Project: Water Quality Control in the Sacramento Valley (California, USA)

Project Proposal

The system of the Sacramento River in California has the configuration shown in Figure 1, where H is a storage power plant with its reservoir R, I an irrigation district and P a pumping station, which extracts water from the Sacramento via diversion D to feed district I, which also receives the natural flow of a small river. In the stretch downstream from section A, algal blooms, stimulated by the drainage flow from I laden with nitrogenous substances, often occur and induce anoxic conditions. The regulation license of reservoir R prescribes that it is the Hydropower Company (HC) managing this plant that must prevent the occurrence of such conditions, by maintaining the dissolved oxygen (DO) concentration cdo in section A not lower than a pre-determined threshold (cdo) for not fewer than 360 days a year. The HC can pursue this result by regulating appropriately the flow turbined by its plant, given that a turbine strongly oxygenates water. In the same section A the total nitrogen (TN) concentration cTN is checked daily: it must be not higher than c-TN for not fewer than 360 days a year. Since, as we have seen, the nitrogen comes from the drainage flow from the irrigated land in I, the task of guaranteeing the non-violation of the standard on TN is assigned to the farmers, who have sluice-gates with which they can control the drainage flow. Obviously, when the latter is reduced, the level of the phreatic surface in I rises, and when this exceeds the level of the plant roots a stress is produced which leads to a reduction in the future harvest. The farmers also control pumping station P.

**Design the regulation system for the farmers of I.**



Figure 1. The Sacramento River system.

Hints

• Reconnaissance:

* + What is the Project Goal? Who is the Decision-Maker?
  + What are the limits and the components of the water systems?

• Identifying the Model:

* + Take special care in describing the legal environmental constraints.

• Designing Alternatives:

* + Define the objectives of the Design Problems.
  + Formulate the Design Problem that expresses the point of view of the farmers.
  + How does one handle the presence of the hydropower plant in the Design Problem of the farmers?
  + How does one solve the Design Problem?

Task:

**Design the regulation system for the farmers of I.**

**And solution to all the 7 points mentioned in the Hints Section.**