BAE 590-601: DRAINMOD Spring 2011

Homework 5: Wetland Hydrology Analyses and the Lateral Effect Method

Problems 1, 3, 4 Due by 5PM EST on Friday, February 18, 2011

Problem 2 Due by 5PM EST on Friday, February 25, 2011

FILES TO SUBMIT

- Report in .doc or .docx format and named as shown below. Replace LastName with your last name.
  - ✓ LastName.590.2011.HW05

- Spreadsheet in .xls, .xlsx, .xlsm format and named as shown below.
  - ✓ LastName.590.2011.HW05

- Zip file(s) including DRAINMOD inputs (PRJ, GEN, SIN, RAI, and TEM). Name your PRJ and GEN file as shown below.
  - ✓ YourInitials_hw05

    - For example, my PRJ file would be named: bdp_hw05.prj
    - If you use different project files for each drain depth, label similar to the following scheme:
      1. bdp_hw05_90cm.prj
      2. bdp_hw05_120cm.prj
      3. Etc…
    - As long as your PRJ and GEN files begin with YourInitials_hw05, a naming scheme is up to you
    - If you use the *Backup* button from within DRAINMOD to zip your project, the zip file generated should reside in your inputs folder.

- PDF's of any referenced material not distributed in the course (when possible)

HW INFORMATION

- Total possible points: 250
- Use the report template – LastName.590.2011.HWxx.dot
- Post questions to the *Homework Q & A* forum

PROBLEM STATEMENTS

1. (100 pts.) The Phillips tract is a wetland restoration site located near Greenville, NC and has parallel drainage ditches spaced 100 m apart. The ditches were excavated prior to harvest of a mixed pine and hardwood forest; they were originally 1.2 m deep but have filled in so they are now effectively 0.9 m deep. The soil type is Rains sandy loam (a hydric soil). Natural vegetation is hydrophytic; and the effective root depth is 30 cm all year.

   Greenville, NC can be found by clicking the link below.

   http://maps.google.com/maps?f=q&source=s_q&hl=en&geocode=&q=greenville,nc

   The average last date of 28°F in the spring and the average first date of 28°F in the fall (50% probability) can be obtained from the soil survey report for Pitt County, NC. However, you should use the growing season information available on the USDA NRCS WETS web site:
   http://www.wcc.nrcs.usda.gov/climate/wetlands.html

   Based on the WETS table, the starting and ending growing season dates are 74 and 320, respectively.

   The HI is 76 and the Latitude is 35D 38M . The effective ditch radius is 25 cm and the DC is 2.5 cm/day. The depth to the restrictive layer, as indicated in Table 1, is 2.5 m.

Table 1. Lateral hydraulic conductivity of the Phillips tract.

Depth (m)	Lateral Conductivity (cm/hr)
0 – 0.3	12
0.3 – 2.5	1.5
>2.5	0

The Phillips tract was not cleared or shaped after tree harvest; natural vegetation was allowed to regenerate. Surface storage (STMAX) is approximately 3.0 cm. Kirkham's Depth may be estimated as 0.6 STMAX.

Use DRAINMOD to determine if the Phillips tract has wetland hydrology according to the 1987 Corps of Engineers Wetlands Delineation Manual but using 14 days of continuous saturation. Base your analysis on a 50 year simulation (1951-2000) using the Greenville weather set.

Would it have wetland hydrology if STMAX = 1 cm? STMAX = 8 cm? STMAX = 15 cm?

► Tabulate and plot the wet years for each STMAX.

►Tabulate the Avg Annual runoff, drainage, ET, and infiltration for each STMAX

For STMAX = 3.0 cm, what is the threshold drain spacing such that the wetland hydrologic criterion is barely satisfied? i.e. satisfied in 1/2 of the years?

► Tabulate and plot the wet years for the drain spacings simulated

For the threshold spacing, how sensitivity is your solution to drainable porosity? Perform simulations for drainable porosity changes in the top 30 cm of +/- 25% and +/- 50%. Remember the volume drained is cumulative,

you may need to adjust some volumes drained deeper than 30cm.

► Tabulate and plot the wet years for each percent change

2. (50 pts.) Due February 25

A site near Plymouth, NC is similar to the one in problem 1 but we don't know the soil type, nor do we have soil water characteristic or other unsaturated soil property measurements.

The profile consists of a sandy loam surface (K = 10 cm/hr in top 30 cm), underlain by 40 cm of sand or loamy sand (K = 6 cm/hr). That layer is underlain by a sandy clay loam (K = 1 cm/hr) and extending to a depth of 3 m where there is a heavy marine clay (K = 0.2 cm/hr) extending to a depth of 5 m (from the soil surface).

The ditches on this site are 200 m apart; vegetation and depressional storage are similar to the first site.

The drainable porosity of the profile is judged to be approximately 3 -5%.

Does the site have wetland hydrology at 3%? 4%? 5%?

►Tabulate the wet years for each drainable porosity approximation.

For each drainable porosity, determine the threshold drain spacing.

►Tabulate the threshold spacing for each drainable porosity approximation.

3. (50 pts.) A single ditch runs through another restoration site near Greenville, NC, the Poole tract. The Poole tract has the same soil and site properties as Phillips tract. The ditch is 1.5 m deep, 0.6 m wide at the bottom with 1:1 side slopes, and an effective radius of 25 cm. Surface storage is estimated to be 2.5 cm.

A consultant claims that the presence of the ditch removes wetland hydrology for a strip of land 150 m wide on either side of the ditch. That is, he claims that the hydrology has been converted to "upland" conditions on a 300 m wide strip with the ditch in the center.

Is the consultant correct? Are you able to say with DRAINMOD? Use the Greenville weather set and a simulation period of Jan 1951 to Dec 2000.

► Tabulate and plot the wet years for the drain spacings simulated

4. (50 pts.) Using the Lateral Effect method (called the Skaggs Method by NC DOT) for determining the lateral effect of a drainage ditch (Phillips, Skaggs, Chescheir, 2010), estimate the distance from the ditch at the Poole tract that wetland hydrology has been removed. That is, estimate the lateral effect of the ditch.

Do the calculations by hand and show your work. T_{25} values for Pitt County can be found in the CTE NCDOT report. Other references for the method are also available on the course web site. Use 30 cm = 1 ft, 2.5 cm = 1 inch.

Then use the Lateral Effect computer model to make the lateral effect calculation. Compare your hand calculations to the computer results. Which is more accurate and where is error introduced when solving the problem by hand.

Note that the Lateral Effect method assumes a linear relationship when calculating the drainable porosity. While not absolutely correct, calculate the drainable porosity for the method by dividing the volume drained at 30 cm by 30.

►Tabulate the result of hand calculations and the software.

►Include your scanned in hand calculations (be neat), and the summary output from the software

<u>Discuss all results for each problem</u>