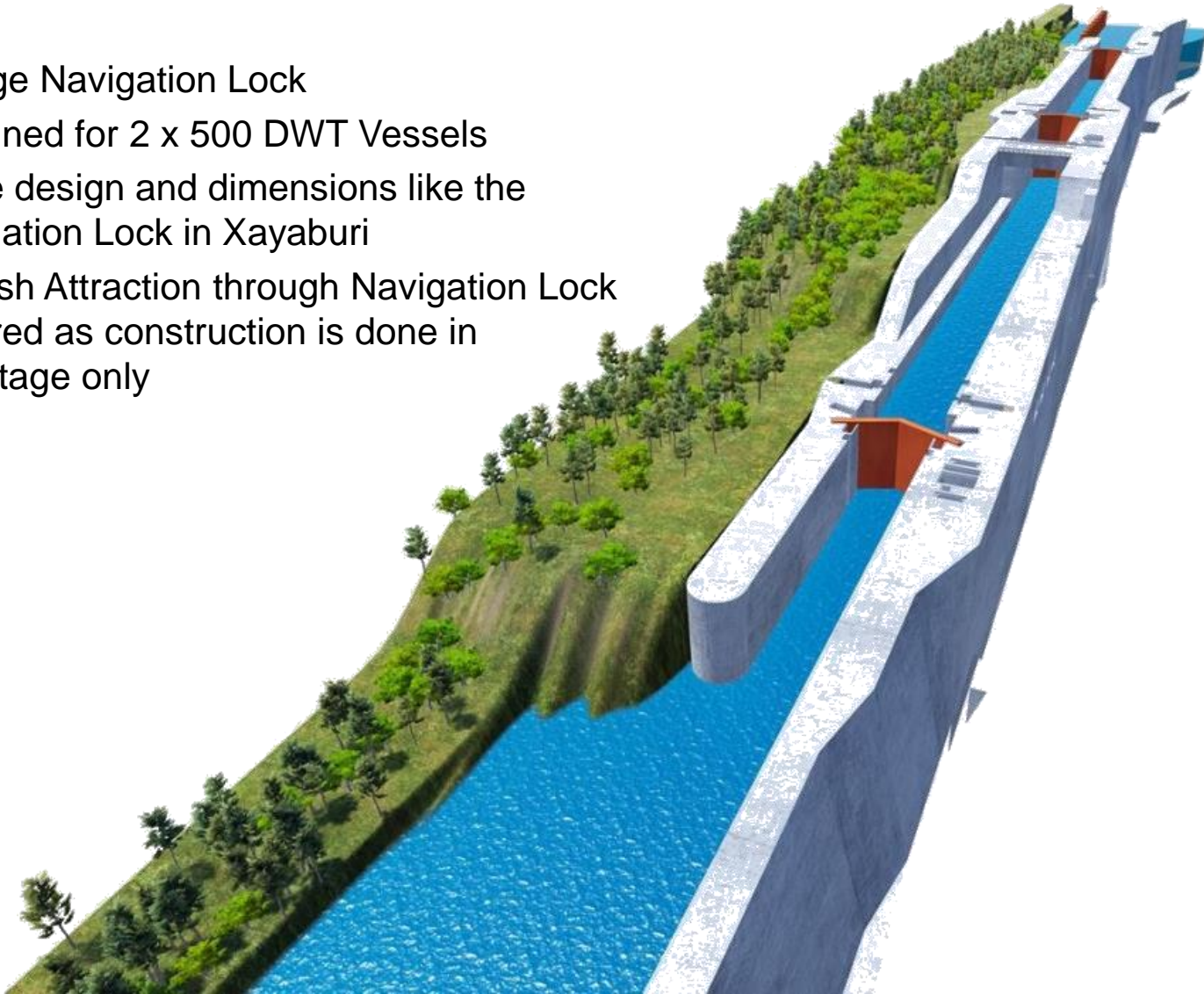
- Designed for 10,000 year flood (one gate not operational)
- PMF – Safety Check Flood
- Total Capacity : 41,400 m<sup>3</sup>/s
- Freeboard (PMF): 2.80 m





