



Memorandum

To: Mike Rolband and Janice Cessna, WSSI

From: W. Lee Daniels, Professor, Va Tech
Rich Whittecar, Professor, ODU
Tess Thompson, Associate Professor, Va Tech

Re: Progress report for *Wetland Water Budget Modeling*

Date: April 30, 2012

C: Zach Agioutantis, Professor, Tech. Univ. of Crete

This extended memo comprises our progress report for work conducted between July, 2011 and April, 2012, on our cooperative research program on Wetland Water Budget Modeling that is funded by WSSI and the Peterson Family Foundation.

From a management standpoint, our primary goal over the last nine months has been to (1) interact with our Windows programmer (Z. Agioutantis) to test the framework and code for our base version of the “WetBud model” that assumes constant groundwater flux, (2) develop and validate the second version of WetBud that uses a MODFLOW based groundwater algorithm to account for groundwater inputs and losses, (3) gather full data sets for two field sites for model validation for both versions, and (4) initiate efforts to include a new surface water/overbank source component in the overall model per the addendum proposal that was approved in June of 2011. More detail on component work by the Virginia Tech BSE Department and ODU is detailed separately below.

Work by BSE Department at VT

The Virginia Tech Biological Systems Engineering research group consists of Dr. Tess Thompson, Eric Neuhaus (graduate research assistant), and Janell Henry (graduate research assistant). Both Eric and Janell started their M.S. programs in August 2011. Eric’s research focuses on testing the original WetBud Model, while Janell is investigating techniques for estimating flood flows for ungauged watersheds to include in overbank flow and stream restoration design calculations. During the period June 2011 – April 2012, we worked with Zach Agioutantis to test the WetBud model. This testing included an assessment of the installation and general functioning of the model. Multiple model versions were downloaded and installed. Currently, they are working on Version 33!

Suggested improvements included adding a user-defined file path for the database, a backup procedure for the database, and a “copy scenario” tool. Additional changes were made to the general appearance of the output. Eric and Zach are also investigating running the database from a server, which would allow multiple users to access projects and/or would allow one user to work from multiple locations.

The functionality of the simple model was assessed by comparing manually gathered data [precipitation, weather data, and solar data (from Dulles International Airport and Oceana, VA)] to the data WetBud uses for calculations, to confirm that the simple model is correctly retrieving basic calculation data. Additionally, each component of the water budget was compared to hand calculations for the Cedar Run 3 site near Manassas, VA. Calculations of daylight length based on latitude were completed and incorporated into the model for calculation of Thornthwaite PET. Runs of the simple model were completed in WetBud for the Cedar Run 3 site using both the Thornthwaite and Penman-Monteith models; model output was compared to hand calculations to verify model correctness.

Reports and data were collected for the Bender Farm site in Fauquier County to continue model testing. Eric Neuhaus visited the Bender Farm site with Dr. Rich Whittecar to get a first-hand understanding of the variability, size, and scope of the site. A simple model is currently being developed for this site.

Research on improved methods to develop stage discharge relationship for riprap outlet structures is ongoing. Following completion of the advanced MODFLOW based version of WetBud, the model will be tested using data from the Cedar Run 3 and Bender Farm sites.

The development of an advanced overbank flow/stream restoration design component was also initiated in the last quarter of 2011 as called for in the addendum contract. The initial step is developing a flood frequency distribution for ungaged sites. Options currently being considered include the source of weather data (i.e. use existing data or a synthetic climate generator) and the precipitation excess model. The most commonly used model in the U.S. is HEC-HMS. However, conceptual models, such as TOPMODEL, are frequently used in Europe and may provide a simpler option for modeling streamflow. Existing streamflow data are being investigated for model development and testing.

Work at ODU

The ODU groundwater research group between July, 2011, and April, 2012, consisted of Dr. Rich Whittecar, John McLeod (grad student), and Hunter Thompson and Jessi Strand (undergraduate students). Our primary continuing focus was to improve existing models used to estimate groundwater available to a specific potential toe-slope wetland site and to build a prototype version

of the MODFLOW-based model WetBud. In addition we evaluated the usefulness of data sets that might be used to test and calibrate models.

During the past nine months (July 2011 – April 2012) we continued the process of documenting the procedures developed previously, text that will be needed for training manuals given model users, and writing journal articles for publication.

We have now tested the usefulness of the Effective Monthly Recharge (Wem) calculations for six groundwater systems: three created wetlands (Nottoway VDOT site; Peters site built by Angler; Oceana VDOT site); a natural wetland system (First Landing State Park), the site of the USGS well in Suffolk, and the Bender Farm mitigation wetland site built by Acorn. The 30-year data set from the USGS well on this hill beside the Dismal Swamp has proven to be immensely valuable in testing and validating the Wem calculations; they form the basis for a large portion of the manuscript in preparation. Wem calculations for the Bender site reinforce our previous finding that the interception value (I) proves to be *very* important in improving the correlation coefficient values that are at the heart of the Wem calibration procedure. For example, we found the Bender site, which is mostly pasture land, had the best results with a low interception rate of 0.10. At other locations studied, we have used interception values of 0.20-0.25 for row crops (corn and beans) and higher values for pine forests. Because the final R^2 seems to be quite sensitive to I (interception) as well as to N (number of months), and D (decay factor), we plan to incorporate I as a “third axis” on the correlation matrix that we will use to calibrate the model.

We also continued the process of designing more versions of WetBud, the MODFLOW-based model that we plan to use. This model will allow the user to select one of several potential designs they might use for a created toe-slope wetland, and to test if the anticipated water sources at that site could be sufficient to support wetland hydrology. The final public version of WetBud will be based on a free version of a finite-difference groundwater flow model developed by the USGS (MODFLOW 2005). Zach Agioutantis (Tech U-Crete) is generating the Windows-based code that will create the files that MODFLOW needs and interpret the files that MODFLOW generates. In parallel, ODU is generating a prototype version of WetBud by using another MODFLOW-based program – Groundwater Vistas 5, that will allow us a separate external validation of how the public version of MODFLOW functions within WetBud.

Previously we generated a model that evaluates the water levels in our generalized created wetland by processing four different hydrologic sources of water on a daily basis and generating a hydrograph for a 365-day trial year (3 head values calculated per day). The model is based on a realistic stratigraphic model with appropriate K_{sat} values, and developed boundary conditions that simulate external influences to simulate appropriate flow rates and heads. The initial WetBud module has four layers: 1) a surface layer that simulates flow through thick grass; 2) a layer for the rooting zone made of permeable topsoil and tilled ground; 3) a low permeability zone lying under the ripped

surface zone; and 4) permeable stream sediment lying under the compacted zone and above impermeable bedrock. A low-permeability compacted berm surrounds three sides of the wetland, and saprolite lines the uphill side of the model. Flow into the modeled area can come from 4 sources that vary over time: 1) precipitation (minus ET) is entered with the Recharge function; 2) groundwater seepage IN occurs due to a General Head Boundary condition on the uphill edge of the wetland; 3) runoff generated by rainfall in a small watershed immediately tributary to the wetland is inputted via a Well pumping into the upper layer of the model; 4) water from a flooding river that enters from a low gap in the downhill side of the berm is simulated by another Well pumping water into the upper layer. Water exits the modeled wetland via ET, groundwater seepage downward and laterally through the sediments, and through a simulated overflow Drain.

Building on this previous work we have developed operating versions of WetBud that contain simple sloping surfaces, the goal being to allow the WetBud user to select, or perhaps to vary, the top and bottom elevations across the surface soil/compacted zone or layer. We plan to build and test a sufficient number of versions with different amounts of slope on those two surfaces to ensure that these “sloped” model versions will run accurately. We must also work with Zach to ensure that our designs and potential options are feasible to fold into the overall advanced WetBud package.

We also have started working on alternative versions of WetBud. One is based on designs that use minimal soil disturbance but that surround the site with a vertical water-flow barrier constructed in deep trenches.

Considerable effort in the time covered in this report went to developing a standardized procedure for selecting a Wet, a Normal, and a Dry year for a particular weather station. We contacted Dave Knepper at the Norfolk District office of the Army Corps of Engineers and asked him how the Norfolk District determines WND years or suggests to permit applicants what years to use. It turns out that they are not happy with their present in-house procedure which is to use the Annual Rainfall for the year and see if it falls within the 30%-40%-30% ranges for annual precipitation spelled out on the WETS Table for that area. Dave said his concern was for the myriad of ways that extremely wet months might throw a mostly dry year into the normal range, or a mostly normal year into the wet range, etc. His thought was that there needed to be some rationale that weighted the spring months most strongly, but the Corps did not have a procedure in mind.

