

*The 6<sup>th</sup> Regional Stakeholder Forum*

*Second Regional Information Sharing on Pak Lay Prior Consultation Process*

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*Luang Prabang, Lao PDR*



## **Second Draft Technical Review on Sediment & River Morphology**

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- I. Why sediments are important
- II. What was reviewed

## II. Main review findings with pay attention to public concerns

- I. Basis for proposal and mitigation, e.g. data used, modelling.
- II. Proposed infrastructure & operations to minimize transboundary impacts

## III. Recommendations

- I. Need for additional information
- II. Recommendations

# I. Background (1)

- Sediments & geomorphology are important because:
  - Control the distribution and quality of aquatic and riparian habitats
  - Provide river channel and bank stability
  - Maintain alluvial reaches and delta
- Hydropower has the potential to alter sediment transport and geomorphology
  - Disruption of sediment transport due to sediment trapping in impoundments, leading to increased bank erosion and changes to water quality
  - Changes to timing of sediment transport wrt the flow leading to increased erosion and changes to habitats
  - Increasing the rate of water level changes leading to increases in erosion and changes in riparian vegetation

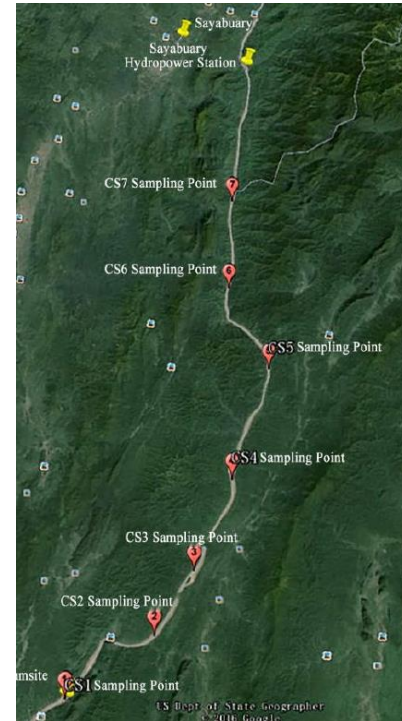


# I. Background (2)

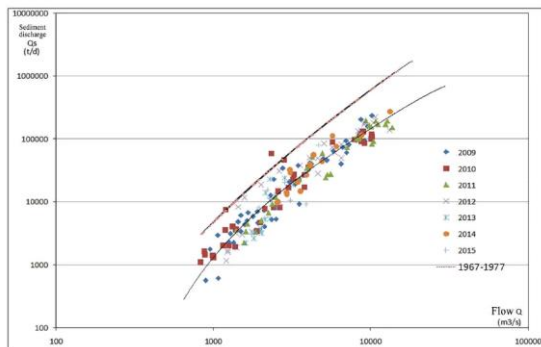
- **Information included in this review provided by the developer**
  - **Feasibility Study Report (Final) Chapters 1 – 8**
  - **Engineering and design drawings**
  - Minor information from EMMP, ESIA, TbESIA, CIA
- **Other information considered**
  - MRC monitoring data and technical reports
    - Discharge sediment monitoring program, Atlas of Deep Pools, Navigation atlas...
  - Xayaburi infrastructure design
  - MRC Hydropower Mitigation Guidelines
  - PDG 2009 used as basis for evaluation
  - DG 2018 considered in discussion only

## II. Main Review Findings – Data used

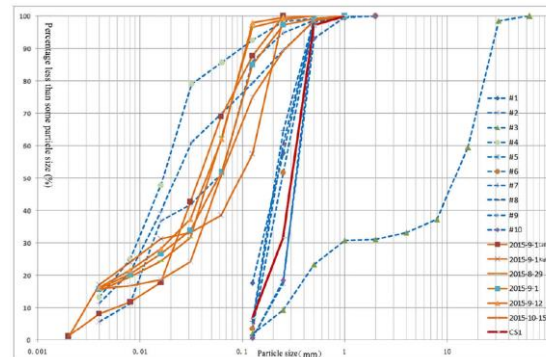
- Suspended sediment transport results from Chiang Khan collected by Thailand
- Recent suspended sediment transport results from dam site collected by developer
- Grain-size distribution from 4 dates at dam site
- Grain-size distribution from previous CNR investigation
- Sediment sampling at dam site is on-going
- Good geomorphic description of impoundment area



