TECHNICAL MEMORANDUM esi

The ECFTX v2.0 Regulatory FTMR Tool

PREPARED FOR: SJRWMD/SWFWMD/SFWMD

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This memo documents the regulatory tool created for ECFTX v2.0 Model with two steady-steady-state stress periods. This version of ECFTX v2.0 is referred to as the ECFTX v2.0 FTMR model to distinguish it from the full transient version of ECFTX v2.0. The ECFTX v2.0 FTMR model can be used as a regulatory tool and has been developed in Groundwater Vistas (GV) Version 8.24 build 20 or higher.

ECFTX v2.0 Regulatory Model in Groundwater Vistas

The ECFTX v2.0 FTMR model contains two stress periods representing Pumps Off (stress period 1), and either Current Pumping (CP) representing average 2014-2018 pumping condition or End of Permit (EOP) (August 2021) for stress period 2. Two Groundwater Vistas Version 8 files are provided for these two cases. The names are **ecftx_baserun-CP.gwv** and **ecftx_baserun-EOP.gwv**. When a permit is evaluated, a third transient stress period is added with the applicant pumping at the proposed rate and all other wells at the same rate as in stress period 2. These scenarios are shown in Table 1.

Table 1. Scenarios to be included in the permitting tool.

Simulation	Stress Period	Model	Applicant Rate	All Other Permits	Initial Condition
A	1	Steady State	Off	Off	
B Option 1	2	Steady State	*Current Pumping Condition*	*Current Pumping Condition*	
B Option 2	2	Steady State	*EOP*	*EOP*	
C Option 1	3	Transient - 3 years	Proposed rates	*Current Pumping Condition*	B1
C Option 2	3	Transient - 3 years	Proposed rates	*EOP*	B2

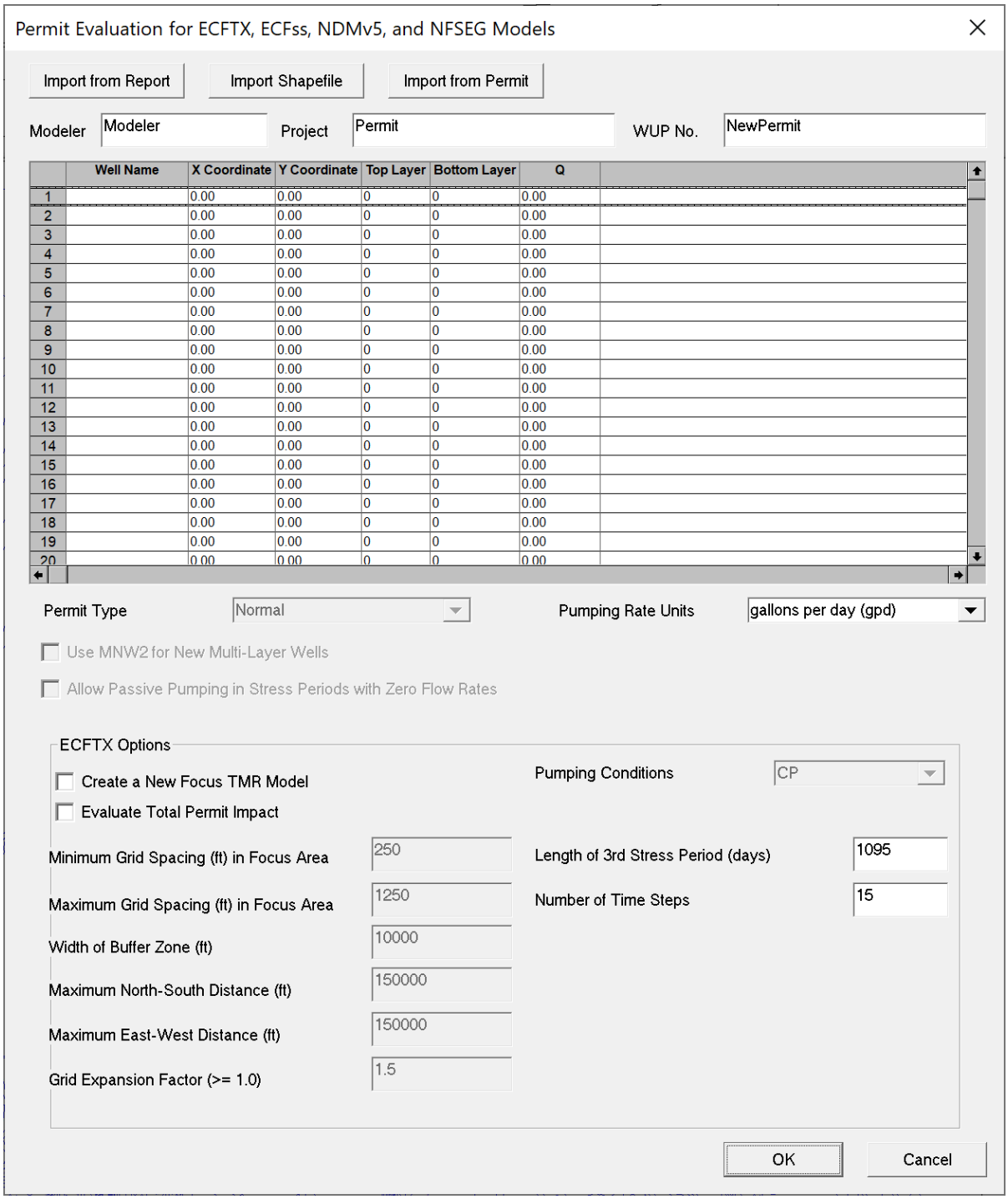
The ECFTX v2.0 model was used to develop the tool. To keep run time to a minimum, the maximum number of outer iterations in solver settings has been changed to 50 for the CP run and 75 for the EOP run. Even though the 2nd stress period does not converge, the mass balance error is 0.00 percent.