# NAVIGATION LOCK

- 2 stage Navigation Lock
- Designed for 2 x 500 DWT Vessels
- Same design and dimensions like the Navigation Lock in Xayaburi
- No Fish Attraction through Navigation Lock required as construction is done in one stage only



# FISH MIGRATION - OVERVIEW

## Auxiliary Powerhouse

- Use of water flow from d/s migration for u/s migration
- Additional water for upstream attraction flow

## U/S Migration

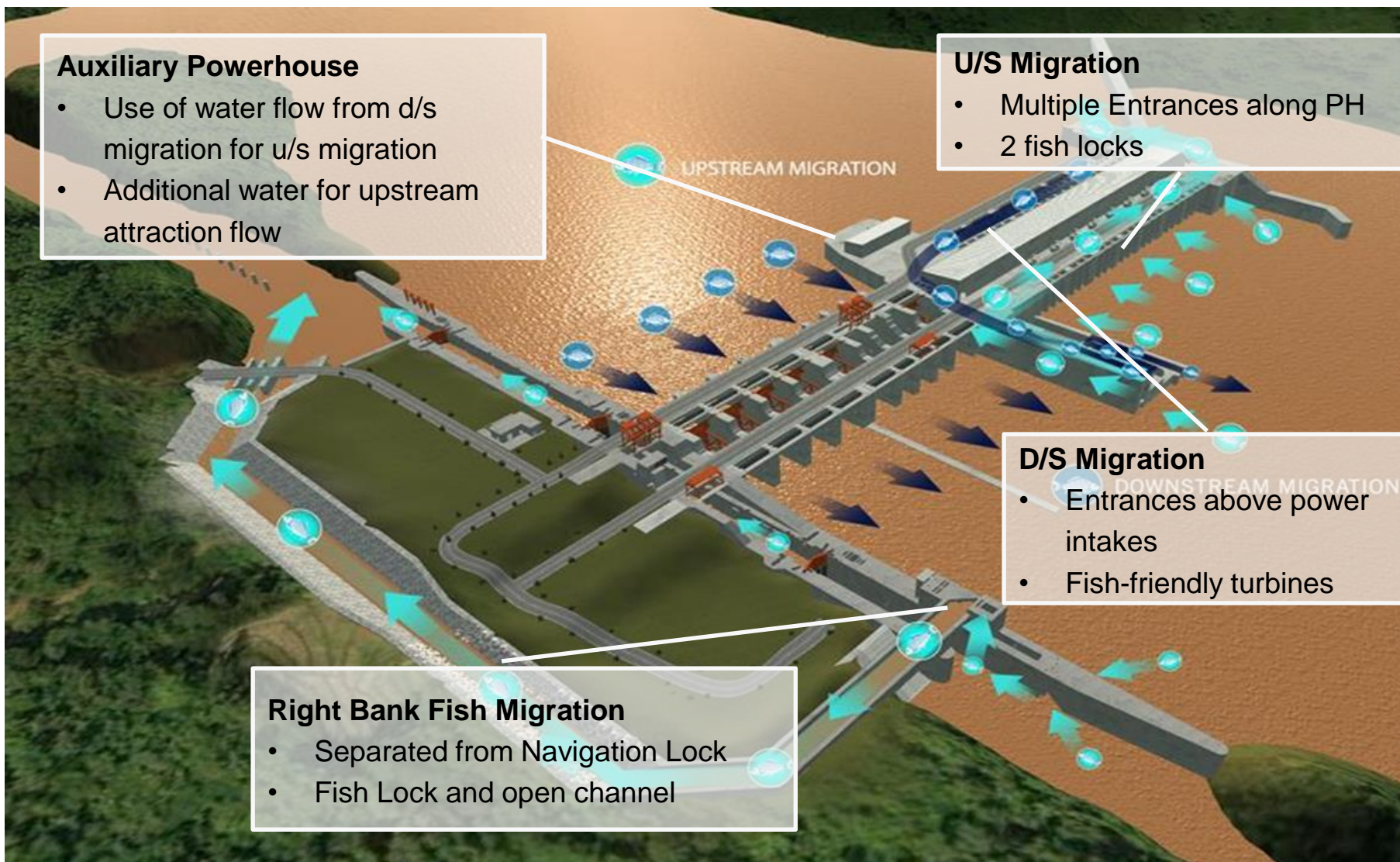
- Multiple Entrances along PH
- 2 fish locks