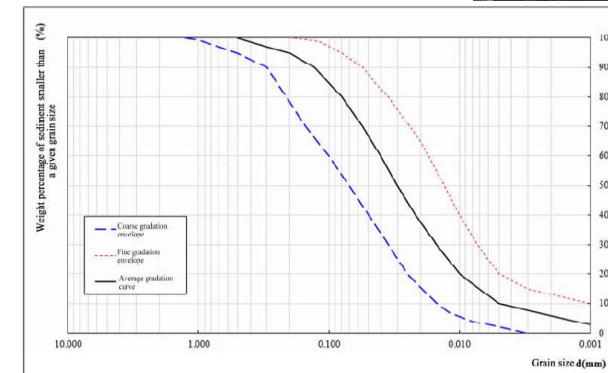
*Samples from throughout impoundment area*



*Recognises changes in sediment transport*



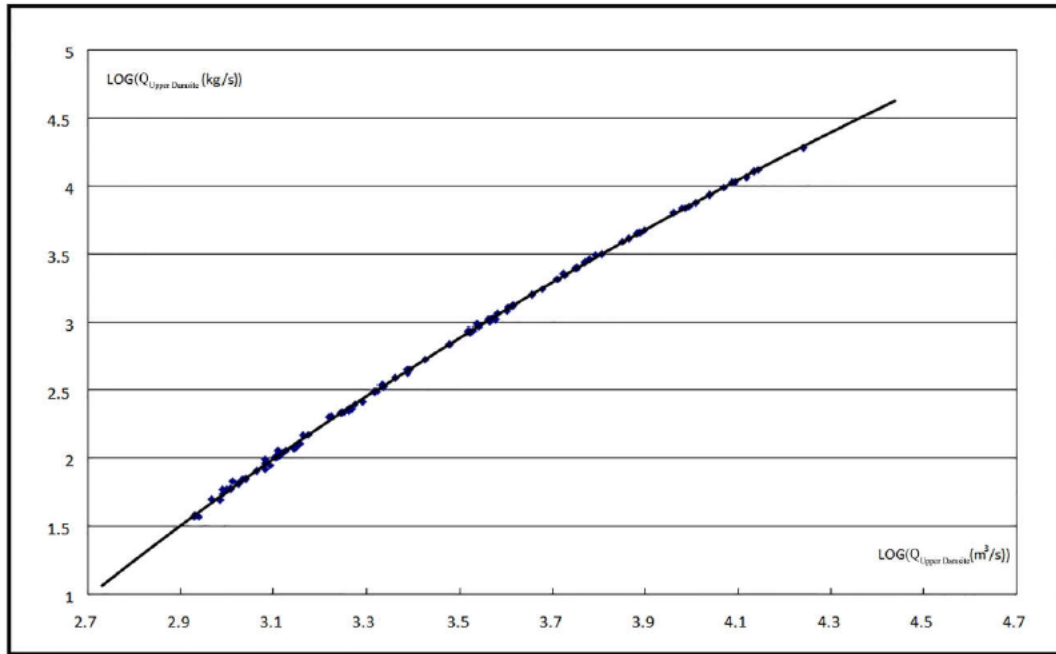
*Draws on multiple data sets*



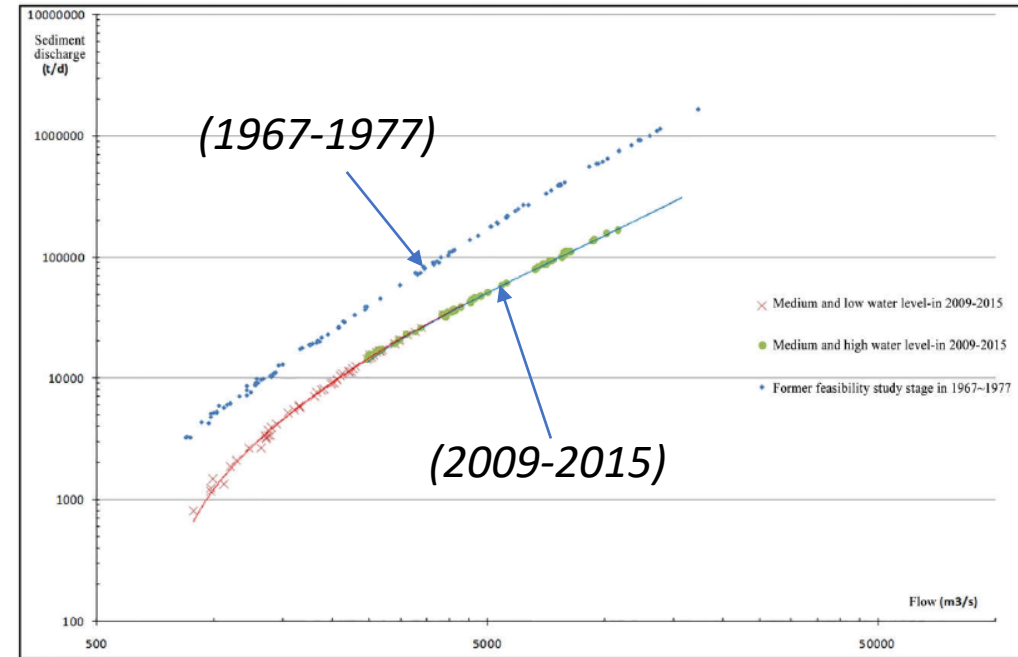
*Considers range of grain-sizes*

## II. Main Review Findings – Data used

- Calculated suspended sediment discharge/concentration at damsite based on measured data from Chiang Khan.



*Correlation between Monthly Average Flow and Monthly Sediment Discharge at Damsite in (1967-1977)*



*Correlation between Monthly Average Flow and Monthly Sediment Discharge at Damsite in (2009-2015)*