Evaluating Effects of New or Modified Permits

This tool and associated files assume you are running the ECFTX v2.0 FTMR regulatory model from a folder called c:\SJRWMDmodels\ECFTX_FTMR. If you use a different folder, make sure to copy all files into the new folder. A folder called backup_ImportantFiles is provided with this tool. All files in this folder must be placed in the working directory you create so that all reports will be generated correctly. In addition, just like all ESI tools created for SJRWMD, you must create a text file in the GWV8 directory called *sjrwmd.txt.* You may also use a text file called *swfwmd.org*.

Open the base model called **ecftx_baserun-CP.gwv** or **ecftx_baserun-EOP.gwv** in Groundwater Vistas and run it. Import results from the base run (any stress period is fine for the imported results). Then use Grid/Export/Focus TMR. If necessary, we can move this tool to another menu, but it was kept here for consistency with other SJRWMD and SWFWMD models. The following dialog is then displayed, which is a simplified version of the FTMR dialog used in other models. The user enters the well information and some descriptive information. Note that well coordinates should be in NAD83 UTM Zone 17 meters to be consistent with the ECFTX coordinates. Default pumping rate units are gallons per day but can be changed using the drop-down list below the spreadsheet.

When evaluating a permit, there are two ways of computing the impact. There is an option called "Evaluate Total Permit Impact". When that option is checked, the pumping rate of an existing well is turned off in stress period 2. In this case, the change in head between stress periods 2 and 3 will be caused by the total pumping rate of the wells in the permit. When the option is not checked, the pumping rate of an existing well remains at either the CP or EOP rate in stress period 2. In this case, the change in head between stress periods 2 and 3 represents the impact of the change in pumping rate between the two periods.