## D/S Migration

- Entrances above power intakes
- Fish-friendly turbines

## Right Bank Fish Migration

- Separated from Navigation Lock
- Fish Lock and open channel





## FISH MIGRATION SYSTEM - GENERAL

- **Compliant with MRC Design Guidance**
  - Upstream Migration with entrances over entire length of Powerhouse
  - Downstream Migration with entrances above Powerhouse
  - Upstream Migration at right bank – Spillway Operation, Navigation Lock
  - Fish Friendly Turbine Technology with survival rates between 92% to 97%
- **Same Functionality like Xayaburi**
  - Simplified and optimized design
  - One (1) Auxiliary Powerhouse (3x20MW) instead of two Pumping Stations (not required)
  - No Fish Ladder needed due to reduced tailwater level fluctuations
- **Experience with Fish Migration System in Xayaburi**
  - Already in operation since several months
  - System works as expected from the very first day

# FISH MIGRATION SYSTEM - VISUALISATION





# NAVIGATION LOCK DESIGN AND OPERATIONS

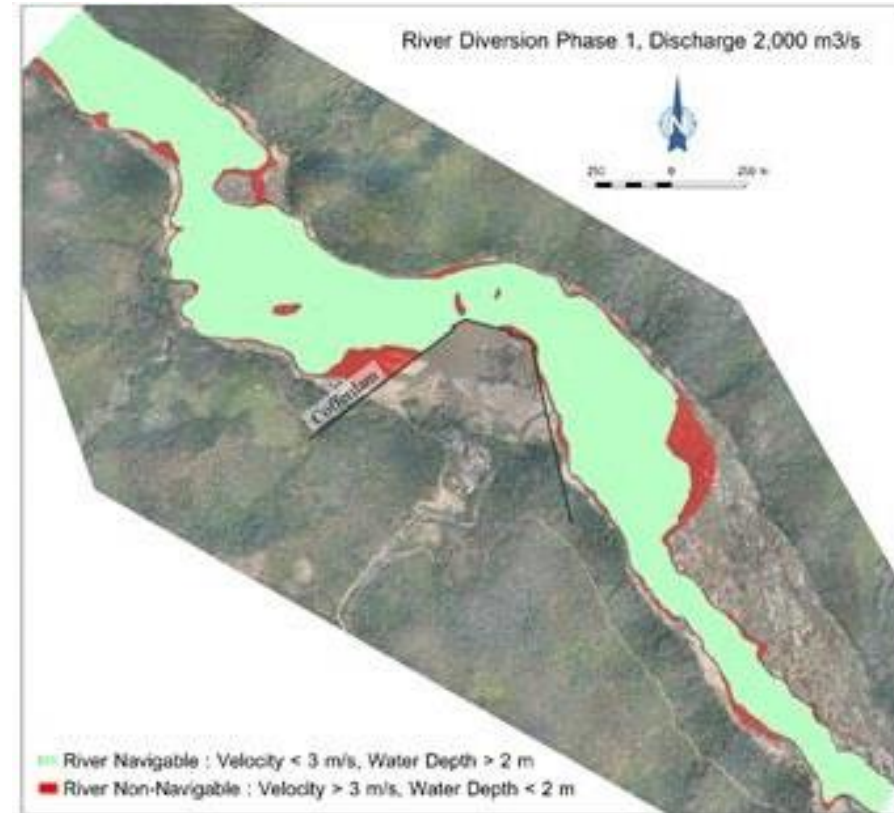
- Design and layout of the Navigation Lock follows the recommendations of the MRC Design Guidance. Same design as in Xayaburi which operates since more than 4 years safely
- All requirements have been addressed adequately in the Design.
- An additional second Navigation Lock is indicated in the design documents.



