**BAE 590-601: DRAINMOD Spring 2011**

**Homework 8: Conventional and Controlled Drainage and Subirrigation**

**Due by 5PM EST on Friday, March 25, 2011**

**Use the report format <u>BUT SKIP</u> Abstract, Problem Statement, and Conclusion sections. They are not required for this HW.**

**<u>Only deliver Methods, Results, Discussion, and Appendices.</u>**

**FILES TO SUBMIT**

- Report in .doc or .docx format and named as shown below. Replace LastName with your last name.
  - ✓ LastName.590.2011.HW08

- Spreadsheet in .xls, .xlsx, .xlsm format and named as shown below.
  - ✓ LastName.590.2011.HW08

- Zip file(s) including DRAINMOD inputs (PRJ, GEN, SIN, RAI, and TEM). Name your PRJ and GEN file as shown below.
  - ✓ YourInitials_hw08

    - For example, my PRJ file would be named: bdp_hw08.prj
    - If you use different project files for each drain depth, label similar to the following scheme:
      1. bdp_hw08_90cm.prj
      2. bdp_hw08_120cm.prj
      3. Etc…
    - As long as your PRJ and GEN files begin with YourInitials_hw08, 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 but skip abstract, problem statement, conclusion sections
- Post questions to the *Homework Q & A* forum
- Download Baton Rouge weather from course web site

## PROBLEM STATEMENT

1. (50pts) Corn (cornNC) is to be grown on a site with an Arapahoe loamy sand and located close to Baton Rouge, LA. The hydraulic conductivity of this soil is 5.0 cm/hr in the top 70 cm and 15 cm/hr for depths from 70 cm to 300 cm where the impermeable layer is located. The lower limit water content is $\theta ll = 0.25$. The soil can be worked for seedbed preparation when there is 3.5 cm of water free pore space in the profile. Rainfall of 1.2 cm will delay field work for one day. Subsurface drains with an effective drain radius of 1.5 cm are 1.5 m deep and 30 m apart. It will be planted by April 15 and harvested in late August. Assume average surface depressional storage of 2.0 cm and local storage (Kirkham depth) of 1.0 cm. Conduct simulations for the 40 year period 1970-2009 for Baton Rouge, LA (Latitude 30D 54M, Heat Index=98) to address the following.

**Plot** the relative yield versus drain spacing at spacings from 10 to 100 m (10m increments).

**Discuss** the effect of conventional drainage on yield? On average subsurface drainage and surface runoff?

**Plot** average subsurface drainage and surface runoff versus drain spacing.

**Tabulate** spacing, yield, subsurface drainage, and runoff results.

**Table 1. DRAINMOD Input Parameters for the problem 1.**

| DRAINMOD Parameter | Description |
|---|---|
| Drainage System | Conventional |
| Simulation Period | Jan 1970 – Dec 2009 |
| Weather Files | BatonRouge4809 |
| Ditch Depths | 150 cm |
| Effective Radius of Drain Lines | 1.5 cm |
| Depth to Impermeable Layer | 3.0 m |
| Drainage Coefficient | 2.5 cm/day |
| Average Maximum Surface Storages | 2.0 cm |
| Kirkham's Depths | 1.0 cm |
| Crop Files | CornNC |
| Heat Index | 98 |
| Latitude | $30^o$ 54' |
| Lower Limit Water Content in the Root Zone | 0.25 $cm^3/cm^3$ |
| Effective Root Depth | Variable |
| Soil File | ArapM |
| Minimum Air Vol to work land | 3.5 cm |
| Rainfall to delay work | 1.2 cm |
| Delay due to rainfall | 1 days |
| Required days to prep beds and plant | 5 days |
| Growing Days – Corn | 130 days |
| Last day to plant corn without yield loss | April 15 (Day 105) |

**Table 2. Lateral hydraulic conductivity problem 1.**

| Depth (m) | Lateral Conductivity (cm/hr) |
|---|---|
| 0 – 0.7 | 5 |
| 0.7 – 3.0 | 15 |
| >3.0 | 0 |

2. (50pts) Controlled drainage is to be used at the above site to reduce drought stress and reduce loss of NO3-N in drainage water during fallow months.

The weir levels will be as follows:

- 50 cm deep for Jan. 1 to Mar. 15
- At depth equal to drain depth from Mar. 16 to Apr. 30
- 60 cm deep from May 1 to July 31
- At depth equal to drain depth from Aug. 1 to Oct. 31
- 50 cm deep from Nov. 1 to Dec. 31

The ditch dimensions are important in controlled drainage. Assume 10 cm diameter drain tubes are to be used. You may assume the drain tubes have negligible storage, but they empty into a trapezoidal ditch which has width (at the depth that the field drains enter the ditch) of 2 m and side slopes of 1:1. So the main ditch does have storage that must be considered in simulating controlled drainage. The dimensions needed in DRAINMOD are those of an imaginary ditch that has the same storage as in the main ditch. The bottom width, $b_f$ of the imaginary field ditch may be calculated as, $b_f$=b(L/l), where b is the width of the main ditch at the depth the drains enter, L is the lateral drain spacing and **l** is the length of the laterals. The side slope, s, of the imaginary ditch may be calculated as, s=L/l. The length of the lateral, l, is 150m.

**Plot** the relative yield versus drain spacing at spacings from 10 to 100 m (10m increments). Remember to calculate width and side slopes of each drain spacing when using controlled drainage.

**Tabulate** your spacing, width and side slope inputs.

**Discuss** the effect of controlled drainage on yield? On average subsurface drainage and surface runoff?

**Plot** average subsurface drainage and surface runoff versus drain spacing.

**Tabulate** spacing, yield, subsurface drainage, and runoff results.

3. (50pts) At the same site, subirrigation will be used to alleviate drought stress during part of the corn growing season (May 1 to July 31). Water will be pumped into the drainage outlet to hold the water level at the weir depth of 60 cm. The site will be in conventional drainage at other times of the year.

**Plot** the relative yield versus drain spacing at spacings from 10 to 100 m (10m increments).

**Discuss** the effect of subirrigation on yield? On average subsurface drainage and surface runoff?

**Plot** average subsurface drainage and surface runoff versus drain spacing.

**Tabulate** spacing, yield, subsurface drainage, and runoff results.