CE 521 WASTEWATER ENGINEERING - BIOWIN DESIGN PROJECT
IN CLASS ASSIGNMENT TUTORIAL
(adapted from assignments by Professor Chris Schmit SDSU – http://learn.sdstate.edu/christopher%5Fschmit/)

Start BioWin by clicking on the BioWin Icon or under the Start – Programs – Environmental – BioWin 32. The drawing screen should be blank. If it is not then select <file> <new> to start a new project.

Go to the <Project> <New Project Options> <Unit System>screen and set the units for flow to be **mgd** (million gallons per day) and the BOD basis to 5 day.

Go to the <project> <info> screen and type in a username (group member) in the appropriate space. Type **In Class Assignment** for the project name and **Town Engineering** for the plant name.

Influent
Select the **BOD Influent** icon from the toolbar <Configure> menu and click on the left side of the white part of the screen to place the influent line.

*Note: To delete or erase an object select the pointing finger icon and then select the object that you want to erase. You can do this by clicking on it or by drawing a box around multiple objects. After the item is selected you can press the **delete** key.*

Right click on the influent element and select name. Type *Influent* in the box. This should change the name of your element to influent.

Right click on the influent element and select the properties tab. The input type should be set to constant. This will assume a constant flow and load to the plant. Chose the **edit data button** under the input type tab. Enter values for the following based on the table:

Wastewater Characteristics	Value
Population	150,000
Design Flow	100 gal/cap-day
BOD_5	250 mg/L
TSS	250 mg/L
VSS	140 mg/L
TKN	40 mg/L
Total Phosphorus	8 mg/L as P
Alkalinity	350 mg/L (11.67 mmol/L)
Temperature (winter/summer)	10/22 C

Note: Choose <Project><Temperature> to adjust influent temperature.
Leave all other values alone! Pay attention to the units. Note flow is in mgd.

Primary Clarifier

Select the **Ideal Clarifier** icon and place a clarifier to the right of the influent line. Allow about 1" of space between the two processes. Make sure you have the pointed finger icon selected to move the process or you will make another clarifier. It this happens delete the extra clarifier.

Right click the primary clarifier and select **Name**. Type in *Primary Clarifier* for the name of the clarifier. Right click the primary clarifier and select **Properties**. Choose the area and depth option (default) under the dimensions tab. Ideal Primary Settling Tank Design Information

Model as one unit, in other words, find the total area and volume of the three and use that value for the model.

# of Units	3
Diameter of Unit	74'
Solids Removal	55 %
Underflow	30,000 gpd
Sludge Blanket Height	0.10 of full depth
Depth of Unit	10'

Go to the Flow Split tab and choose the amount of underflow that will be removed from the primary clarfier. Select the underflow split method and enter in the underflow rate in mgd. Go to the Operation tab and enter the percent removal and sludge blanket height.

Bioreactor (Activated Sludge)

Select the **Bioreactor** icon and place a bioreactor to the right of the primary clarifier. Allow about 1" of space between the two processes. Make sure you have the pointed finger icon selected to move the process or you will make another bioreactor. It this happens delete the extra bioreactor.

Right click the bioreactor and select **Name**. Type in *Activated Sludge Aeration Basin* for the name of the bioreactor. Right click the bioreactor and select **Properties**. Under the dimensions tab select specify by volume and depth. The volume can be found by using the flow rate and the HRT. Enter the volume in the appropriate spot. Under the operation tab set the DO setpoint according to the table. Note that specify aeration method must be set to DO setpoint to be able to do this.

Bioreactor Design Information (Activated Sludge CSTR)

HRT of Units	8 hours
Depth of Units	14 feet
DO Setpoint	2.0 mg/L

You need to **define** how the **SRT** is calculated. Choose SRT from the project menu. Select elements for total mass (the tanks to calculate SRT) and choose your CSTR from the list. Select wastage elements (where you are wasting) and select your WAS effluent. Click Ok when done. Do not click control SRT at this time.

Final Clarifier

Add a final clarifier to the system by selecting the **Ideal Clarifier** icon and following procedures outlined previously. Right click the clarifier and select **Name**. Type in *Final Clarifier* for the name of the clarifier.

Right click the clarifier and select **Properties**. Under the dimensions tab choose specify by area and depth. Find the depth and calculate the combined area from the four final clarifiers from the information given in the table. Enter this information into the appropriate locations.

Ideal Clarifier Information	
# of Units	4
Diameter of Unit	82 feet
Depth of Unit	13 feet
Solids Removal	99.99%
Sludge Blanket Height	0.20 of full depth
Underflow	100% of influent flow (flow paced)
Flow Splitter (waste)	0.5 MGD

Choose the flow split tab to set up the WAS and RAS from the system. The WAS will be taken from the RAS which will be set up to be 100% of the influent flow. To accomplish this check the flow pacing box and set to 100% of influent. Chose the operation tap and select the appropriate percent removal and sludge blanket height.

Effluent

The next step is to add in all of the effluents. There are a total of three effluents: Primary sludge, Waste activated sludge, and Discharge Effluent.