We subsequently developed the following procedure to select a specific year as representing Wet conditions for wetlands, one for Dry conditions, and one for Normal conditions, for a given county in Virginia. We are using the data sets provided by NRCS for each of the WETS Table calculations. They have established one or two WETS Tables for nearly county in Virginia. These are our steps:

- 1.** Rank all of the annual total precipitation data given with that WETS table; usually the record is at least 30 years and may be more.

2. Use the values on the WETS Table to split that list of precipitation into the WET, NORM, and DRY years.
3. Select the year with the median precipitation value in each of those splits.
4. Look at the monthly data for the key months of March, April, May and June, and use the standard NRCS procedure to determine if each of those months are WET, NORM or DRY. The procedure uses the values of the three preceding months to make the determination. Assign a score of 3, 2, or 1 to each month, as does the NRCS for WET, NORM and DRY, and total the scores for the four key months. Those values will range between 4 (for 4 DRY months) to 12 (for 4 WET months). We decided that these four "spring" months would be DRY if they had a score of 4-6, they would be NORM if they had a score of 7-9, and they would be WET with a score of 10-12.
5. Therefore, a typical WET year would be one with a median WET annual precipitation AND a WET spring; a NORM year will have a median precipitation in the NORM range AND a NORM spring, and a DRY year will have a precipitation value that is median in the DRY range and a DRY spring,

Using this procedure, we tested it for all counties/sites in the Piedmont of Northern Virginia using published WETS Table data. We are in the process of preparing a description of the process and sample results to send to Dave Knepper at the Corps office for review. We also are determining suggested Wet, Normal and Dry years for the rest of the Piedmont and the Coastal Plain of Virginia.

In the past nine months we continued to present our research results and conceptual models at professional meetings, including the international meeting of the Society of Wetland Scientists (Prague), the regional (Wilmington) and the national meetings (Minneapolis) of the Geological Society of America and the fall workshop of the Virginia Association of Wetland Professionals (Richmond).

In coming months we plan to:

Finish the manuscript describing the procedures and calculations necessary to develop the Wem model for specific sites and submit it for publication.

Continue to develop the prototype version of WetBud and to work with Zach to develop the code that will integrate the Effective Monthly Recharge model with the other parts of the package.

Test the WetBud model using the pre-and –post construction data from Bender Farm Site. Also test it at two natural wetland sites where multi-year studies are nearly complete – a pitcher-plant bog at Joseph Pine Preserve, and a Piedmont toe-slope wetland in Powhatan Wildlife Management Area.

Present results of our research at the regional meeting (Asheville) and the national meeting (Charlotte) of the Geological Society of America, and the international meeting of the Society of Wetland Scientists and INTECOL in Orlando.

Overall Project Coordination and Summary

Overall project coordination by W.L. Daniels at Virginia Tech over the past six months has included (1) execution and supervision of the WetBud programming contract with Dr. Zach Agioutantis, (2) continued analysis of the overall daily water levels in the Cedar Run 3 wetland to be used for future model validation/calibration, (3) assessment of the Piedmont soils data base needed for integration into WetBud, and (4) overall project fiscal management including the ODU subcontract.

With respect to WetBud programming, Dr. Agioutantis has continued his development of the user interface and input programming for both versions of WetBud and a sequence of screen shots and text description of this comments and input on his programs are attached at the end of this report.

This project was initiated in August of 2008 with a proposed ending date of August 2011. In June of 2011, we negotiated an addendum proposal to extend the project to August of 2013 to (A) allow for full development and testing of the two WetBud versions and (B) to develop the stream overbank water source module described above. The first year of the addendum was funded by WSSI/Peterson in mid-summer of 2011 and we will provide you with a renewal proposal for the final year in mid-June of 2012.

We admit that our initial progress on this major interdisciplinary research program was slowed by the enormous complexity and difficulty of developing the base codes and associated inputs for the WetBud model(s). In particular, the incorporation of MODFLOW was much more difficult than anticipated. However, over the past year, working cooperatively with Dr. Agioutantis, we feel that we have made significant progress in that we now have a “working version” of both model versions. That being said, we also fully recognize that it will take a major concerted effort by all of our investigators over the next year to complete and validate both models by the summer of 2013 and then to develop the supporting final report and “user’s manual” by the fall of 2013.

Please contact me (W. L. Daniels) as shown at the top of page 1 if you have any further questions on our progress to date. We deeply appreciate the continued support of WSSI and the Peterson Family Foundation in this program.

1. Example Screens and Comments on Groundwater Vistas Based Model

A. General

The screenshot shows the 'MODFLOW Options' dialog box with the 'Basic' tab selected. The 'Data Set Titles' field contains the text 'MODFLOW Data Set Created by Groundwater Vistas'. The 'Number of Stress Periods' is set to 366. The 'Use Stress Period Number' is set to 1. The 'Simulate a subset of stress periods from' is set to 1 to 1. The 'Save Starting Heads' checkbox is checked, and the 'Head Value for No-Flow Cells' is set to 10. The 'Print Comments in Dataset' checkbox is checked. The 'Continue MODFLOW Simulation Even if Convergence Not Achieved' checkbox is checked. The 'Convert Dry Cells to No-Flow Cells' checkbox is checked, and the 'Also Convert Dry Cells in Steady-State' checkbox is unchecked. The 'Use Diffusion Zones for IBOUND Active Cells' checkbox is unchecked. The 'Time Units' dropdown is set to 'Seconds' and the 'Length Units' dropdown is set to 'Meters'. The 'MODFLOW-SURFACT DATUM' is set to 0. The 'Write Input Files in Free Format' checkbox is unchecked. The 'Number of Significant Digits to Write' is set to 8. The dialog box has buttons for 'OK', 'Cancel', 'Apply', and 'Help'.

MODFLOW Options

IBS/SUB | Density | I/O Formats | Streams | Wells | MNW Package | Wetlands

Basic | BCF - LPF | Output Control | Initial Heads | Recharge - ET | Resaturation | CHDs

Data Set Titles

MODFLOW Data Set Created by Groundwater Vistas

Steady-State Simulation Number of Stress Periods 366

Use Stress Period Number 1 For Steady-state Simulation

Simulate a subset of stress periods from 1 to 1

Save Starting Heads Head Value for No-Flow Cells 10

Print Comments in Dataset

Continue MODFLOW Simulation Even if Convergence Not Achieved

Convert Dry Cells to No-Flow Cells Also Convert Dry Cells in Steady-State

Use Diffusion Zones for IBOUND Active Cells

Seconds Time Units

Meters Length Units

MODFLOW-SURFACT DATUM 0

Write Input Files in Free Format

Number of Significant Digits to Write 8

OK Cancel Apply Help

366 stress periods.

	Period Length	No. Time Steps	Time Step Multiplier	
1	3000000	5	1.2	
2	86400	3	1.2	
3	86400	3	1.2	
4	86400	3	1.2	
5	86400	3	1.2	

First period is 3 000 000 seconds (1 mo.) -- steady state
 Other periods are 86400 seconds (1 day) -- transient

MODFLOW Options

IBS/SUB | Density | I/O Formats | Streams | Wells | MNW Package | Wetlands
 Basic | BCF - LPF | Output Control | Initial Heads | Recharge - ET | Resaturation | CHDs

