

3 WATER BALANCE MODELLING

3.1.1 Baseline

Scenario simulations were carried out with the internationally recognised software MikeBasin, which is a *water balance model* for simulation of water allocation, reservoir operation, irrigation and other water uses.

A baseline scenario was established by attributing catchment runoffs to gauging stations at Chiang Saen, Vientiane, Thakek, Savannakhet, Pakse and Kratie. The runoff series were established by subtracting the discharge at the gauging station upstream. For example the runoff series for Pakse was computed as the Pakse discharge minus the Savannakhet discharge.

For Nam Theun at Theun-Hinboun (TH) headpond the runoff series was extended to 50 years by correlating the observed series at Theun-Hinboun with the long Ban Signo series. A similar correlation analysis with respect to Ban Signo was carried out for Mahaxai in Xe Bang Fai to obtain a long baseline series.

The baseline simulation was based on observed/extended monthly discharge series and included the operation of the Theun-Hinboun hydropower diversion. The result of the baseline simulation is a discharge series 1950-2000 which serve as a basis for comparison in the subsequent scenario simulations.

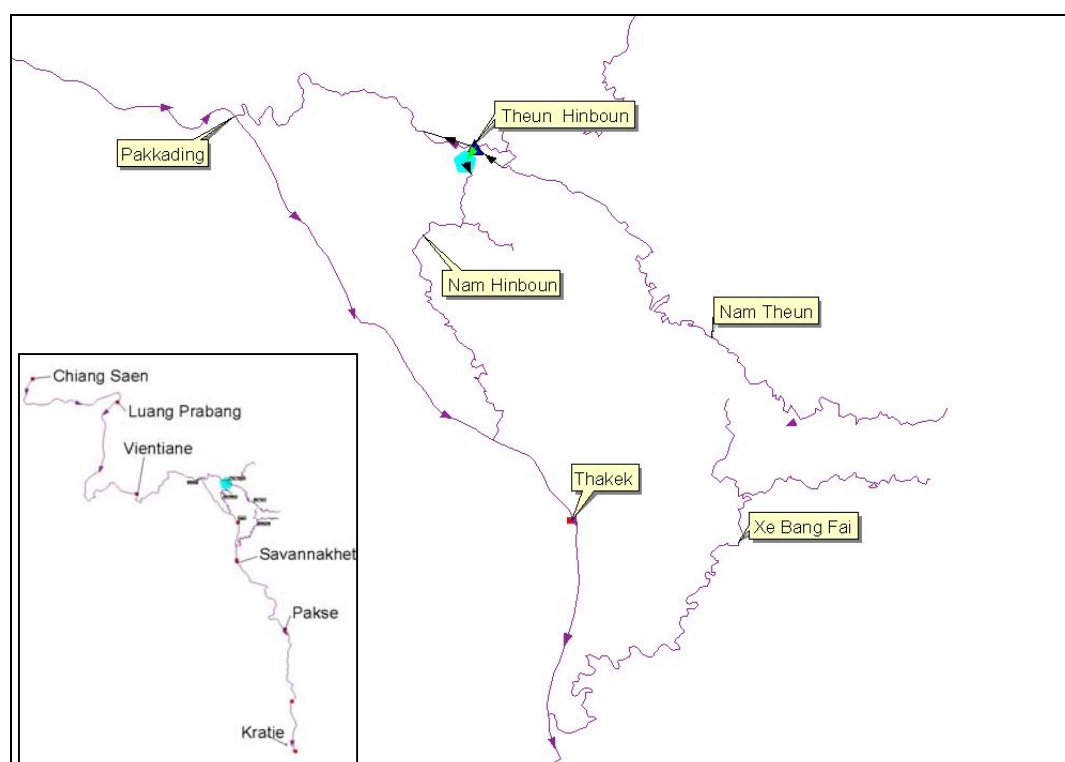


Figure 2 Detail of MikeBasin water balance model for hydrological simulations: The baseline setup simulates only TH hydropower. The little figure shows the entire model area.

3.1.2 NT2 Impacts

The NT2 dam and reservoir were introduced in the MikeBasin model setup, as illustrated schematically in Figure 3. Basic information such as reservoir storage curves, spillway capacity, turbine capacity, operation rules were taken from available documents, predominantly the NT2 EIA documents.