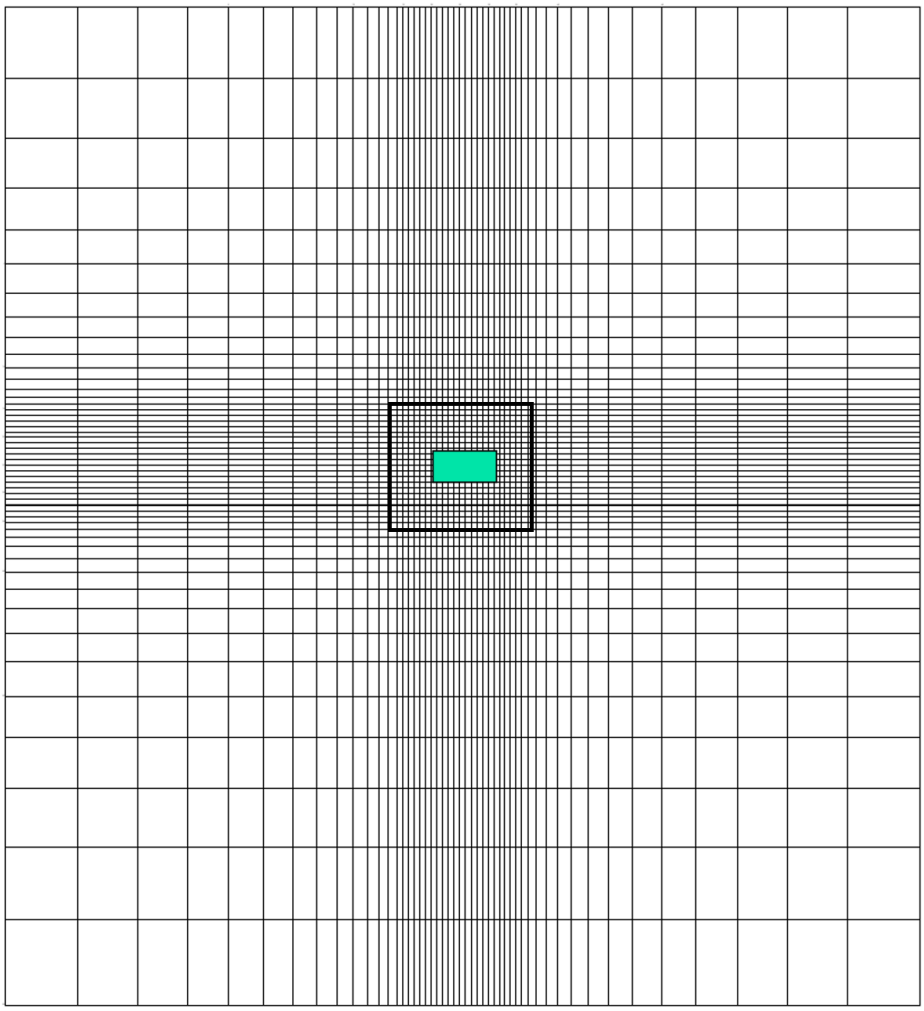


There are two ways of evaluating a permit. The first involves running the entire regional model. This is the default case where the option "Create a New Focus TMR Model" is unchecked. In this scenario, you enter the well information at the top of the dialog box and then choose the length of the 3rd transient stress period in days (default: 1,095 days or 3 years) and the number of time steps (default: 15). This is the fastest way of evaluating a permit because a new model does not need to be created.

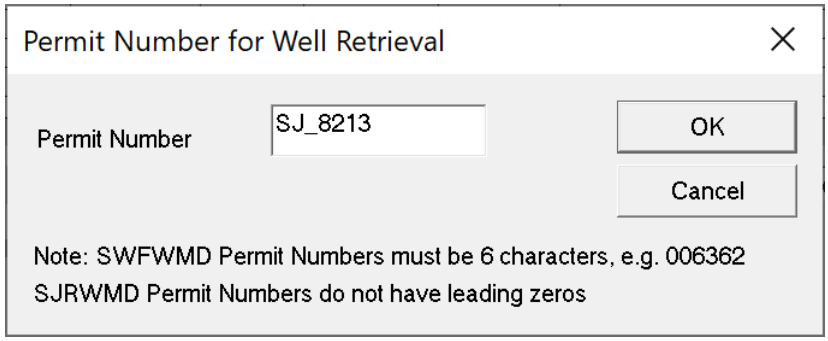
The second method of evaluating a permit is to create a new Focus Telescopic Mesh Refinement (FTMR) model with finer grid spacing surrounding the wells in the permit. Finer grid spacing is sometimes chosen to facilitate a more detailed, spatial review of potential impacts of the groundwater withdrawals and provides greater numerical stability if the changes in groundwater levels are large within a short time frame. To use this method, check the option called "Create a New Focus TMR Model". A series of options controlling the grid characteristics of the new model will then be available to edit. These include the minimum and maximum grid spacings, width of the buffer zone, grid expansion factor, and maximum north-south and east-west distances.

Creating a FTMR model can be quite time consuming compared to the first method of just running the regional model. The time necessary to create the FTMR increases as the width of the buffer zone increases and the minimum grid spacing decreases. The overall north-south and east-west dimensions can also increase the time to make the FTMR model, although not as much as the buffer zone width and minimum grid spacing.