Definition of the Leakage Coefficient and Top Elevation

Compute Leakage (VCONT) Use Top Elevation Zones

Leakance Zones Represent: Leakance

Layer Types

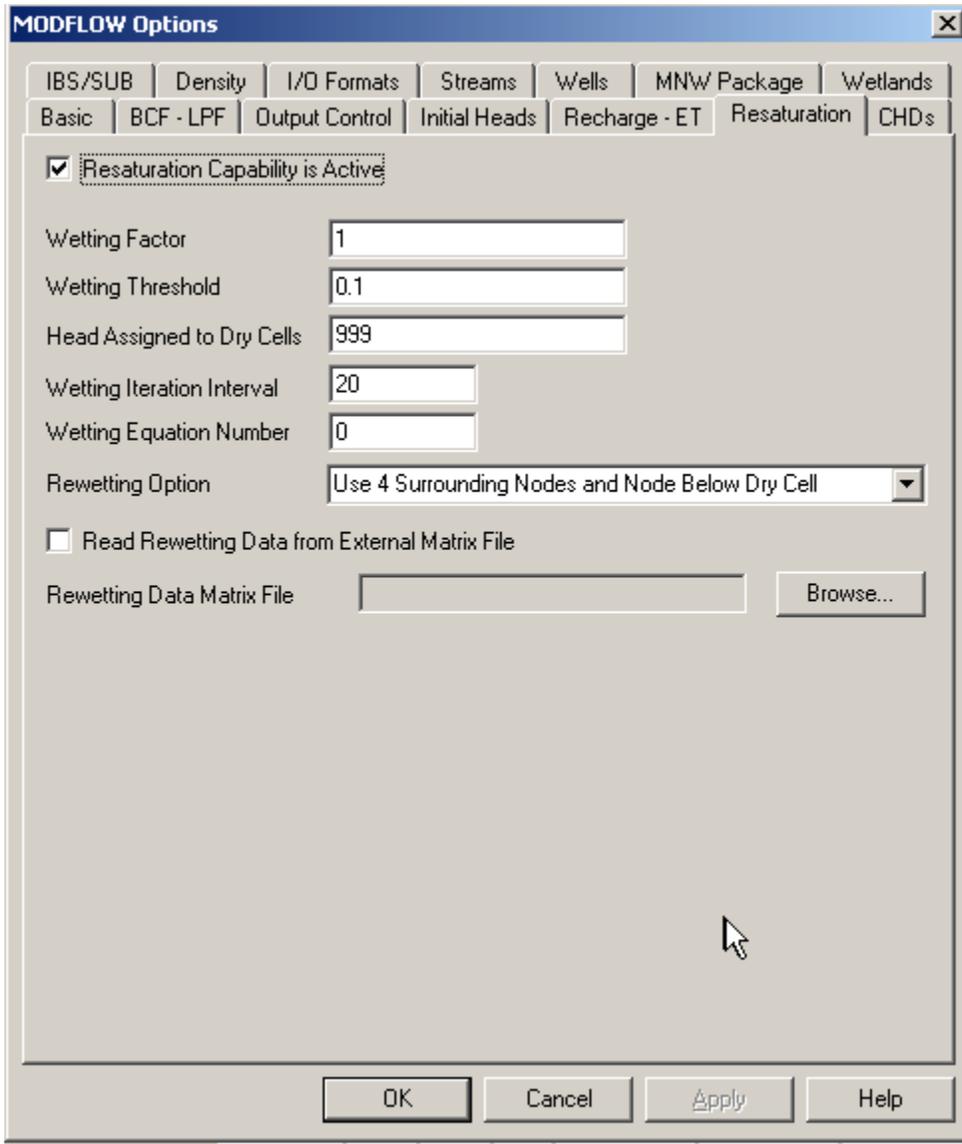
Layer	Layer Type (LAYCON)	BCF3/4 Averaging
1	3 - Unconfined (T Varies)	Harmonic
2	3 - Unconfined (T Varies)	Harmonic
3	0 - Confined	Harmonic
4	0 - Confined	Harmonic
5	0 - Confined	Harmonic

Use Variable Anisotropy (Ruskauff and Kladias, 1996)
 Compute Aquitard Leakage Like ModelCad
 Storage Coefficient Represents Specific Storage (Ss)
 Multiply K Times Layer Thickness for Confined Layers
 Write Vertical Anisotropy to LPF File Instead of Kz

All Layers Confined
 All Layers Unconfined

OK Cancel Apply Help

4 layers with 20x20 elements. First 2 layers are unconfined...



Re-saturation active (corrected iterations to 20)

MODFLOW Solver Packages [X]

PCG4/PCG5	PCGn	Link-AMG (LMG)	
PCG2	GMG	SIP	SOR

Maximum Number of Iterations:

Number of Iteration Parameters:

Acceleration Parameter:

Head Change Criterion for Convergence:

Iteration Seed Computed by: [v]

Iteration Parameter Seed:

Head Change Printed Every: Iteration

OK Cancel Apply Help

Using SIP as solver (STRONGLY-IMPLICIT PROCEDURE SOLUTION PACKAGE)

B. Properties

South Cross-Section Along Column 7

5 10

5
10
15
20

Zone Database Information

Zone Database

Top Elevation Property Zone Values

Stress Period Number: 1 (Recharge/ET Only)

Number of Zones:

	Top				Color
1	12.5	0	0	0	
2	12	0	0	0	
3	11.5	0	0	0	
4	11	0	0	0	
5					
6					
7					

OK Cancel Apply Help

Top elevations

South Cross-Section Along Column 7 North

5 10

5
10
15
20

Zone Database Information

Zone Database

Bottom Elevation Property Zone Values

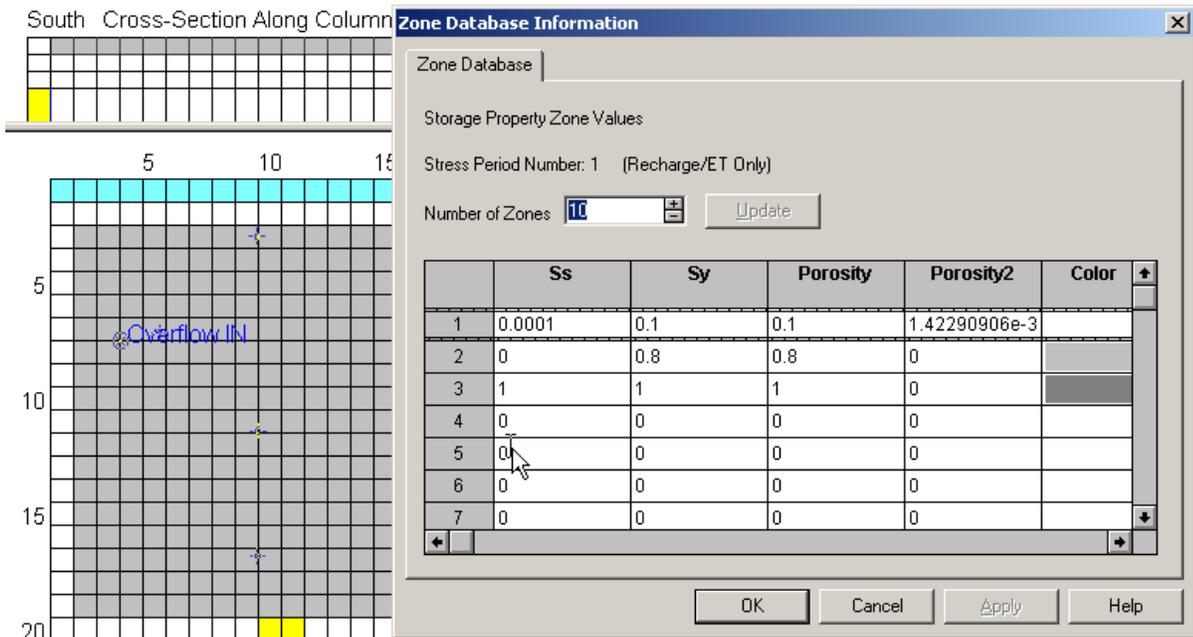
Stress Period Number: 1 (Recharge/ET Only)

Number of Zones:

	Bottom				Color
1	12	0	0	0	
2	11.5	0	0	0	
3	11	0	0	0	
4	10	0	0	0	
5					
6					
7					

OK Cancel Apply Help

Bottom elevations ... (corrected)