## II. Main Review Findings – Data used

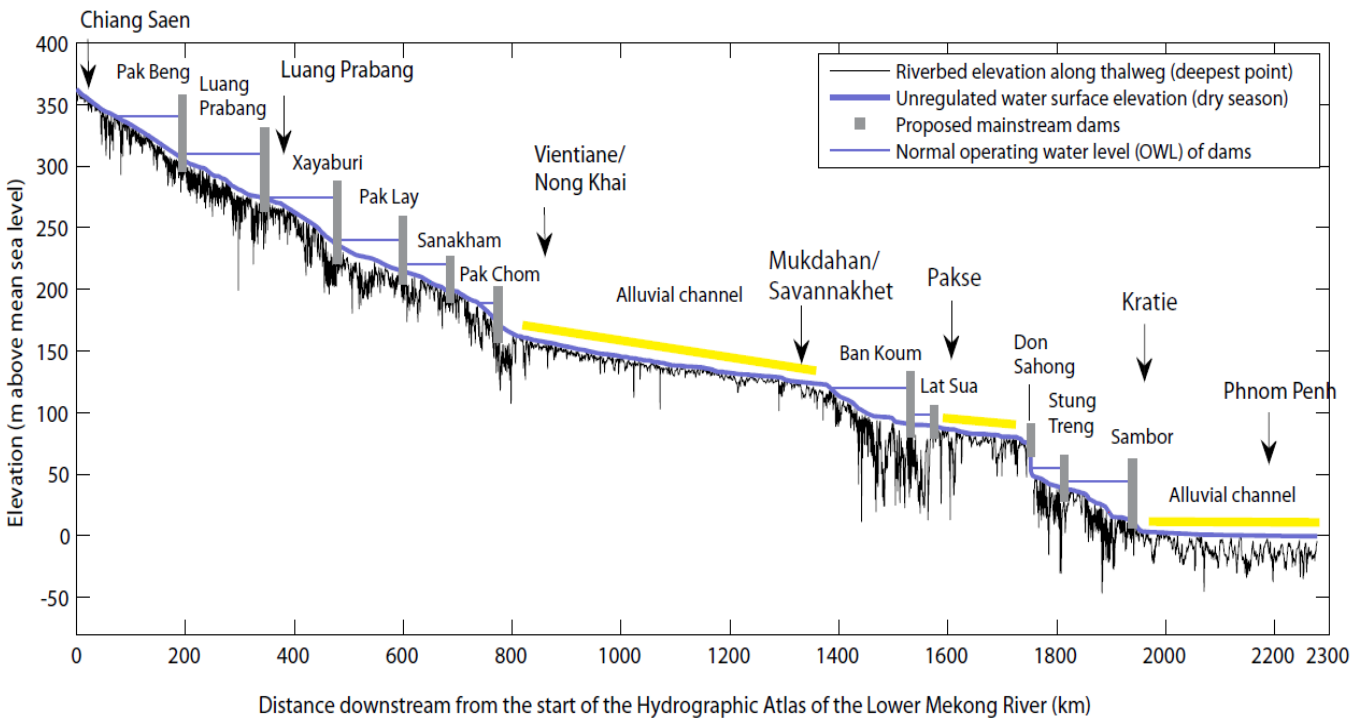
- Data consistent with MRC monitoring results and present understanding
- On-going monitoring is commended but larger data set is required
- Need to consider potential changes between dam site and Chiang Khan (~112 km)
- Grain-size information is limited to only a few samplings over a short period
- Percentage of sand reported by developer is considerably less than reported at Luang Prabang or Nong Khai in MRC coordinated sediment monitoring program
- **Under-estimating sand in sediment load will affect sediment trapping predictions and sediment flushing modelling**

