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eptisa

EY Building a better working world

Narmada River Basin Model

Pre-Bid Conference

National Hydrology Project

Background

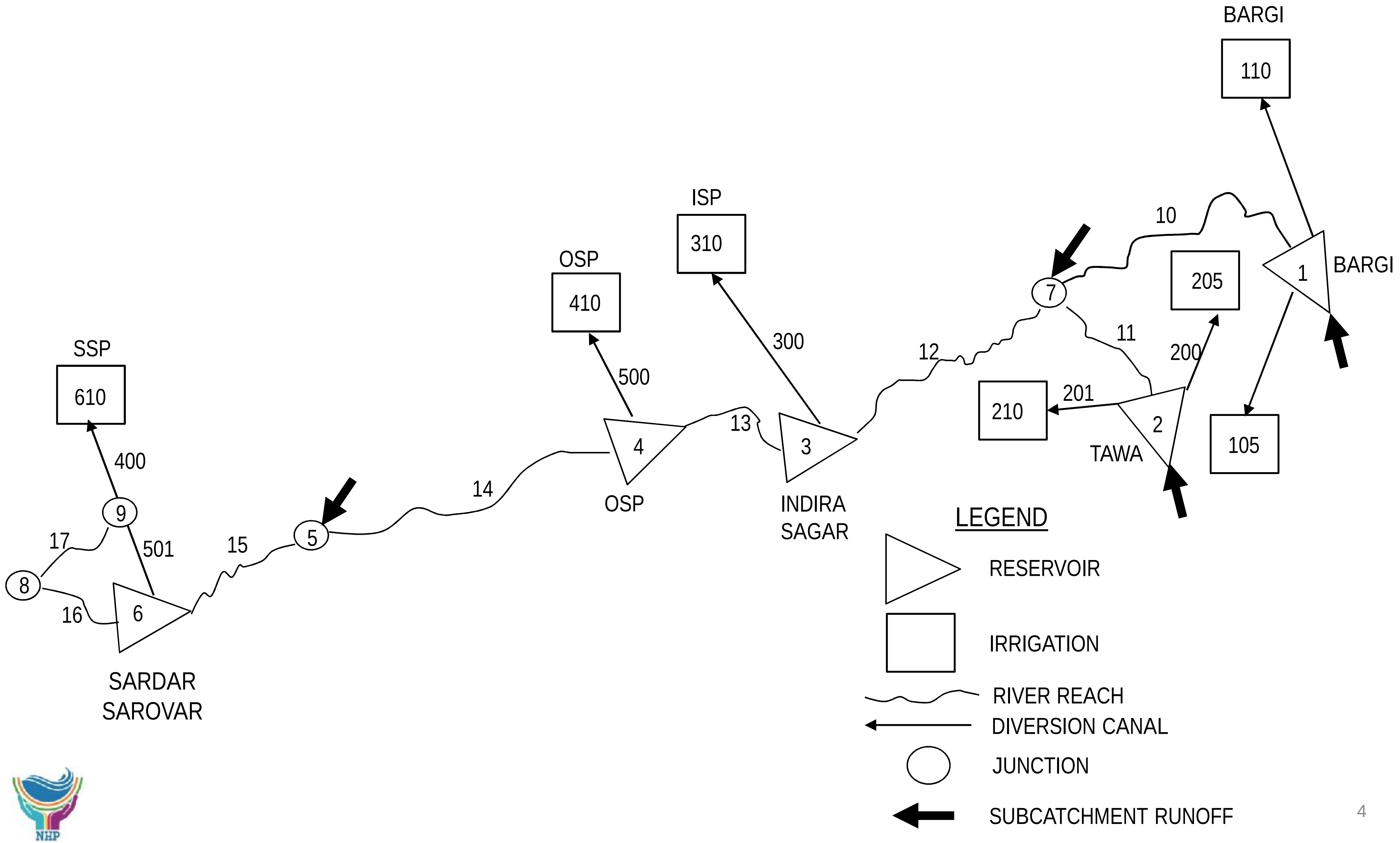
1. Narmada Control Authority approach NHP with a request to assist in the model selection
2. A test problem was proposed to be part of the selection process and the proposal was accepted
3. This project will involve:
   - compilation of all historic hydrologic input (50-60 years of historic data) relevant for Narmada River basin
   - Model setup that will include more detailed representation of the Narmada River basin (inclusion of additional storage reservoirs, water use, and hydro power components)
   - Integration with the results of EHP project and eSWIS database
   - Training of the NCA staff and technical support