Figure 4 shows the results of reservoir simulation in terms of in-and outflows from/to the NT2 Nakai reservoir. The green curve shows the natural inflow to the reservoir, the dotted red curve shows the diversion through turbines to Xe Bang Fai, which varies from a maximum of 280 m³/s (as an average for a week) to almost zero at the end of the dry season. In a number of years spilling (black curve) occurs during the flood season.

Figure 5 shows again the post-NT2 turbine discharges at TH, but here together with the baseline (pre-NT2) turbine discharge for comparison. The figure illustrates the impact by NT2: during the dry season, the TH diversion (and hence energy production) is heavily reduced, while in the wet season the TH operation is unchanged.

Figure 33 shows the pre- and post-NT2 discharge in Nam Kading just before the Mekong confluence, and it illustrates that the flow reduction is significant. Figure 34 shows the corresponding discharges for Xe Bang Fai at Mahaxai. In this case there is a significant increase of the discharge due to the release from the turbines. The main report presents summary curves of these hydrographs with average, 10% resp. 90% percentiles for each of the year's months.

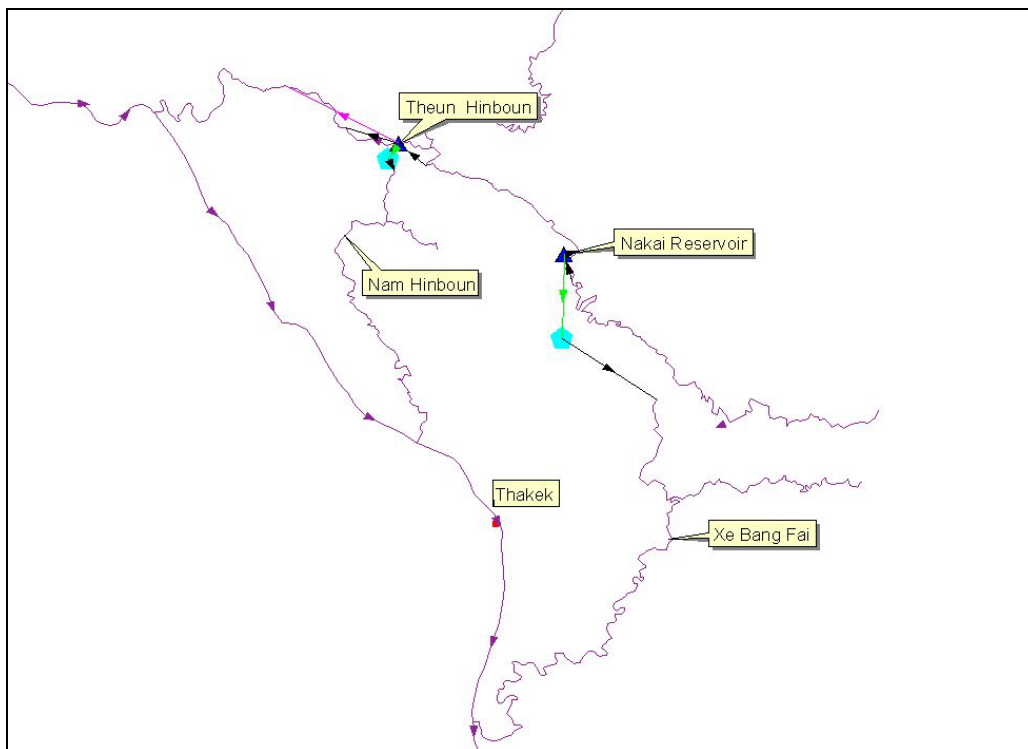


Figure 3 Detail of MikeBasin water balance model for hydrological simulations. Setup for simulation of NT2 operation. Compare with Figure 2.