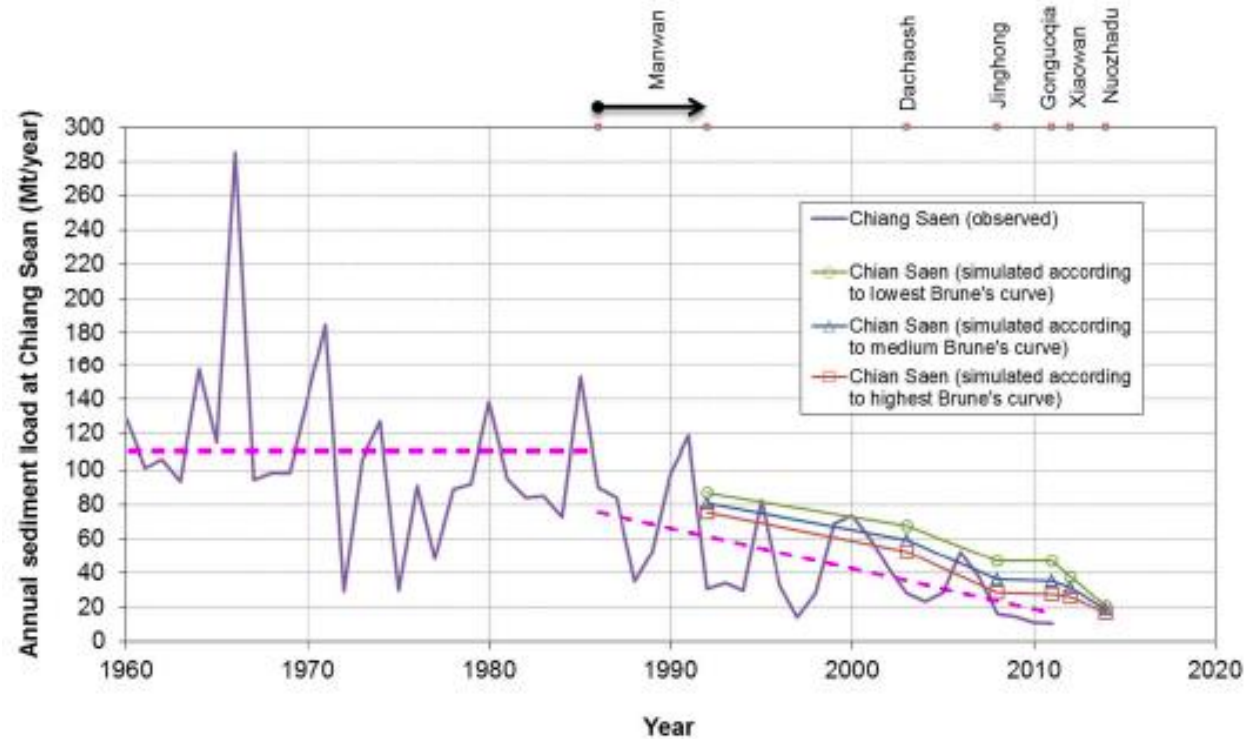
Salient Features	
Type of Lock	2-step Navigation Lock
Design Vessel	2 x 500 DWT
Max. Passage Time	50 Minutes
Max. Lifting Height	35.50 m
Length / Width (chamber)	120 m / 12 m
Min. water depth	5 m
Standards used:	MRC Design Guidance PIANC report n.o. 106

# NAVIGATION DURING CONSTRUCTION

- Navigation Requirements
  - Up to 8000 m<sup>3</sup>/s safe navigation in the main channel is possible
- Numerical Model
  - 2D numerical model to check the navigability and proved
- Conclusions
  - Outcrop removal to improve navigability
  - Support during construction
    - Tugging boat support will be provided (for smaller vessels or higher discharges)
    - Small boat transfer with overland trailer



