CE 717 RIVER MECHANICS
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Computer problem #2 – Numerical River Modeling - due February 26, 2009

You would like to design a one-dimensional numerical model for contaminant advection and dispersion from instantaneous point sources in a 20 km reach of the Poudre River at a bed slope $S_0 = 0.002$. The main processes include contaminant transport by advection and longitudinal dispersion. You consider a one-dimensional Leonard scheme in the downstream direction. You read somewhere that a grid Peclet number around 4-5 should yield satisfactory results. Assume a constant flow velocity through the reach and a constant dispersion coefficient. Take a representative reach from Fort Collins and Greeley. Assume that the river is 100 ft wide, 7 ft deep, Manning n = 0.04, during floods. Determine the following:

1) Estimate the slope, velocity and dispersion coefficient for this river.
2) Determine the length scales for vertical and lateral mixing.
3) Select an appropriate grid size and time step for your model?
4) Is your model stable?
5) How could you use a larger grid size and a longer time step?
6) What are the coefficients of your algorithm?
7) What would a negative coefficient mean?
8) What type of initial and boundary conditions do you need to satisfy?
9) How do you make sure that no contaminant will numerically leak out of the upstream boundary?

Simulate the advection and dispersion of a 15 min pulse at a concentration of 200,000 mg/l followed with a second pulse at 600,000 mg/l over 5 minute. (*e.g. Example 11. 2 p. 370*)

- What is the maximum concentration to be observed 10 km and 20 km downstream of the source.
- Plot the concentration as a function of time at these two points.
- Both pulses contain the same mass of contaminant. Which of the two pulses results in a higher downstream concentration, and explain why.