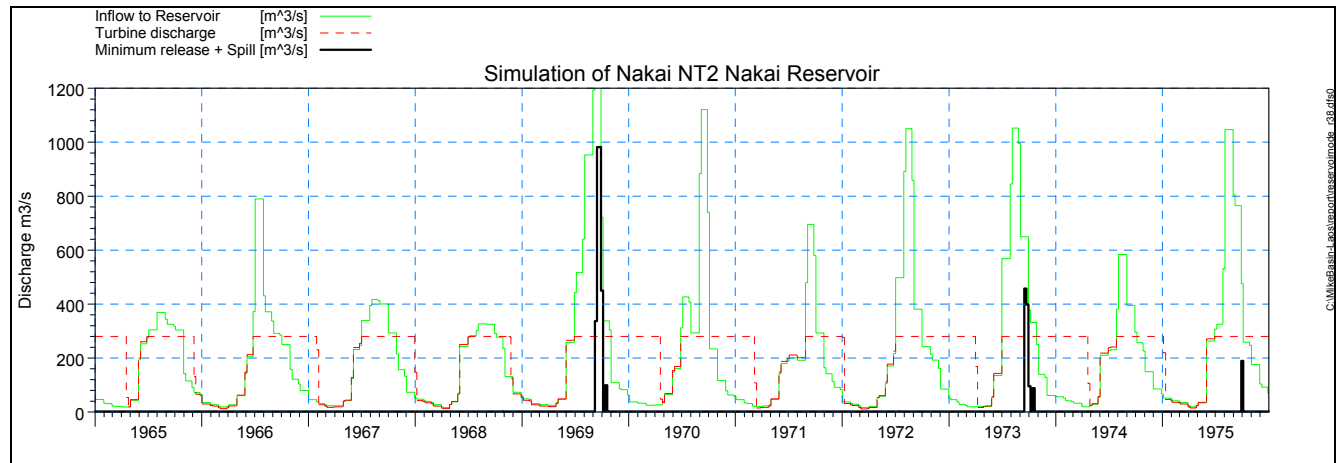


Figure 4 Result of reservoir simulations of NT2: Reservoir inflow, turbine discharge and spills. Weekly average discharges 1950-2000.

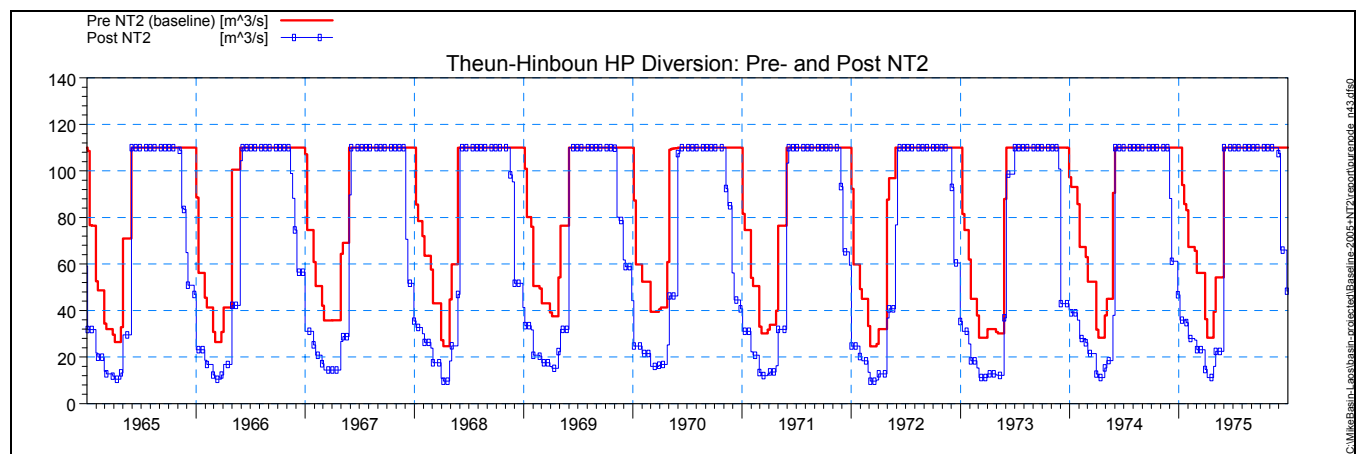


Figure 5 Simulated turbine discharge at Theun-Hinboun HP, pre-NT2 baseline (bold red) and post-NT2 (blue with markers).