*Comparison of monitoring GS results and developer's results*

Location	DSMP Sand >0.063 mm	Feasibility Study Range of Sand >0.063 mm
Luang Prabang	75%	
Pak Lay		10% – 55% (Average 30%)
Nong Khai	52%	

## II. Main Review Findings – Data used

- Information presented in EIA and TbESIA are out of date and inconsistent with FS
- Lack of detail about geomorphic characteristics downstream of dam site
- Lack of discussion about future changes to sediment budgets due to other HPPs



*More consideration of regional context & transboundary EIA is desirable*

*Consideration of geomorphology downstream of project*

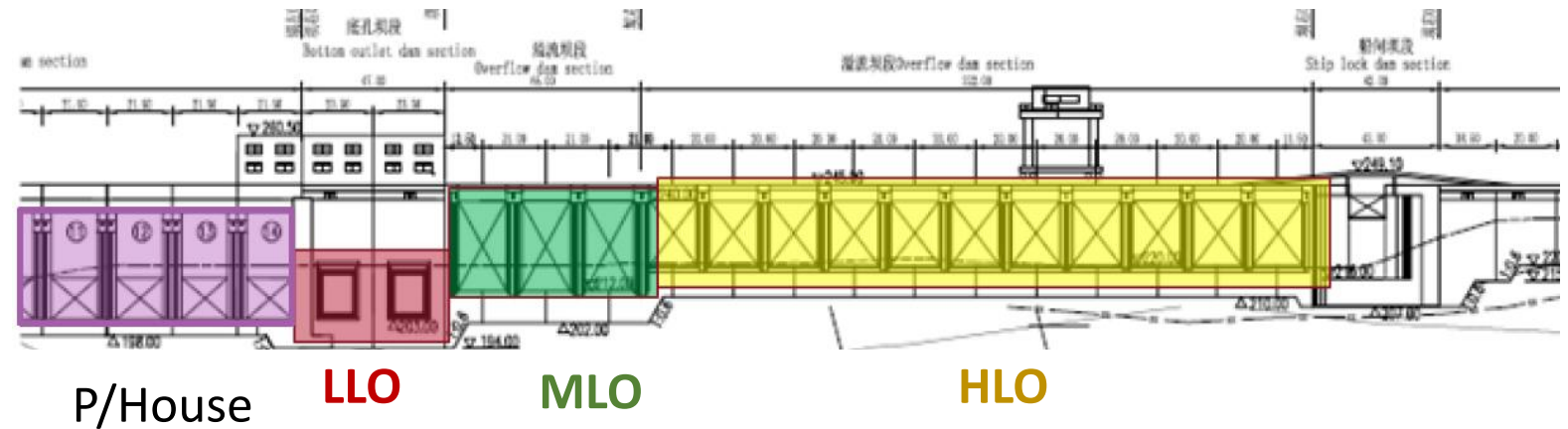
*Consideration of Deep Pools within impoundment & downstream*

*Geomorphic analysis if last dam in cascade*



## II. Main Review Findings – Infrastructure for Sediment

- Two Low-Level Outlets (**LLO**) at river bed level (10 m x 10 m)
- Three Mid-Level Outlets (**MLO**)
- Eleven High-Level Outlets (**HLO**)