Choose the **Effluent** icon and place the discharge effluent to the right of the final clarifier. Place the primary sludge effluent under the primary clarifier. Place the waste activated sludge effluent below and to the right of the final clarifier. Right click each effluent and choose **Name**. Name the effluents: *effluent, primary sludge,* and *waste activated sludge* appropriately.

Pipes

Use the **Pipe** icon to connect each process and all effluent lines. To use the **Pipe** icon, select it and then select the origin process and then select the destination process. A blue line with the arrow pointing in the direction of flow will appear when the connection is made.

Pipes can be moved to make the drawing look nice. Select the pipe and a red **handle** will appear. The red handle can be moved. If the handle is not going in the direction that is desirable that right click on the pipe and change the pipe type.

The Flow from the final clarifier to the WAS has to be run through a splitter so that some of the flow can be recycled back to the activated sludge tank.

Place a **splitter** below the final clarifier. Connect the bottom of the clarifier to the influent side of the splitter. Connect the side stream to the waste activated sludge effluent and connect the effluent side of the splitter to the activated sludge tank. Make all connections with the **pipe** icon. Make sure that the vertical part of the T is going to the WAS. The vertical part of the T is the side stream.

Right click the splitter to set the flows into and out of the splitter. Right click the splitter and choose properties menu. Click on the flow split tab. Select Rate in side as the split method and type in 0.5 MGD for the flow. Make sure the constant box is checked.

Simulation

You plant should look like the one illustrated at the end of the tutorial. At this time, run the steady state simulation. Your results should be as follows:

CODt = 26.61 mg/L
NH3-N = 0.82 mg/L

You can check you results by moving your mouse over the effluent pipe and looking at the bottom right of the screen.

SRT

The SRT is based on the amount of solids wasted in the WAS and the biomass in the system. Remember to select both you **Activated Sludge Tank** for your elements for total mass and your **WAS Effluent** for your wastage element. Rerun the simulation and note the SRT.

The SRT should be 5.09 days at the initial conditions.

Temperature

Try seeing what happens in winter by choose **Properties : Temperature** from the menu at the top of the screen. Set the temperature to 10 and rerun the simulation. Look at the effluent results. Repeat the procedure with the temperature set at 22 C. Notice the difference.

Album

This part of the tutorial will walk you through the creation of the first two pages of your album required for the in class assignment.

The album is a way to display the data within the Biowin program. The album is divided into pages with each page displaying a different set of data. Most album pages are created by the user.

Open the album by selecting <view> <album> from the menu or by hitting <ctrl-A>. The album will open up with 4 page tabs on the bottom. This means that the album currently has 4 pages and they are all blank.

Create a table on page 1 of the album by right clicking on page one and selecting <table>. An edit table screen opens up. The table is created by selecting **Elements** for the rows and **Compounds** for the columns. Every time you run the simulation the table will be updated.

Create a table in BioWin with the following attributes at Page 1:

Elements	Compounds
Influent	Flow
Primary Clarifier Effluent	Total Suspended Solids
Activated Sludge Tank	Volatile Suspended Solids
Final Clarifier Effluent	Total BOD
Return Activated Sludge	Soluble BOD
Waste Activated Sludge	Ammonia-Nitrogen
Primary Sludge	Nitrate-Nitrogen
	Total Phosphorus

The **RAS Element** is actually the splitter so select that element for the RAS. You can go back and change anything on the table by right clicking the page and selecting <edit table>.

Use the up and down arrows on the right side of the edit table screen to move an element up or down. These tables are very flexible. You can even change the column widths to fit everything on a page by clicking and dragging the vertical lines between columns.

To create a **Bar Chart** in the album select the page 2 tab with the mouse. Right click the page and select <chart>. A default chart will appear. Like the tables in Biowin the charting operation is very flexible and the numbers are updated every time you run the simulation.

Note: Editing page titles is a lot like editing sheets in an excel spreadsheet. By right clicking the page tab you can move the page, create a new page, or delete a page.

After you create a chart, a blank chart will appear on page 2. Right click the chart and select <add series> to add data to the chart. A screen will come up with a variety of choices on what type of series to make. For our page 2, we will be making a current value

graph. Select the **current value** tab. You will now need to select the elements to be part of the chart. Use these elements: influent, primary clarifier, activated sludge, and the final clarifier effluent. On the bottom of this window is the **compound** window. Select NH_3-N as the compound to be charted. You will also need to select the chart type by clicking on **Plot Select**. Select a bar chart and make it 3D for fun. When you are finished you should have an ammonia-nitrogen profile through the plant (influent, primary clarifier, activated sludge, and final clarifier).

You can edit charts much like in Excel. Explore the editing features by putting the title "Ammonia-Nitrogen Through Plant" on the chart.

Continue by making a **current value** bar chart of BOD_t on page 3.

On the fourth page we will add a pie chart showing the different forms of nitrogen in the effluent. This will explore the automatic charting features available in BioWin. To automatically chart the forms of effluent ammonia-nitrogen right click the **effluent** element on the BioWin screen.

Select **Add to Album**
Choose **Chart**
Select **No** when asked to add
Select **Special** under plot selected parameters
Choose **All nitrogen concentrations**
Click the **Plot Selected** tab and choose Pie Chart
A fifth page should be added to your album with the nitrogen concentrations in the effluent. Delete your blank fourth page and rename this one page 4.