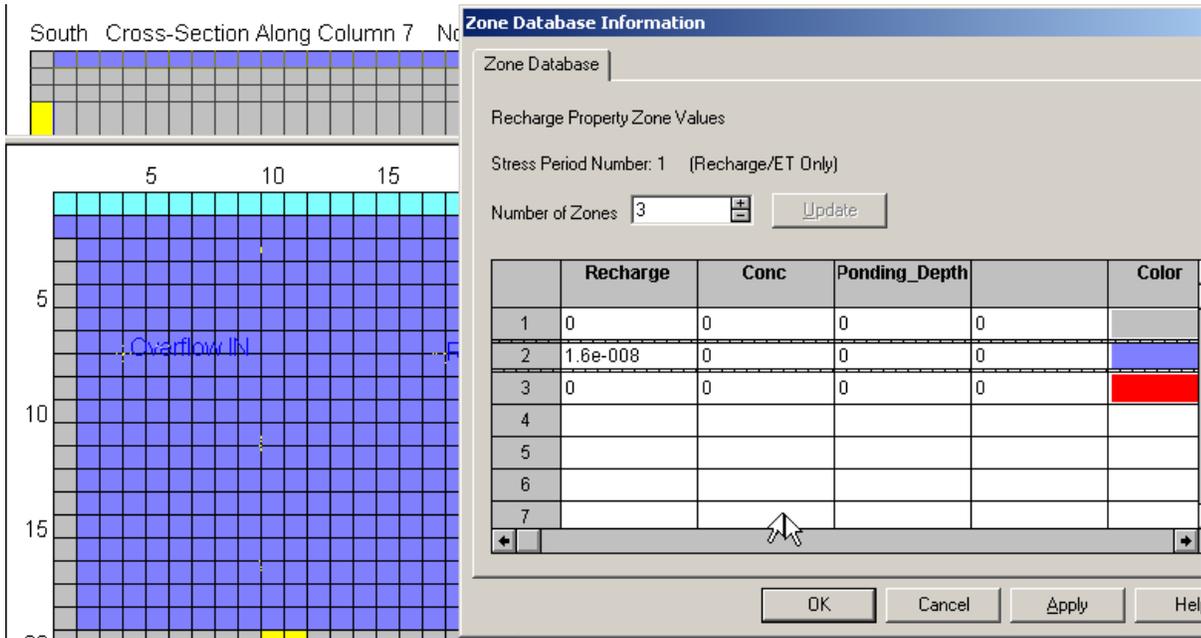


Storage

e property (corrected)

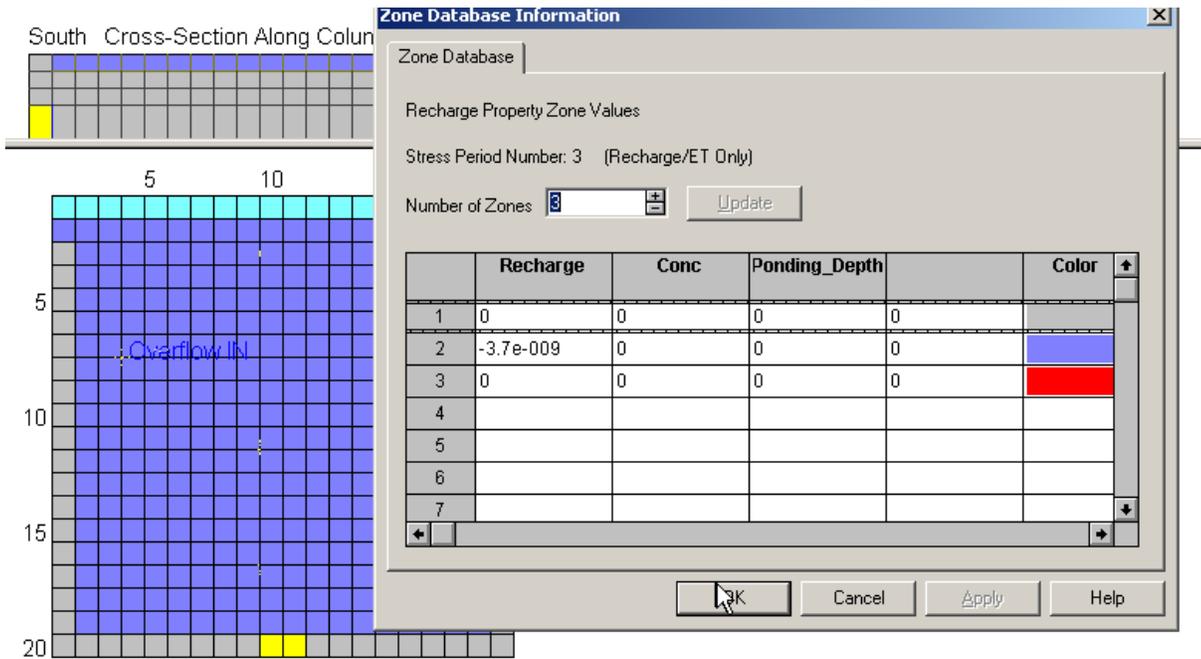
Note that:

- ✓ Zone 2 is supposed to correspond to the wet area (water, plants, etc.)
- ✓ **Specific storage (S_s)** and its depth-integrated equivalent, storativity ($S = S_s b$), are indirect aquifer properties (they cannot be measured directly); they indicate the amount of groundwater released from storage due to a unit depressurization of a confined aquifer. They are fractions between 0 and 1.
- ✓ **Specific yield (S_y)** is also a ratio between 0 and 1 ($S_y \leq \text{porosity}$) and indicates the amount of water released due to drainage from lowering the water table in an unconfined aquifer. The value for specific yield is less than the value for porosity because some water will remain in the medium even after drainage due to molecular forces. Often the porosity or effective porosity is used as an upper bound to the specific yield. Typically S_y is orders of magnitude larger than S_s . Note: I changed S_y to zero (0).



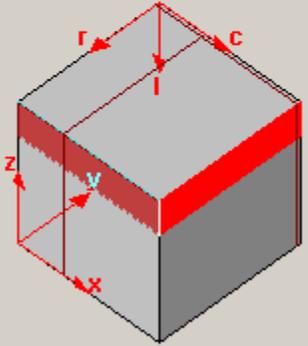
Recharge for Stress period 1

Recharge for the middle part of the top layer is set to 1.6×10^{-8} (m/s) which is about 500mm/year –



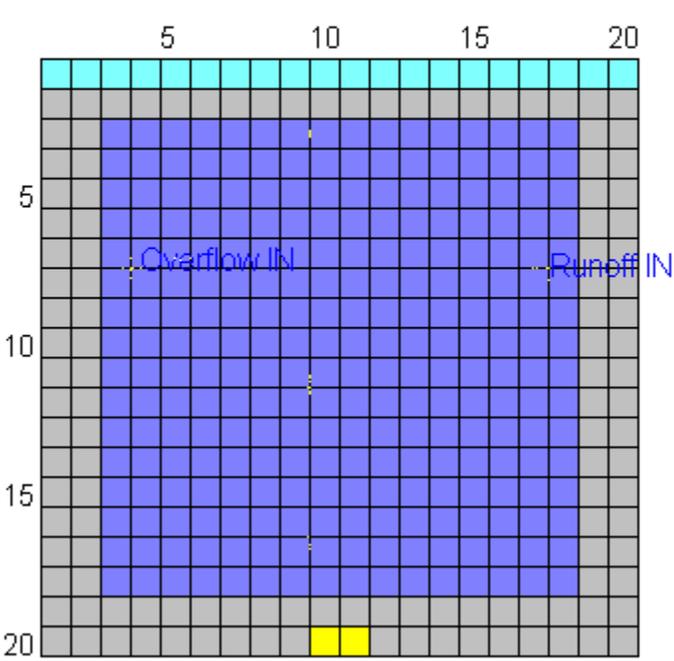
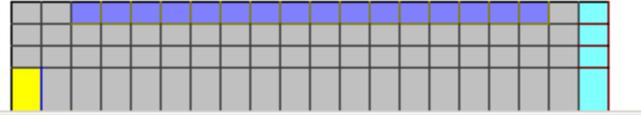
Recharge varies by Stress Period. There are also negative numbers as shown here for period 3. I guess negative recharge takes in ET as well?

Row Number:
 Column Number:
 Layer Number:
 Stress Period:
 Component Number:
 Figure Number:

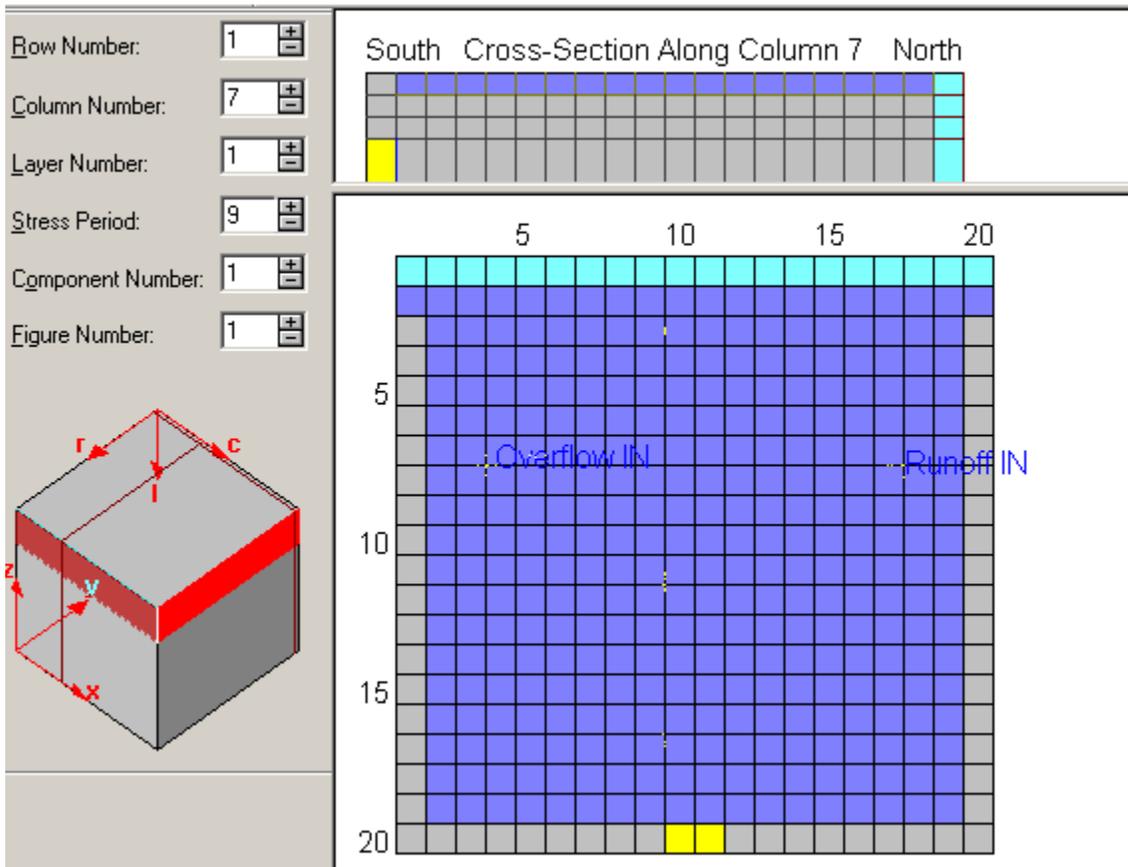


A 3D diagram of a rectangular block. The top surface is shaded gray, and the front and right vertical faces are shaded red. Three coordinate axes are shown: x (pointing right), y (pointing forward), and z (pointing up). Three dimensions are labeled: r (width), c (depth), and l (height).

South Cross-Section Along Column 7 North



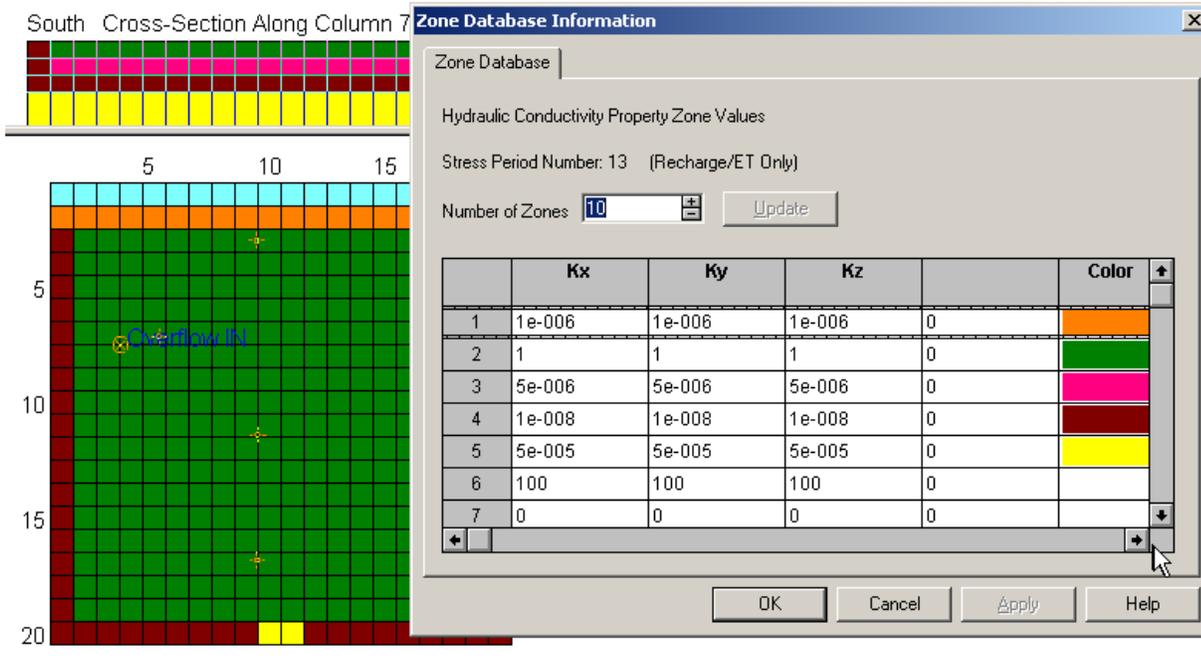
Contour



Above images show that recharged cells **vary** per stress period (not logical).

	1	0			
	18	1.000 (10e12.4)		-1	
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
0.0000e+00	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
0.0000e+00	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
0.0000e+00	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
0.0000e+00	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
0.0000e+00	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
0.0000e+00	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08
-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08	-1.2000e-08

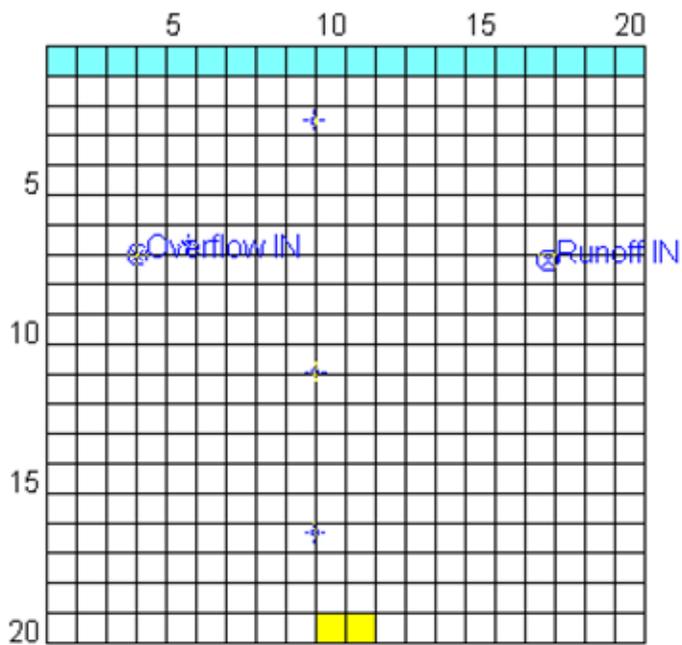
As a result, raw data of recharge data in raw data are “funny” and more work on output x interpretations will be needed.



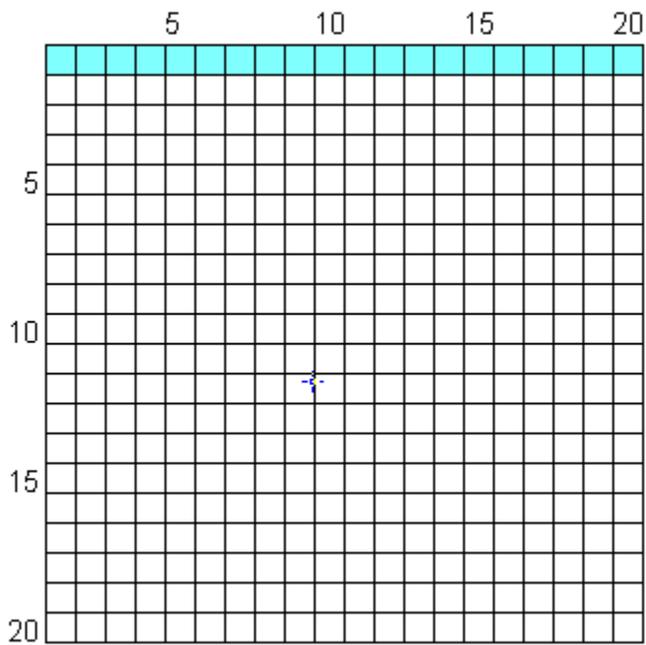
Hydraulic conductivity

It is set in m/s. The middle part of the top layer has high conductivity... Same for drain area. Not sure at this time if drain properties and cell properties are co-evaluated.