Test Problem

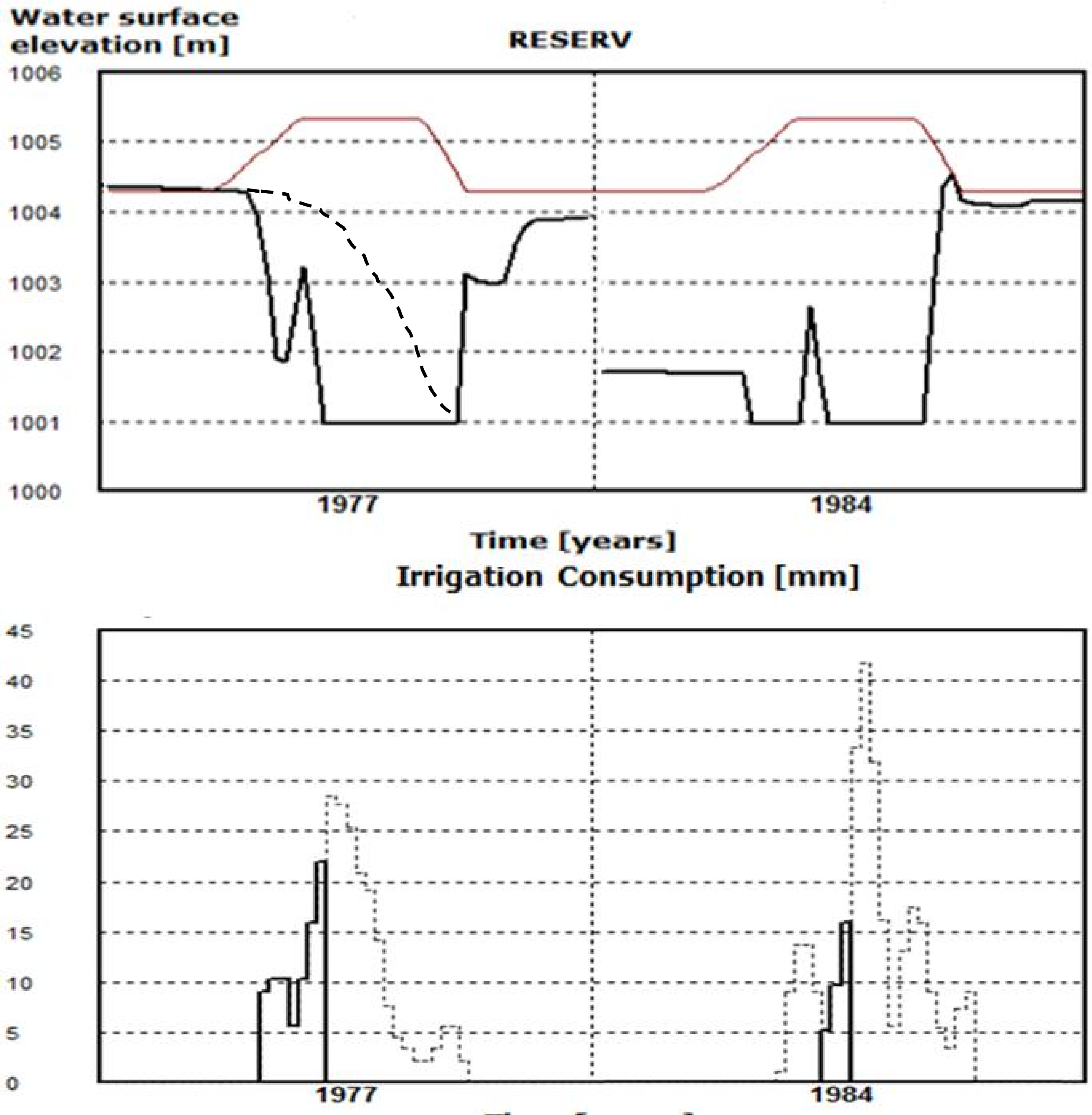
Modeling objectives were developed with input from NCA:

- Have a model that can be used both for planning and seasonal operation based on the input from the results of the EHP project
- Find the best possible storage operation based on the way storage reservoirs are presently operated
- In dry years when deficits are inevitable, apply equal deficit sharing and time and in space among selected irrigation components
- Reduce flood damage, provide downstream maintenance flows, and supply water to irrigation canals
- Maintain the minimum storage levels on June 30th of each year
- Use 10-daily time steps and start the 9 year simulation on July 1st
- Model reservoir net evaporation losses based on the surface area

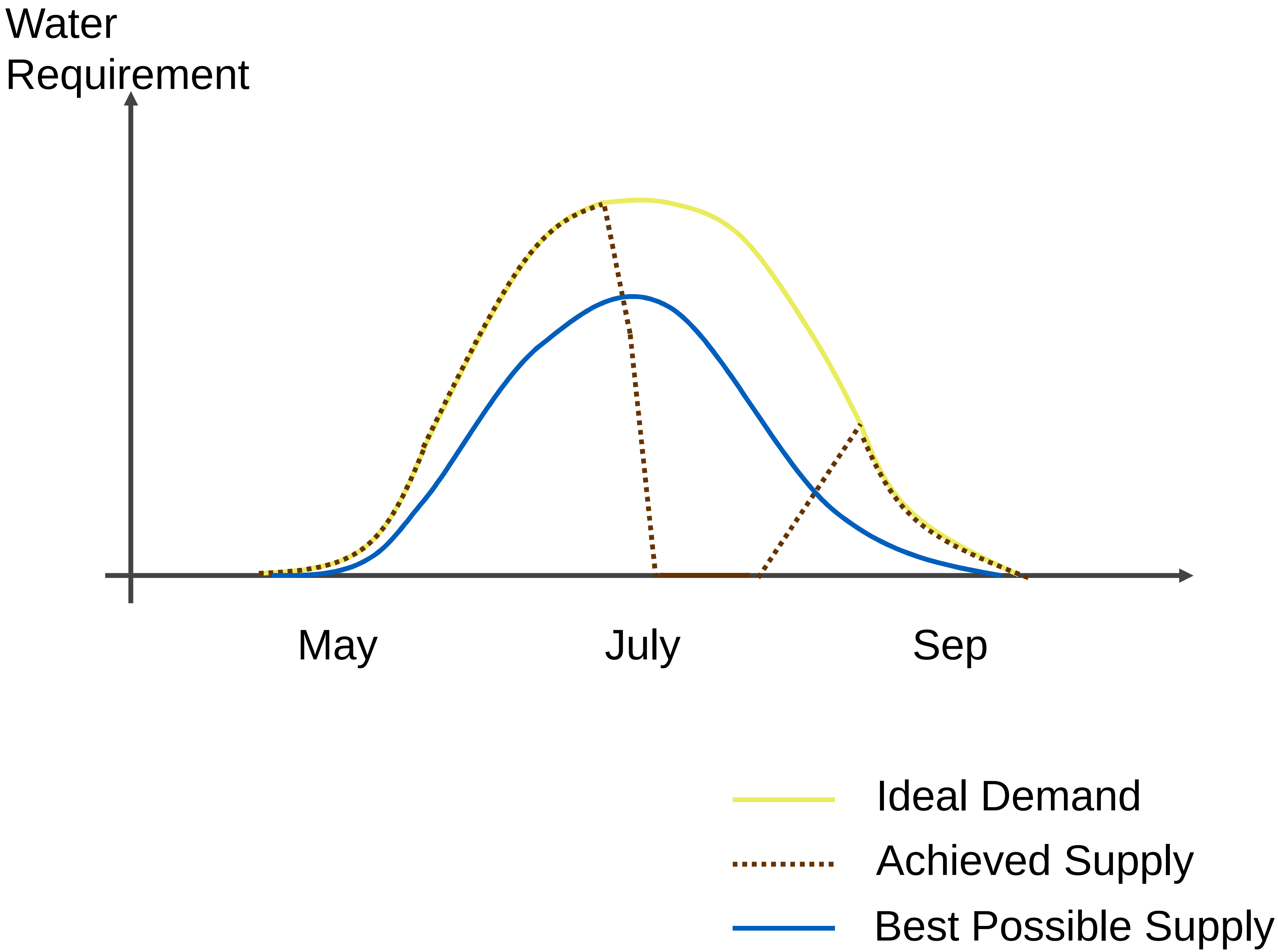
Narmada Basin Modeling Schematic



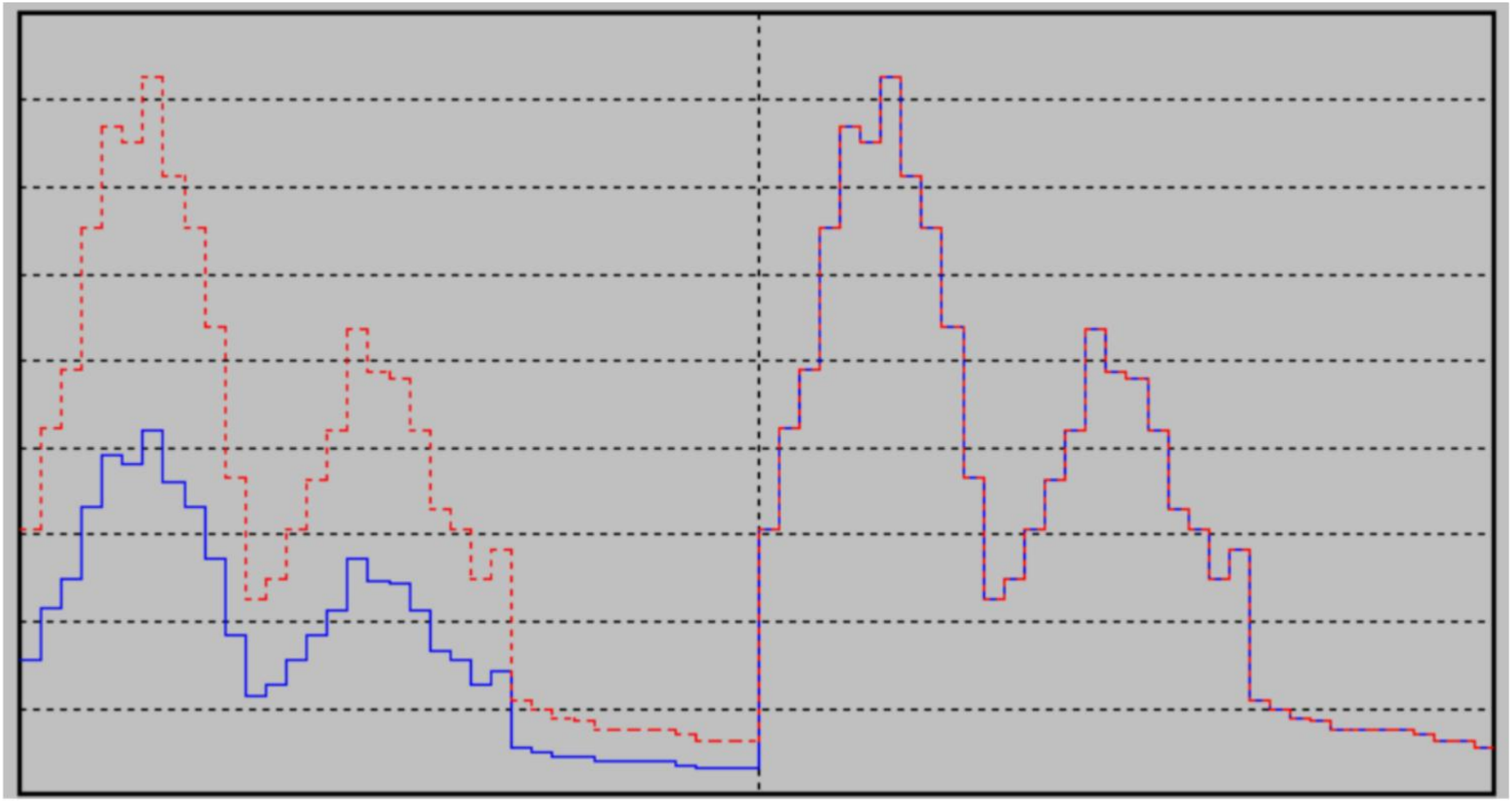
The need for “reservoir rule curves”