# SEDIMENT DEVELOPMENT IN THE LOWER MEKONG BASIN



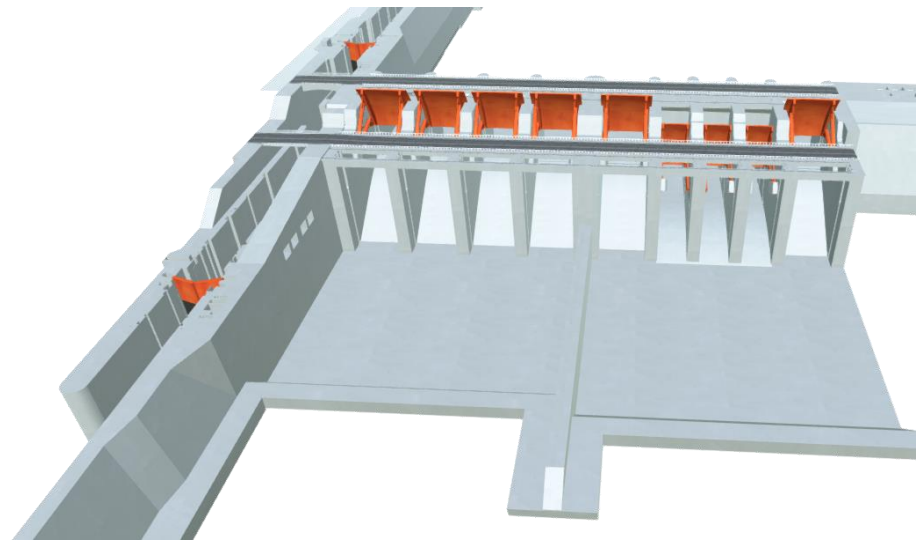
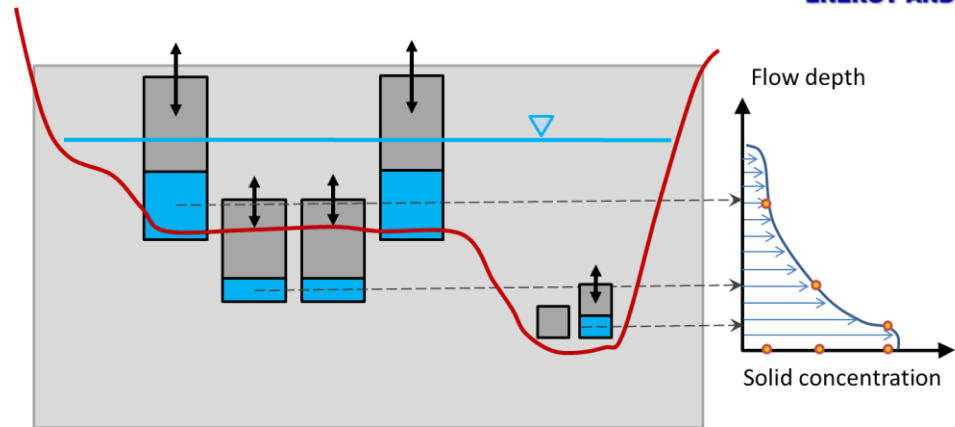
Source: Compagnie Nationale du Rhône

- Sediment Data, all available data collected
- Impact of u/s Lancang Cascade, Reduction from about 110 million ton per year to about 20 to 24 million ton per year