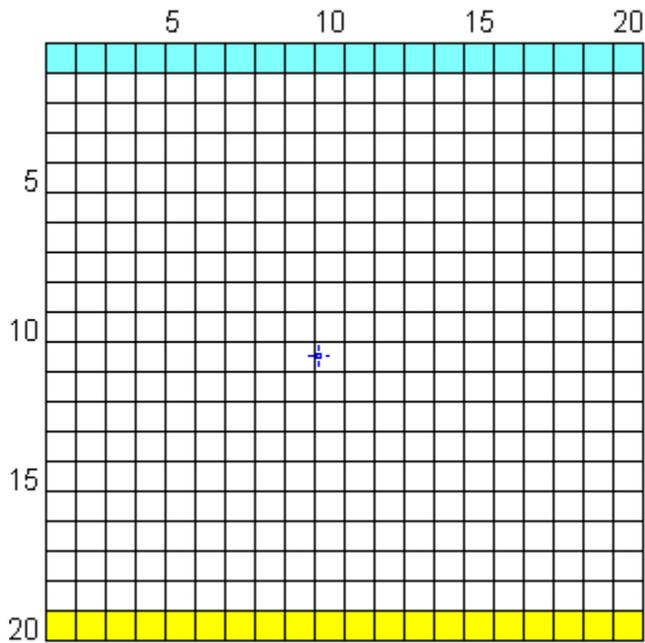
C. Boundary conditions



Layer 1: General Head Boundary (North), Drain (South)



Layer 2 & 3 General Head Boundary (North),



Layer 4 General Head Boundary (North), Drain (South)

With parameters:

General Head Boundary Condition

Modify One Boundary Cell

Spatial Location

Row number:

Column number:

Layer number:

Reach number:

Options

Steady-state Boundary Condition

Computed Boundary Condition

GHB Characteristics

Head at Boundary:

Saturated Thickness of Cell:

Width of GHB Cell:

Distance to GHB Head:

Hydraulic Conductivity:

Concentration at Boundary:

Conductance = 5.00000e-006

Store Data for All Chemical Components

Color: Transient Data: Component C: OK: Cancel:

Title:

Replace Select Option when Editing an Existing Boundary Condition

	Starting Stress Period	Ending Stress Period	Head (Q for Wells)	Concentration	Kv	Width (Stream Only)	
1	1	1	12.4	0	1e-005	0	
2	2	2	12.4	0	1e-005	0	
3	3	3	12.4	0	1e-005	0	
4	4	4	12.4	0	1e-005	0	
5	5	5	12.41	0	1e-005	0	
6	6	6	12.41	0	1e-005	0	
7	7	7	12.41	0	1e-005	0	

Transient data vary between 12.4 and about 11.x for all layers

Summary

I have run a number of simplified models using Constant head as well, with simple input and output to try to find out how it behaves. As Rich has already pointed out, the model is very sensitive to input parameters (properties, boundary conditions, etc.).

Thus, such a very sensitive model may be very frustrating to the end user unless we can work out enough of the standard template inputs to minimize this.

2. Example Screens and Text for WetBud with MODFLOW

2.1 Setting up a Model

Setup Modflow Models

New Model

Search

MP_COD	MP_DESCR
zach	test case

General | Units | Layers | Setup | Name File

Code: zach 1

Description: test case

Number of Layers: 4 Columns: 20 Rows: 20

Number of Stress Periods: 366

Column Width: 5 Row Width: 5

Grid Origin X: Grid Origin Y: Grid Origin Z:

Active Head for No-Flow Cells: 10

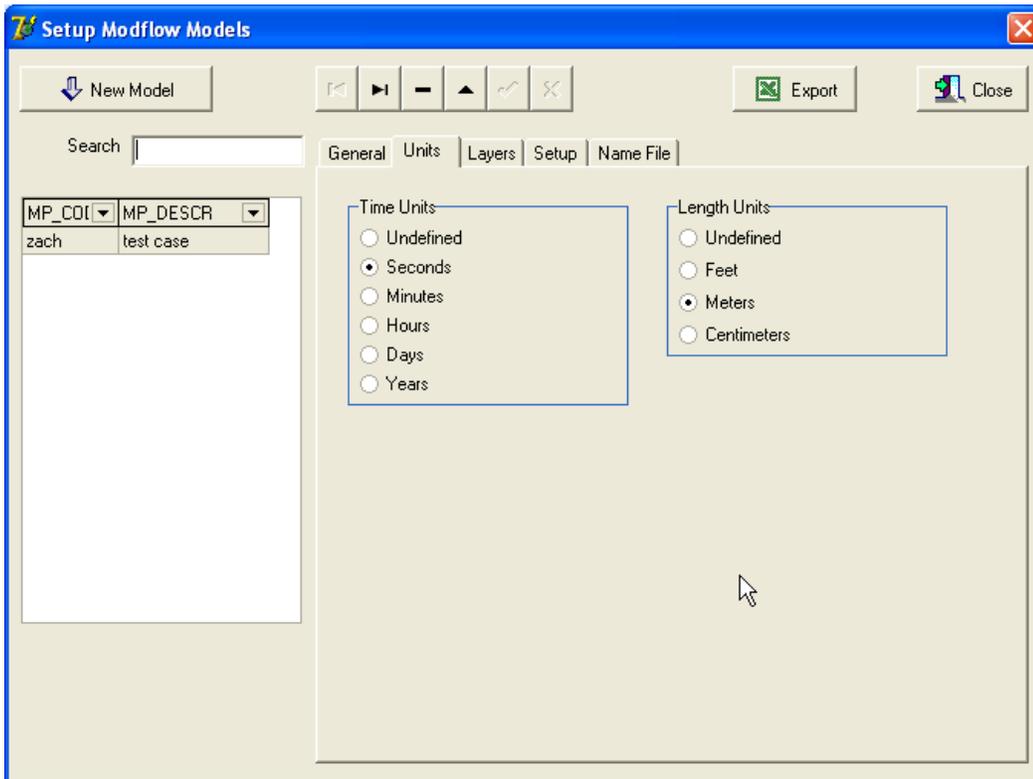
Adjust Area

Export Close

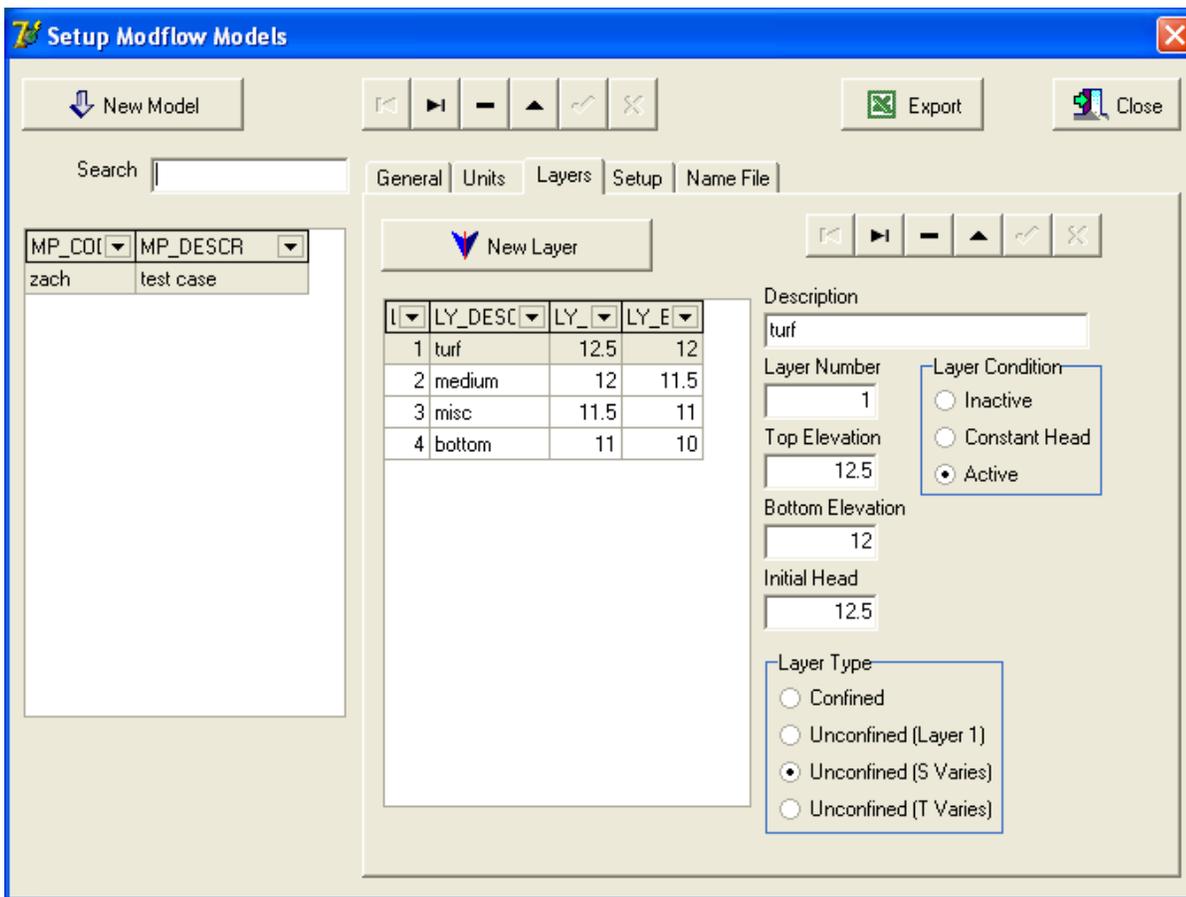
Test BAS File

Test DIS File

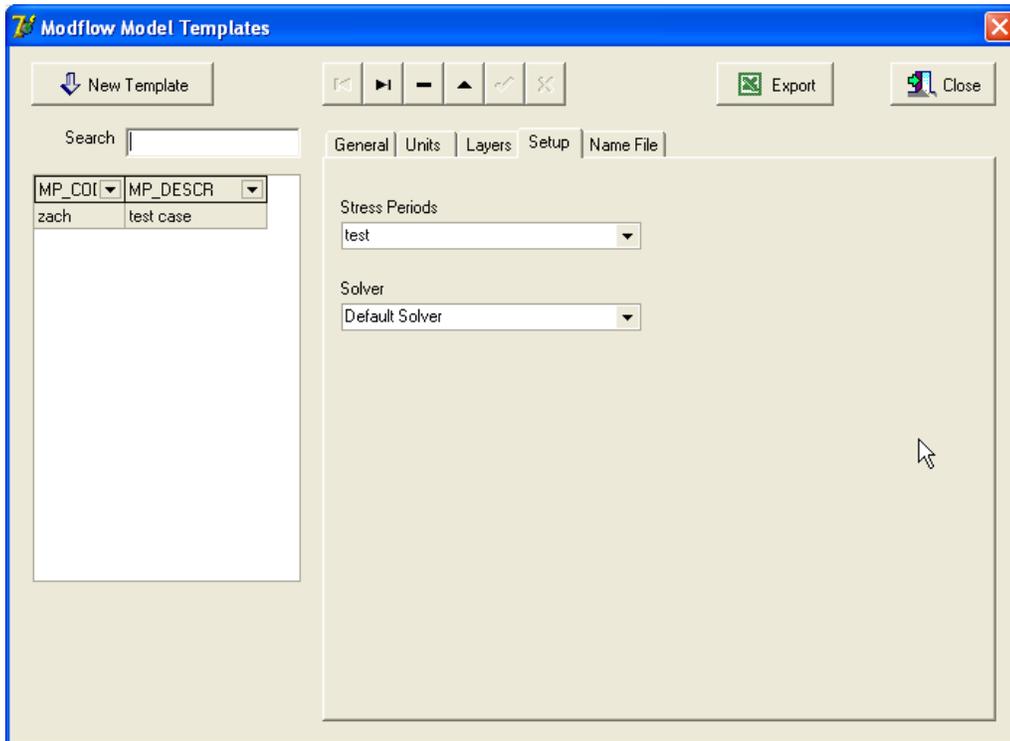
Model Setup 1/5



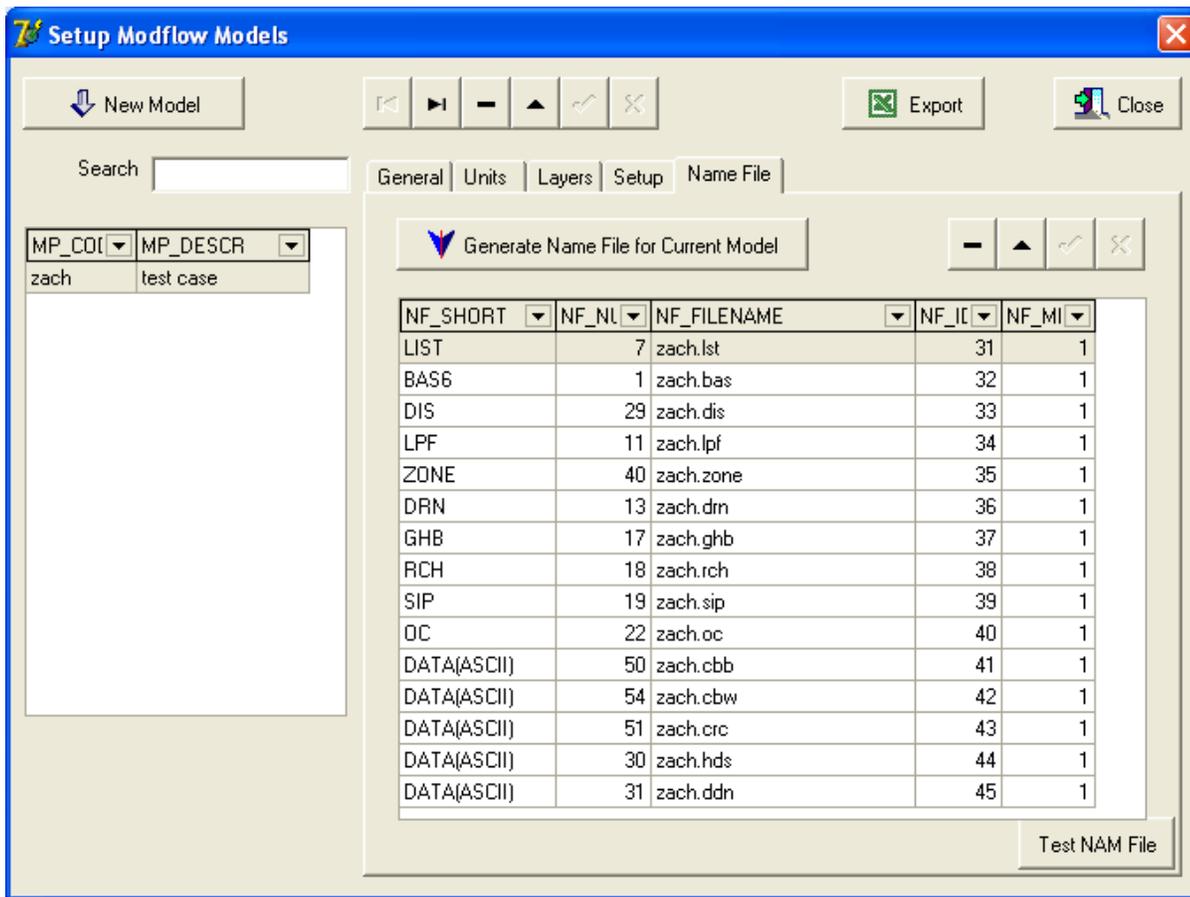
Model Setup 2/5



Model Setup 3/5



Model Setup 4/5



Model Setup 5/5

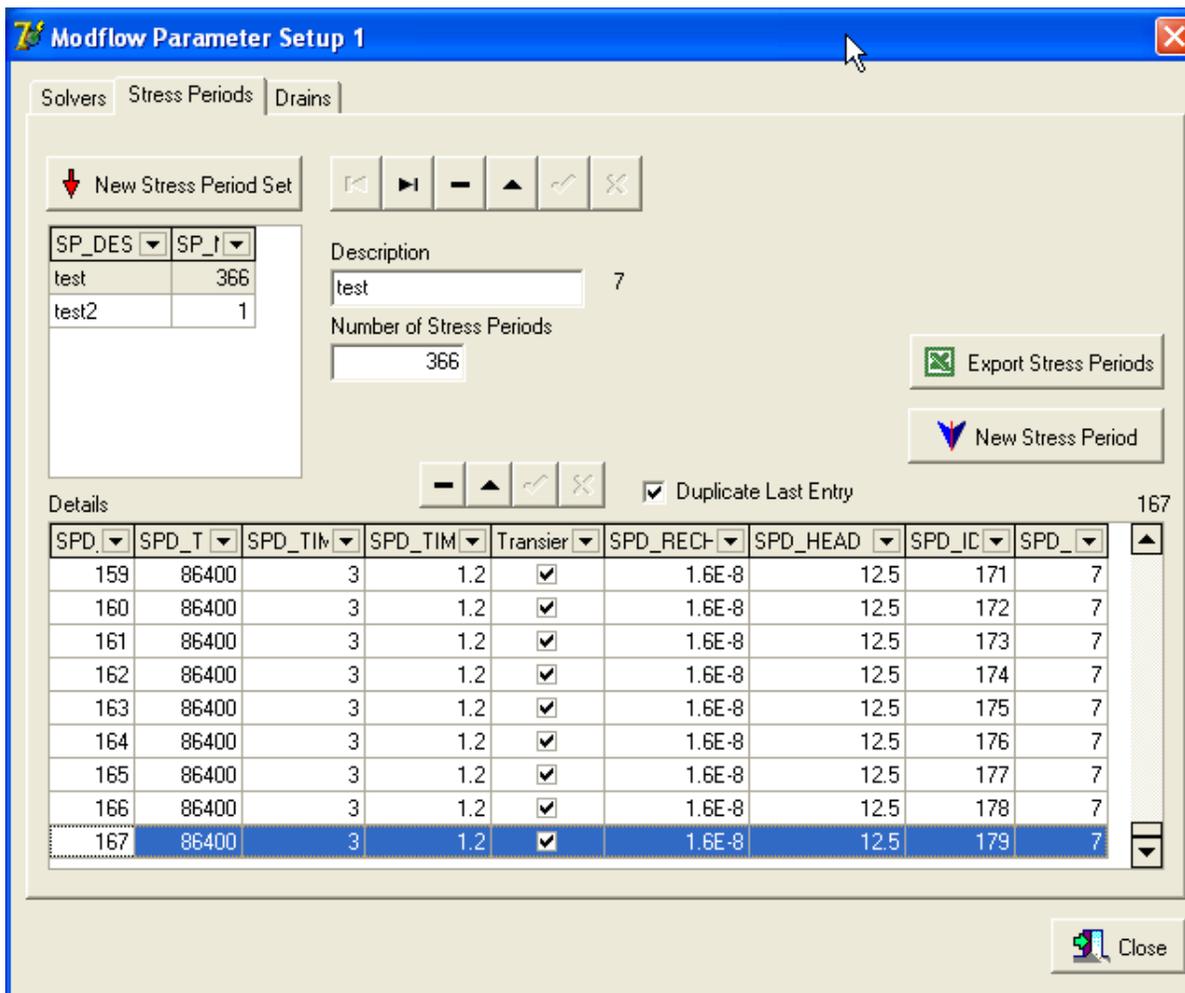
2.2 Model Parameter Setup 1

The screenshot shows the 'Modflow Parameter Setup 1' dialog box with the 'Solvers' tab selected. The 'SV_NAME' dropdown menu is set to '..'. A 'New SIP Solver Set' button is visible. The parameters are as follows:

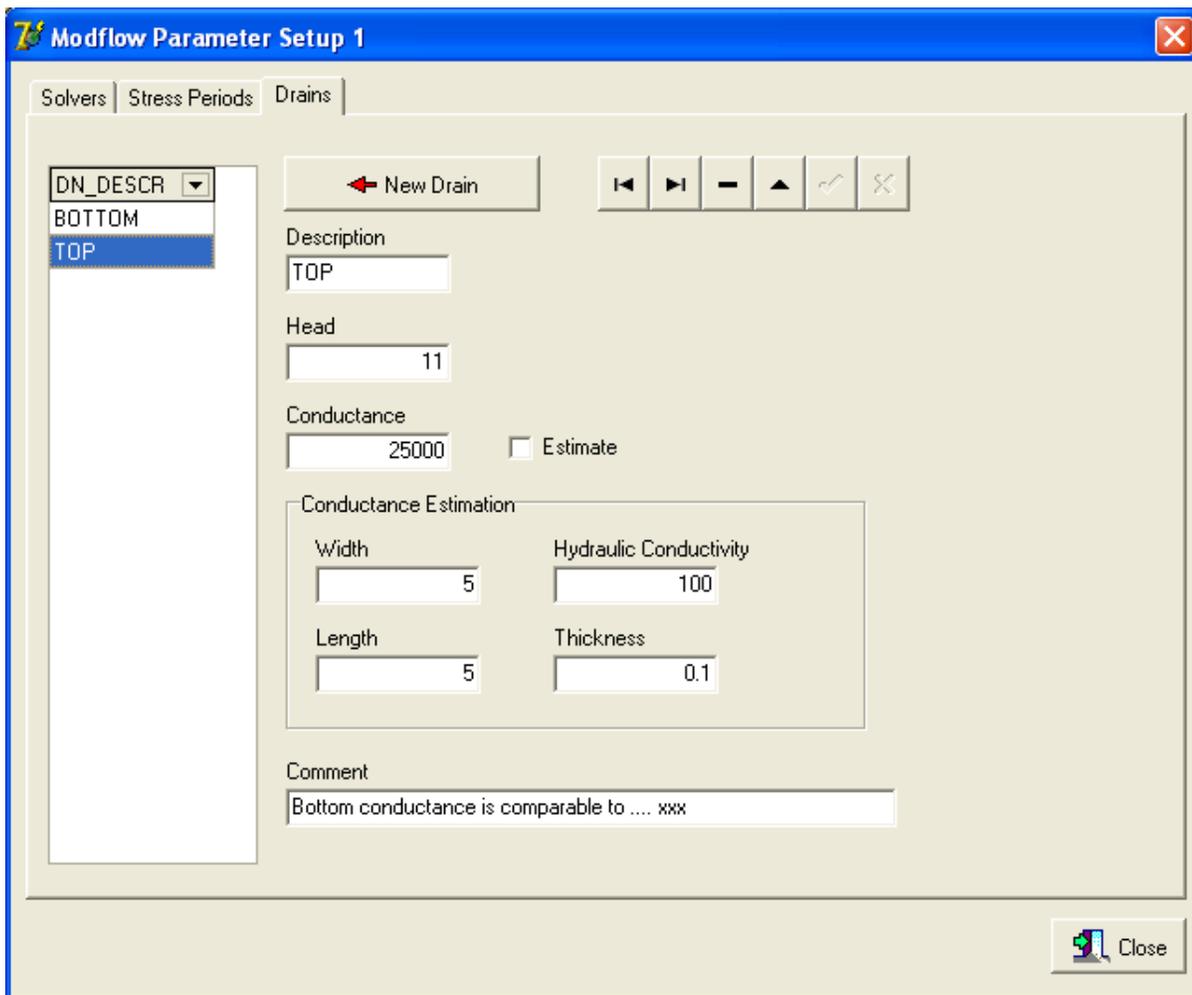
Parameter	Value
Name	.. 2
Solver Type	SIP
Maximum Number of Iterations	100
Number of Iteration Parameters	5
Acceleration Iteration Parameter	1
Head Change for Convergence	0.05
Iteration Seed Computed by	1
Iteration Parameter Seed	1
Head Change Print Interval	5

Navigation buttons (back, forward, home, end, OK, Cancel) are located at the top right. A 'Close' button is at the bottom right.

Setup Parameters 1: Define Solver Parameters



Setup Parameters 1: Define Stress Period Sets and Entries per set. To simplify data input, Recharge and Head change (in the General Head Boundary) per period are also entered here