### Review of infrastructure

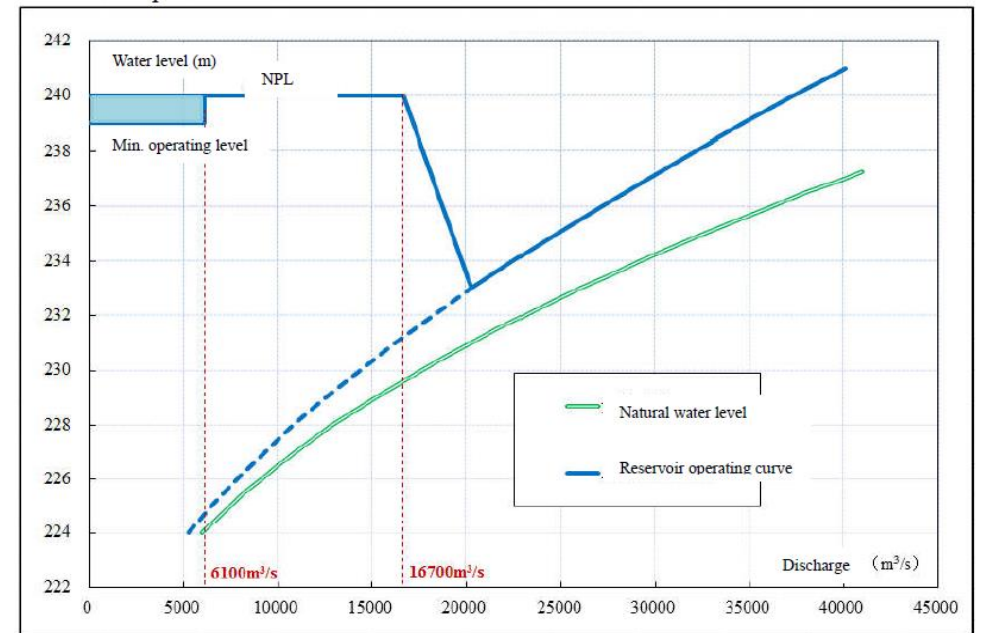
- Small surface area for passing sediments-only 200 m<sup>2</sup> cf. 768m<sup>2</sup> at Xayaburi
- Small size limits ability to flush sediments resulting in large deposition within ~60 m of dam
- No quantification of sediment flushing through LLOs or MLOs
- No model runs optimizing sediment flushing as function of flow & drawdown rate

## II. Main Review Findings – Operating Regime

- Proposed to flush sediment at  $Q > 16,700 \text{ m}^3/\text{s}$
- Additional flushing when Xayaburi flushes and / or guided by monitoring
- HPP may operate in peaking mode

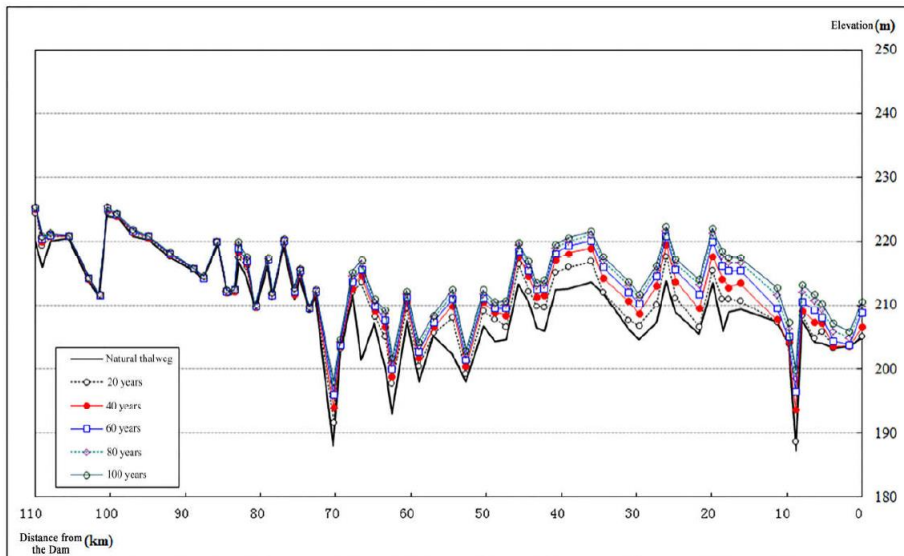
### Review of operations

- Discharge of  $16,700 \text{ m}^3/\text{s}$  does not occur annually so flushing will be infrequent
- WL difference across dam at  $16,700 \text{ m}^3/\text{s}$  is low, so flushing is limited to near dam wall (no scouring of sediment from impoundment)
- No evaluation of impact of water level changes during peaking operations on bank stability in impoundment or downstream of dam. Additional modelling should be completed to establish the rate of water level fluctuations at various distance downstream.
- Flushing guided by monitoring is consistent with Adaptive Management but require more details