3.1.3 Cumulative Impacts

Cumulative impacts 2010 and 2025 include the operation of a number of new hydropower projects. In both cases NT2 is included and simulated like reported above. For other hydropower projects the simulations were carried out separately by sub-basins. Table 3 below shows the reservoirs which constitute the input to the hydrological impact simulations. The table shows the grouping of reservoirs by Mekong sections. The table also shows an aggregate regulation coefficient by section, i.e. the ratio between annual runoff and total active storage in the sub-basin, a coefficient that indicates the degree of seasonal variation. The table shows that the Yunnan part of Mekong will be subject to a large degree (36%) of seasonal regulation in 2025, and that the degree of season variation decreases downstream, due to more unregulated than regulated inflows downstream.

The separate hydropower simulations are reported separately in more detail in Annex 3 and are therefore not commented further here. Figure 6 however shows the result of the hydropower simulations in terms of the change of river discharge for the Yunnan part of the basin. The negative peaks represent reductions of the river discharge, namely as flood control, while the positive less pointy peaks represent increases of the flow, namely during

the dry season. The figure illustrates an input to MikeBasin, similarly as for the Nam Ngum and the Se San/Se Kong/Sre Pok basins.

Figure 7 shows the result from the MikeBasin water balance simulations: the regulated discharge at Kratie, in the two scenarios 2010 and 2025, as well as baseline for comparison.

Table 3 Overview of planned reservoirs in the Mekong Basin, as input to hydrological simulations. Grouped by river sections..

Mekong section	Project	Country	Active storage (mill. m ³ /yr.)		Flow Mekong (mill. m ³ /yr.)	Overall Regulation coefficient	
			2010	2025		2010	2025
Upper Mekong (Yunnan)	Manwan	China	257	257			
	Dachaoshan	China	367	367			
	Xiaowan	China	9,900	9,900			
	Gonguoqiao	China		120			
	Jinghong	China		249			
	Nuozhadu	China		12,300			
	Mengsong	China		-			
	Ganlanba	China		-			
	SUM		10,524	23,193	64,000	16%	36%
China border to Pak Kading	Nam Leuk	Lao PDR	123	123			
	Nam Lik	Lao PDR	826	826			
	Nam Ngum 3E	Lao PDR		983			
	Nam Ngum 2B	Lao PDR		150			
	Nam Ngum 5	Lao PDR		252			
	Nam Ngum 4A	Lao PDR		337			
	Nam Bak 2B	Lao PDR		119			
		Section Sum		949	2,790		
	ACCUM. SUM		11,473	25,983	187,000	6%	14%
Pak Kading to Pakse	Nam Theun 2	Lao PDR	3,510	3,510			
	Theun Hinboun Ext.	Lao PDR	2,870	2,870			
		Section Sum	6,380	6,380			
	ACCUM. SUM	17,853	32,363	289,000	6%	11%	
Pakse to Outlet/Delta	Huoay Ho	Lao PDR	480	480			
	Xepon	Lao PDR	361	361			
	Xe Kaman 3	Lao PDR		108			
	Xe Kaman 1	Lao PDR		3,340			
	Xe Kong 5	Lao PDR		2,210			
	Nam Kong 3	Lao PDR		299			
	Xe Xou	Lao PDR		1,710			
	Yali	Vietnam	779	779			
	U. Kontum	Vietnam		123			
	Pleikrong	Vietnam		1,022			
	Se San 4	Vietnam		470			
	D Xuyen	Vietnam		484			
	Ban Tou Srah	Vietnam		483			
	Lower Se San 2D	Cambodia		NA			
	Lower Se San 2U	Cambodia		NA			
	Lower Sre Pok 2	Cambodia		NA			
	Section Sum		1,620	11,869			
	ACCUM. SUM		19,473	44,232	460,000	4%	10%