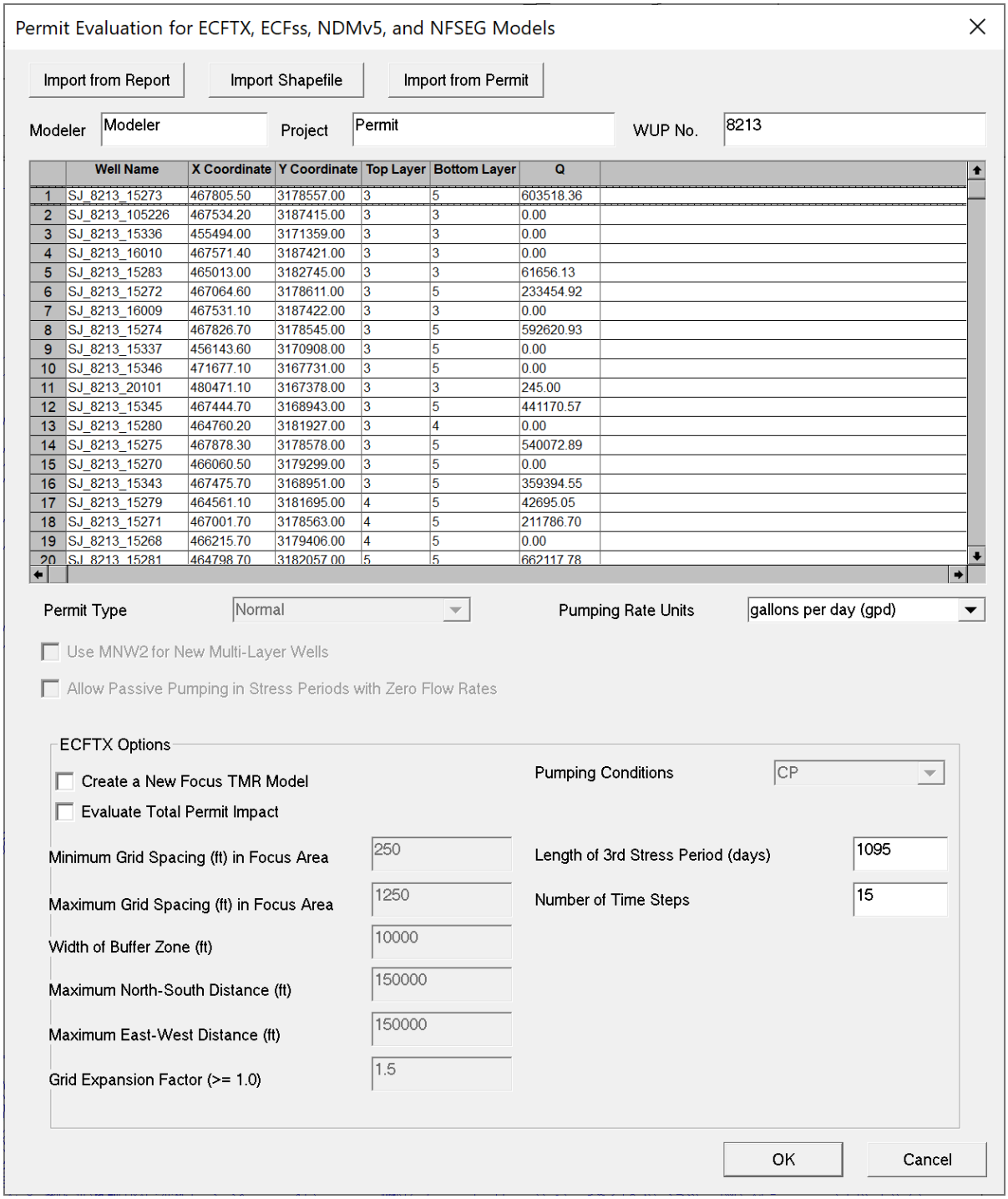
The figure below illustrates the meaning of these parameters. The green rectangle is the smallest rectangle containing all of the wells in the permit being evaluated. The width of the buffer zone is a distance added to each side of the green rectangle to define the area of the minimum grid spacing. The maximum north-south and east-west distances define the outer edges of the new model. Constant heads are defined at these edges unless a regional constant head or general head boundary (ghb) boundary is specified.



When evaluating an existing permit, the wells in that permit can be automatically assigned to the spreadsheet by clicking the "Import from Permit" button at the top of the dialog box. The following dialog box is displayed where you enter the permit id. For wells in SJRWMD, you can enter either the permit id or "SJ_" followed by the permit id. For South Florida Water Management District wells, enter "SF_" plus the permit id. For Southwest Florida Water Management District, enter "SW_" plus the permit id.



When you click OK, GV will put all wells for that permit in the spreadsheet, as shown below. You then simply modify the pumping rate (Q) column for the desired changes. You can also add a well for the permit. If a well is to be removed from the permit, make the pumping rate zero. It is also a good idea to put the permit id in the field called WUP No. at the top of the dialog box. The name of the new model run will include this value, making it easier to identify the MODFLOW files associated with the simulation.