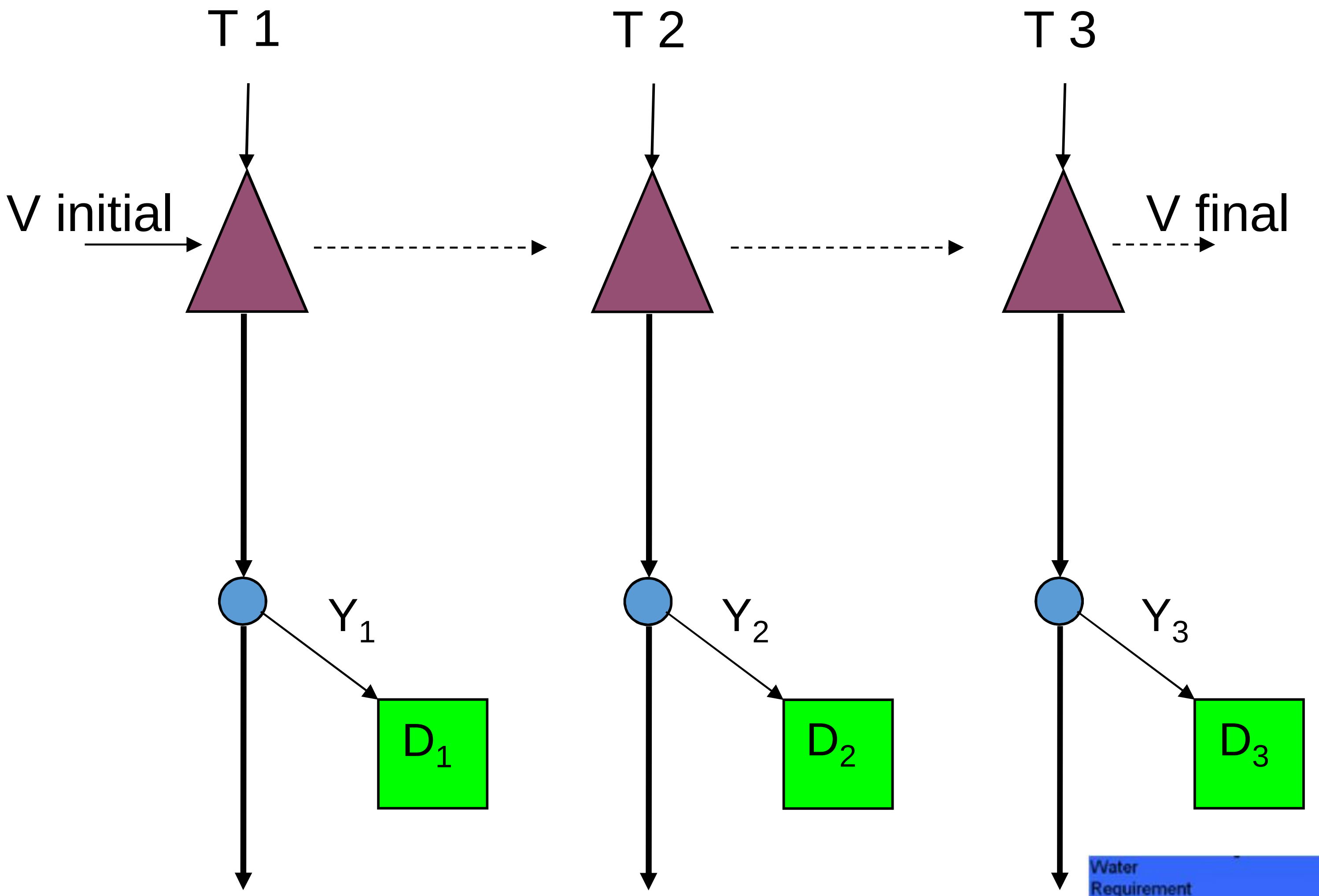
Typical Seasonal Water Demand

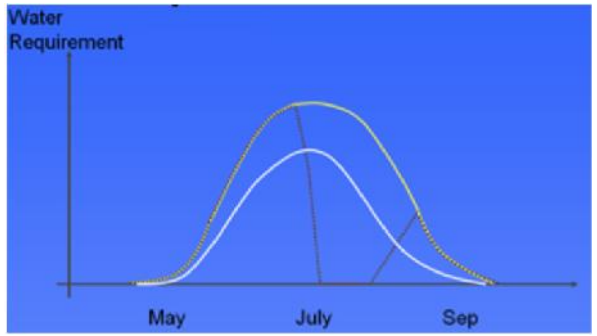


Example of Equal Distribution of Deficits in Time (Hedging of Water Dewands) for a year with deficits compared to a year without deficits. Once the level of hedging has been decided, there is no need to meet the original target demands any more, since the demand has been adjusted.



Multiple Time Step Optimization (MTO)





The model finds the best set of storage releases for all time steps and finds the best hedging policy simultaneously

Modeling Objectives

Objective Function$_f$ = OF (F) =

$$\text{Min} \sum_{t=1}^{t=36} \{\$1000[\max(Q_{15}(\text{t}) - 7600,0) + \max(Q_{10}(\text{t}) - 4000,0) + \max(Q_{11}(\text{t}) - 2800,0)]\}$$

Objective Function$_e$ = OF(E) =

$$\text{Min} \sum_{t=1}^{t=36} \{ \$100 [\max(T_{10}(t) - Q_{10}(t), 0) + \max(T_{11}(t) - Q_{11}(t), 0) + \max((T_{12}(t) - Q_{12}(t), 0) + \max((T_{15}(t) - Q_{15}(t), 0)]\}$$

Objective Function$_i$ = OF(I) = $\text{Min} \sum_{t=1}^{t=36} \sum_{i=1}^{i=7} \{ \$10 [D_i(t) - Q_i(t)]\}$

Year	Objective Function Values			Total
	Flooding	Environmental Flows	Irrigation Supply	
2008				
2009				
2010				

Evaluation of Constraints

Table 3. Feasibility Check Criteria

Year	Time Interval	Feasibility Check Table					Total Number of failures
		Compliance with storage limits	Compliance with reservoir outflow limits	Accuracy of Reservoir Evaporation (% error compared to manual calculation)	Compliance with deficit sharing constraints	Compliance with mass balance constraints	
2008	1						
2008	2						
2008	3						
.	.						
.	.						
2009	1						
2009	2						
.	.						

Thank you