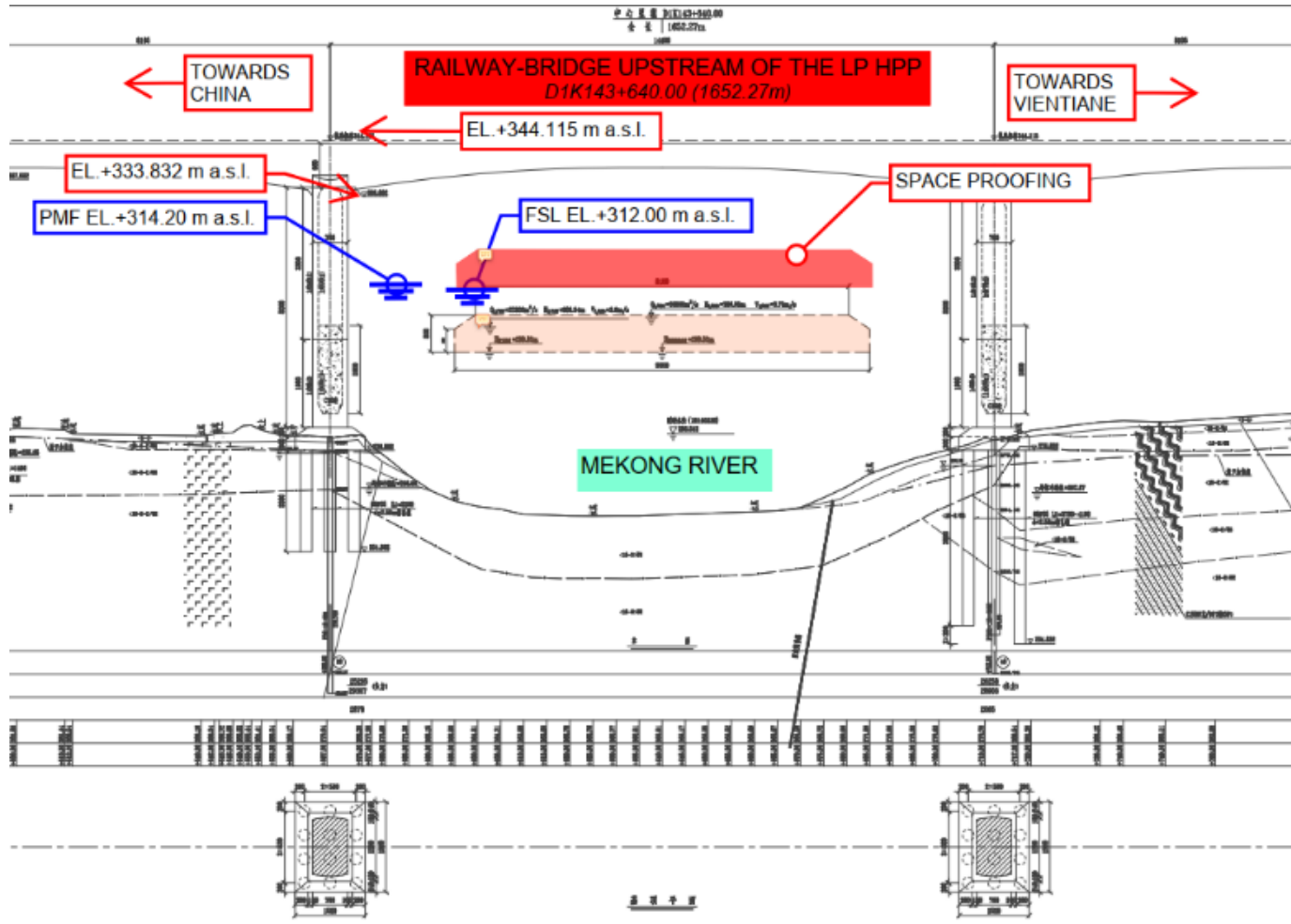
# SEDIMENT MANAGEMENT

- The Sediment management is envisaged to route as much sediment (fine and suspension fractions) through the Low Level Outlets and the turbines.
- The Low Level Outlets are the first gates to open beyond Mekong flow of 5,355 m<sup>3</sup>/s
- This will avoid large sediment concentration flows downstream and negative environmental impacts
- Maintain similar sediment concentration as in natural conditions
- The exact geometry of the approach channel will be evaluated in the hydraulic model test currently ongoing



# EXISTING INFRASTRUCTURE

The existing infrastructure has been checked, e.g. railway bridge



# THANK YOU