

**CE 5333 – Special Topics in Water Resources Exercise Set 6**

Purpose: Application of Simulation Modeling and Linear Programming to a Groundwater Allocation Situation

**Exercise**

1. Read :
  - a) Chapter 10 of Bear, Hydraulics of Groundwater. The chapter is about groundwater models. Pay special attention to pages 447-455 (Multiple-Cell Balance Models).
  - b) Chapter 12 of Bear, Hydraulics of Groundwater. The chapter is about LP application to groundwater management.
  - c) Chapter 17 of Practical Computational Hydraulics in **R** (the URL is listed below). The chapter explains how to build a functioning groundwater model using **R**<sup>1</sup>.
2. Use the readings and build a groundwater model to compute the influence matrix that is needed for the linear program model to replicate Example 2 on page 505 of Chapter 12 in Bear.<sup>2</sup>
3. Once the groundwater model is built and running, use it to generate influence coefficients to replicate Example 2 on page 505 of Chapter 12 in Bear. Use **lpSolve** tool in **R** to find the water allocations.
4. Prepare a report that documents the entire analysis, including construction of the groundwater model to compute the influence coefficients and the LP model to perform the allocation. Produce three allocations for the case where recharge is 100 mm/yr (original problem), 50mm/yr (a drought condition), 150mm/yr (a case where global climate change has increased average rainfall).

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<sup>1</sup>The reading is located at <http://www.rtfmps.com/university-courses/ce4333-PCHinR/3-Readings/PCHinR-LectureNotes/PCHinR.pdf>

<sup>2</sup>You can build the necessary groundwater model using **R**, MODFLOW, or even Excel – steady flow, single layer models are straightforward. A spreadsheet model that could be adapted (need to add recharge and wells) for this exercise is located at <http://theodores-pro.ttu.edu/software-archive/spreadsheets/ssgwhydro/>