Setup Parameters 1: Drain Parameters. Note drain parameters are assumed constant for all stress periods.

2.3 Zone Data

The screenshot shows the 'Modflow Parameters Setup 2 (Zone Data)' dialog box with the 'Hydraulic Conductivity' tab selected. On the left, a table lists zones:

Z	ZC_DES
1	turf
2	grass

On the right, the 'New Conductivity Zone' section contains the following fields:

- Name: turf
- Number: 3
- KX: 1E-5
- KY: 1E-5
- KZ: 1E-5

Navigation buttons (back, forward, minus, plus, checkmark, close) are located at the top right. A 'Close' button is at the bottom right.

Hydraulic Conductivity Zones

The screenshot shows the 'Modflow Parameters Setup 2 (Zone Data)' dialog box with the 'ET' tab selected. On the left, a table lists zones:

Z	ZT_DES
1	grass
2	--

On the right, the 'New Evapotranspiration Zone' section contains the following fields:

- Description: grass
- Number: 1
- Value ET: 44

Navigation buttons (back, forward, minus, plus, checkmark, close) are located at the top right. A 'Close' button is at the bottom right.

ET Zones

2.4 Grid Data

The form below can (so far) handle 3 properties and 2 boundary conditions as shown in the respective options.

Zone data definitions are shown to the lower left and grid cells can be clicked to define a new zone.

