BAE 590-601: DRAINMOD Spring 2011

Homework 9: Onsite Wastewater Management

Due by 5PM EST on Friday, April 8, 2011

FILES TO SUBMIT

- Report in .doc or .docx format and named as shown below. Replace LastName with your last name.
  - ✓ LastName.590.2011.HW09
  - ✓ Include final OUT and WET output in appendix
  - ✓ Include 4 month calibration RAI and TEM file data in appendix

- Spreadsheet in .xls, .xlsx, .xlsm format and named as shown below.
  - ✓ LastName.590.2011.HW09

- Zip file(s) including DRAINMOD inputs (PRJ, GEN, SIN, RAI, and TEM). Name your PRJ and GEN file as shown below.
  - ✓ YourInitials_hw09

    - For example, my PRJ file would be named: bdp_hw09.prj
    - If you use different project files for each drain depth, label similar to the following scheme:
      1. bdp_hw09_90cm.prj
      2. bdp_hw09_120cm.prj
      3. Etc…
    - As long as your PRJ and GEN files begin with YourInitials_hw09, 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: 150
- Use the report template – Include All Sections
- Post questions to the *Homework Q & A* forum

PROBLEM STATEMENT

Refer to the "Forest Park Schematic.pdf". A site near Elizabeth City, NC is being developed as a residential community (Latitude 36D 19M, Heat Index 75). The site was previously in agricultural production. It is flat and is drained by parallel ditches 120 cm (4ft) deep and 30.5 m (100ft) apart. The soil series is Roanoke which is classified as poorly drained; the surface is crowned such that the land surface midway between the ditches is 30 cm higher than it is adjacent to the ditch. Account for this feature as shown in class. The drainage ditches empty into collector canals 135cm (4.5ft) deep as shown on the schematic.

Water table data (depth in cm) were collected from three observation wells located midway between the drains as shown on the schematic. Data were collected for the period Jan1 to April 30, 1992 and are given on the spreadsheet, "ecity92.onsite.casestudy.data.xls". Daily rainfall (cm) and maximum and minimum temperature (°F) data are given in the same spreadsheet. A description of the soil profile, as well as a copy of Table 20 from the County Soil Survey giving information on the Physical Properties of the soil can be found in "ecity soil properties.pdf".

We do not have soil property measurements specific to the site. DRAINMOD inputs for unsaturated soil properties (the .SIN files) are given for 4 sites on Roanoke soil. Three of the 4 are for agricultural sites (Roanoke-BeauAg.sin, RoanokeTRS6.sin, Roanoke-TESUK.sin). The other soil had a forest shrub cover (Roanoke-H.sin). You may choose to use one or more of these data sets to calibrate the model.

You may assume the drain lines in the septic drain field are 3.3 m (11ft) apart, buried 45 cm (18 inches) deep and are each 30.5 m (100ft) long. Assume the site needs to treat 360 gallon of wastewater per day.

Calibrate DRAINMOD for the Jan – April 1992 period such that the Average Absolute Error (AAE) is less than 10 cm. Then determine if the rules for onsite waste water treatment regarding water table are satisfied. That is, the water table should **not** be closer than 45 cm to the bottom of the trench for 14 consecutive days or more in 30% of the years (ecity weather files 1951-2000, 50 year long term simulation). That is, it may exceed the 45cm-14 day threshold during the wettest conditions, but in not more than 3 years in 10 on average.

- **Tabulate** calibration trials (soil, K for each layer, initial w.t. depth, AAE, other inputs changed).
- **Plot** final Observed / Predicted water table calibration plot and add statistical results in text box located on the plot.

Notes:

- This HW will be graded at a more difficult level, i.e. I expect a well thought out and logical methods, results, and discussion.
- Wastewater Lectures: 17, 18, 20, 21, 22
- You should consider writing the methods section as you do your calibrations.
- **Include in methods section how you adjusted for the turtleback field, accounted for lateral seepage, and calculated the irrigation rate.**
- When you set the initial water table value, it most likely will not be the value of the water table listed for Day 1. The initial water table is the day 1 hour 0 water table. In the .PLT or .DAY file, the water table listed is for the end of the day.

Additional Weather File Information

Converting columnar daily max/min temp to DRAINMOD format

The program reads a four column daily maximum and minimum temperature file and writes a daily maximum and minimum temperature file in DRAINMOD format (.TEM file). The first and second columns of the input file are the year and the day of the year. The third and fourth columns are the maximum and minimum temperatures, respectively, (in ^{o}F or ^{o}C) for that day.

Sample input lines (temperature in ^{o}F)

1960	1	64	49
1960	2	53	29
1960	3	49	27
1960	4	49	28
1960	5	36	16
1960	6	65	15

Converting columnar daily rainfall to DRAINMOD format

The program reads a three column daily rainfall file and writes an hourly rainfall file in DRAINMOD format (.RAI file). The first and second column of the input file are the year and the day of year. The third column is the rainfall amount (in inches, centimeter or millimeter) for that day.

Sample input (inches)

1990	1	0.58
1990	2	0
1990	3	0.02
1990	4	0
1990	5	0
1990	6	0.29
1990	7	0.05