

**MASSACHUSETTS INSTITUTE OF TECHNOLOGY**  
**Department of Civil and Environmental Engineering**

**1.731 Water Resource Systems**

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**Suggested Project Topics**  
**Oct. 5, 2006**

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Please prioritize the topics listed below and send your ranked list to me by Tuesday Oct. 10, 2006. I will circulate your responses to all students so you can organize teams yourselves. By Oct. 17 your team should meet to focus your topic, select a preliminary site, and schedule an initial meeting with me. We will meet as required in the last half of October to go over the information you need to compile for a detailed (2+ pp.) team project proposal due Nov. 2. A final team report on your project will be due on the last day of classes. All or part of your team can meet with me during November as required to go over questions, etc.

Wherever possible, your project should be based on data from a real site or problem.

The effort spent on one of these projects should be about the same as 5 problem sets (about 45 hours), so please scope your project topic so that you can produce a satisfactory result within this time constraint.

**1. Real-time reservoir control**

- i) Take measurements of relevant variables (i.e. compile historical measurements for use in a retrospective test of your control strategy))
- ii) Predict future inflows based on past data, accounting for both short and longer term temporal correlation.
- iii) Determine optimal reservoir releases for all time steps out to a specified time horizon
- iv) Implement releases for next time step only, then repeat entire process

**2. Integrated water resource management for a semi-arid area**

- i) Consider all sources and demands for water for the selected area
- ii) Design a system that extracts, collects, conveys, treats, recycles, disposes water at various locations and seasons, with the overall goal of making best use of this limited resource
- iii) Optimize your candidate system by selecting the “best” components, facility capacities, operating policies, etc., considering both cost and performance.

### **3. Parameter estimation**

- i) Formulate a well-posed parameter estimation, specifying model parameters to be estimated and measurements to be used, for a model of “reasonable” size and complexity. Use real data if possible.
- ii) Simplify the model, as required, to make the parameter estimation procedure computationally feasible.
- iii) Test and compare more than one method for estimating the parameters for your problem.
- iv) Analyze the computational feasibility/scalability and performance of your approach for larger problems.

### **4. Capacity expansion**

- i) Formulate alternative options for meeting growing water demands in a large city.
- ii) Decide on the best way to expand capacity/develop these options over time, considering the time value of money, economy of scale, and demand uncertainty.

### **5. Management of a common pool resource**

- i) Formulate a problem where multiple users each have an incentive to deplete a shared resource (e.g. a common pool).
- ii) Construct an optimization model that reproduces individual (self-interested) behavior and analyze the resulting impact on the common pool resource.
- iii) Construct an alternative model that maximizes community benefit (summed over all individuals). Evaluate the associated individual benefits.
- iv) Formulate and evaluate an institutional mechanism (e.g. externality charges, water trading, etc.) that approaches the community and individual benefits of iii) by changing the constraints of ii).