NA=Not available

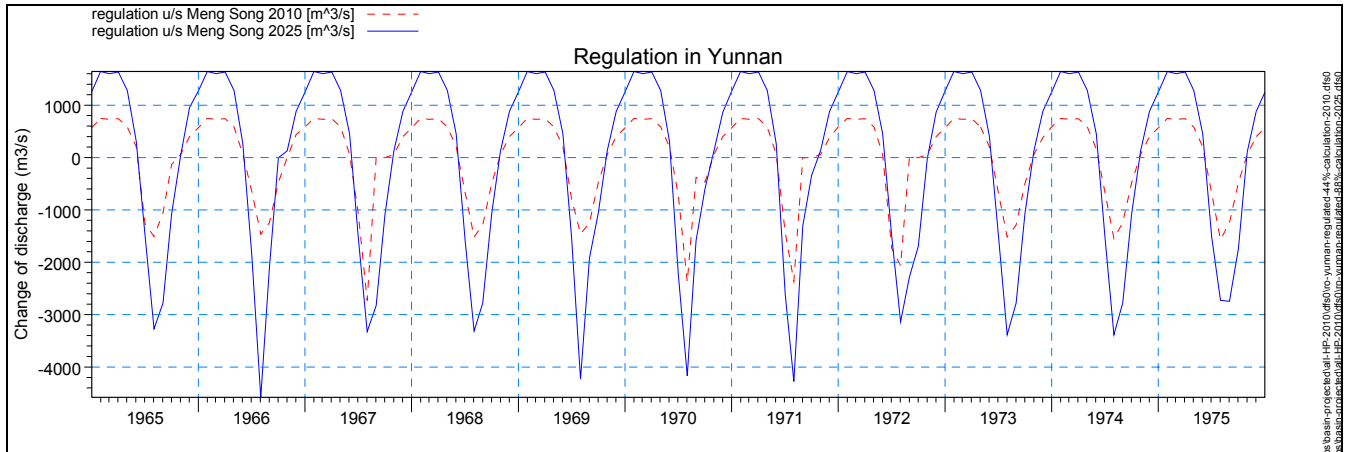


Figure 6 Input to MikeBasin water balance calculation: Regulation in Yunnan (2010 and 2025), as a result of hydropower simulations.

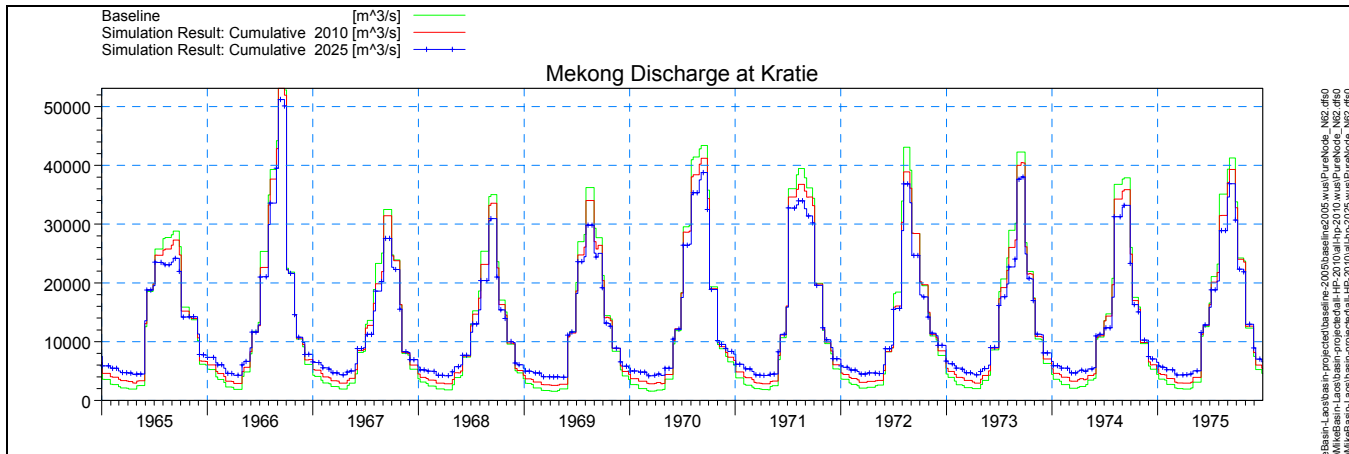


Figure 7 Result output from MikeBasin water balance simulations: Mekong Discharge at Kratie – baseline and regulated (cumulative 2010 and 2025).