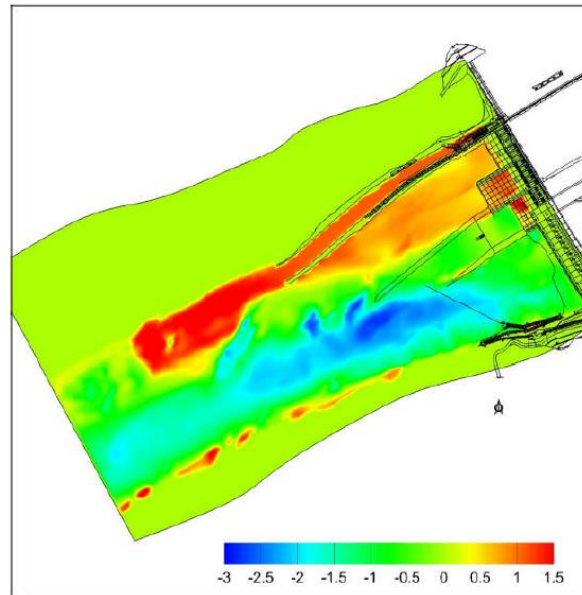


## II. Main Review Findings – Sediment Modelling

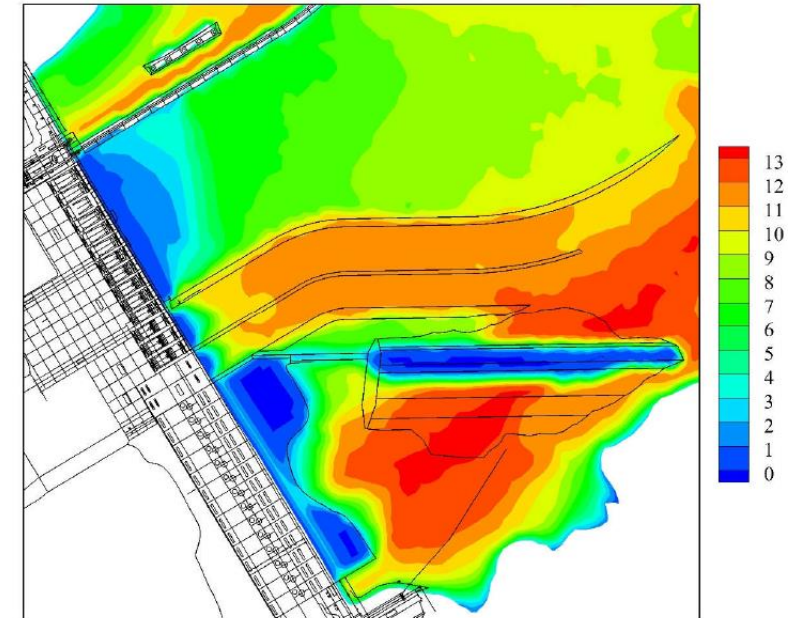
- Sediment trapping modelled using 1-D over 100 years. Results show more sand leads to higher trapping rate
- Sediment deposition / erosion near infrastructure modelled using 2, 3-D and physical model. Results show deposition upstream, erosion downstream and suggests dredging will be required near power house



1D-model impoundment



2D-model upstream & downstream of dam

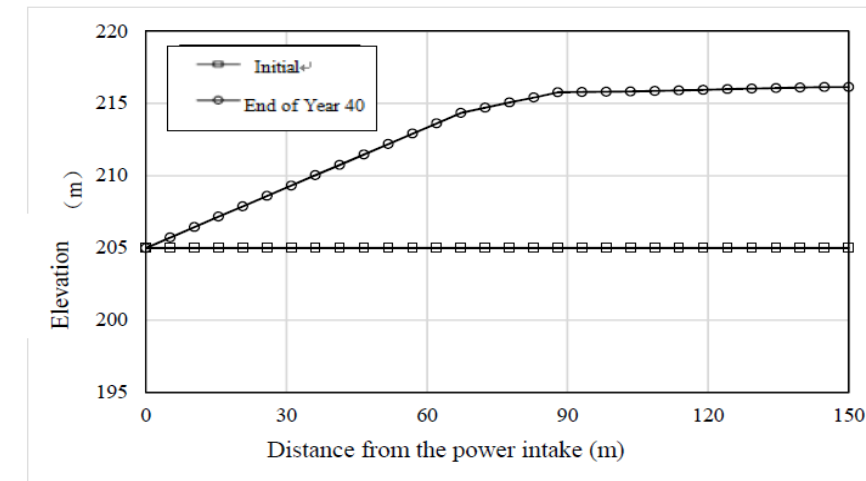
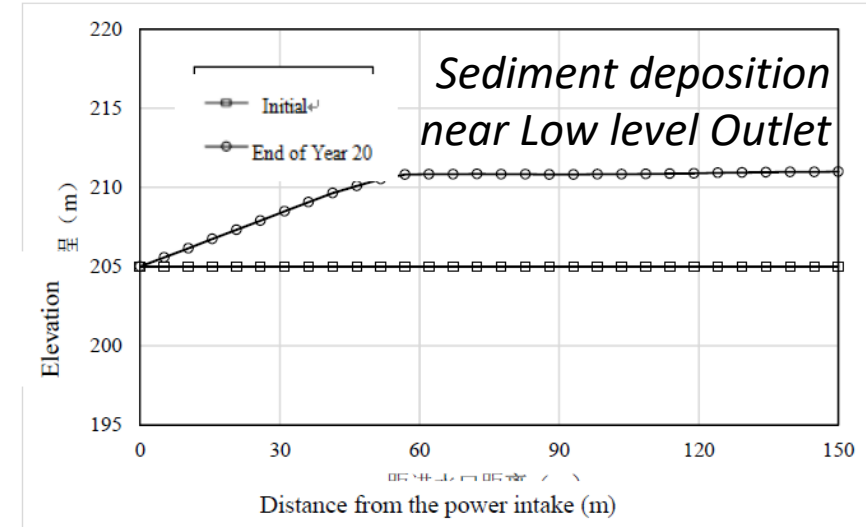


3D-model detail near infrastructure

## II. Main Review Findings – Sediment Modelling

### Review of modelling

- Lack of information about models used, parameterization and calibration. Lack of justification for parameters extracted from other river models & no discussion of model error
- Lack of comparison between numeric and physical model results
- Sensitivity analyses did not include higher proportion of sand in sediment load (only higher total sediment load). 1-D will not accurately capture sediment trapping in all areas of impoundment
- Need to be updated using results from longer term monitoring data set
- Models should be used to optimize sediment flushing
- Need to include a map showing the alluvial banks downstream locations that will be susceptible to erosion.



## II. Main Review Findings – Monitoring

- Monitoring integrated with hydrologic & hydraulic monitoring
- Includes sediment inflows & outflows to impoundment, cross-sections in impoundment & monitoring of river banks downstream of dam
- Relate results to hydropower operations in annual report and use to guide operations

### Review of proposed monitoring

- Proposed monitoring is consistent with Adaptive Management, but is only a general strategy;
- Lack of details about monitoring sites, frequency, field or laboratory methods
- Lack of information about monitoring of downstream impacts, thresholds and management responses
- Lack of detail about how results will be linked to management actions
- Potential for integrated monitoring with Xayaburi and future downstream HPPs

## II. Main Review Findings – Transboundary Impacts

- Feasibility study based on recent sediment information but does not discuss transboundary impacts
- TbESIA discusses transboundary impacts but is based on out of date information. States that Paklay will: *likely be responsible for transboundary sediment, morphology and nutrient impacts, leading to environmental impacts... (in) not only the channel but also the floodplains, wetlands and seasonal lakes, the Delta, the nearby coastal area, and the offshore sediment plume.*

### Review of TbESIA

- TbESIA conclusion is consistent with understanding of ‘full-development’ of hydropower in LMB, but unlikely Pak Lay will be solely responsible for all of these impacts
- Require greater consideration of incremental impacts associated with Pak Lay if no other HPPs constructed downstream, and if other HPPs constructed downstream

## III. Recommendations

- Greater information about the source (s) of data used in the FS should be provided, along with the actual datasets.
- Additional site-specific sediment monitoring information being collected by the developer should be analysed and provided to the MRC.
- Models / infrastructure / operations should be reviewed and updated based on longer term data set
- A more assessment of potential transboundary impacts associated with Pak Lay HPP should be provided. Analysis should consider Pak Lay as last dam in cascade and as 'middle' station in a cascade
- Greater information/consideration regarding coordination of HPP operations in the cascade for sediment management is required, including 'triggers' for flushing and coordination to minimise downstream impacts.

# Thank you