	Well Name	X Coordinate	Y Coordinate	Top Layer	Bottom Layer	Q
1	SJ_8213_15273	467805.50	3178557.00	3	5	603518.36
2	SJ_8213_105226	467534.20	3187415.00	3	3	0.00
3	SJ_8213_15336	455494.00	3171359.00	3	3	0.00
4	SJ_8213_16010	467571.40	3187421.00	3	3	0.00
5	SJ_8213_15283	465013.00	3182745.00	3	3	61656.13
6	SJ_8213_15272	467064.60	3178611.00	3	5	233454.92
7	SJ_8213_16009	467531.10	3187422.00	3	3	0.00
8	SJ_8213_15274	467826.70	3178545.00	3	5	592620.93
9	SJ_8213_15337	456143.60	3170908.00	3	5	0.00
10	SJ_8213_15346	471677.10	3167731.00	3	5	0.00
11	SJ_8213_20101	480471.10	3167378.00	3	3	245.00
12	SJ_8213_15345	467444.70	3168943.00	3	5	441170.57
13	SJ_8213_15280	464760.20	3181927.00	3	4	0.00
14	SJ_8213_15275	467878.30	3178578.00	3	5	540072.89
15	SJ_8213_15270	466060.50	3179299.00	3	5	0.00
16	SJ_8213_15343	467475.70	3168951.00	3	5	359394.55
17	SJ_8213_15279	464561.10	3181695.00	4	5	42695.05
18	SJ_8213_15271	467001.70	3178563.00	4	5	211786.70
19	SJ_8213_15268	466215.70	3179406.00	4	5	0.00
20	SJ_8213_15281	464798.70	3182057.00	5	5	662117.78

After the applicant rates are modified in spreadsheet, click OK. Groundwater Vistas will automatically use **File/Save As** to create a new GWV file for the permit evaluation if you are not using FTMR. It is important not to overwrite the base Groundwater Vistas file after clicking OK, so GV will name the file as the base run name plus an underscore character and the text located in the "WUP No." field on the dialog ("8213" in the example above). You can alter the file name if you wish and then simply click the "save" button.

For FTMR analyses, GV will prompt you to create a new *.tmr file. GV will then write all information defining the new model to this tmr file. Note that this step can take a few minutes to complete. If the maximum north-south and east-west dimensions are increased the time needed to write the tmr file will also increase. After creating the tmr file, select File|New, click OK, and then click on the TMR button to import the file you just saved and create a new model. This can also take a few minutes to accomplish.

After the new model is saved, or the tmr model created, click the calculator button on the toolbar and create the datasets. MODFLOW-NWT will run the three stress periods and return to Groundwater Vistas. Import heads for any stress period. The cell-by-cell flows are not needed because all spring and river flows are computed from heads. You also do not need to import drawdown since the scenario drawdown shapefiles are computed from heads in each stress period.

Groundwater Vistas will automatically create the following reports and shapefiles. The head and flux changes are computed for the scenarios listed in Table 2. Note that the impact scenarios described in Table 2 do not reflect the "Evaluate Total Permit Impact" option.

Table 2. Impact Scenarios to evaluate with the ECFTX regulatory tool

Scenario	**Current Pumping (CP) Condition Analysis**
A – B1	Cumulative impact
A – C1	Cumulative impact based on applicant's proposed rates
B1 – C1	Applicant's individual impact from CP to proposed rates
Scenario	**EOP Condition Analysis**
A – B2	Cumulative impact
A – C2	Cumulative impact based on applicant's proposed rates
B2 – C2	Applicant's individual impact from EOP to proposed rates

- Spreadsheet of flux at springs for all stress periods and the change in flux for the drawdown scenarios listed in **Table 2**. This file is called SpringFlow_out_ecftx_cp_permit.csv, where "permit" is the permit number entered on the setup dialog. Also note that CP will be replaced by EOP for End of Permit evaluations.

- Spreadsheet showing the UFA (layer 3) head beneath lakes for all stress periods and the change in head for the drawdown scenarios listed in **Table 2**. When running the full regional model, the head reported for each lake is the average

head for all cells that lie within the lake polygon. For FTMR models, the head is interpolated at the centroid of each lake. This file is called Lake_Heads_out_ecftx_cp_permit.csv. Also note that cp will be replaced by EOP for End of Permit evaluations.

- Spreadsheet showing the simulated flux at river baseflow gages in the model and the change in flux for the drawdown scenarios listed in **Table 2**. This file is called RiverGage_out_ecftx_cp_Permit.csv, where "permit" is the permit number entered on the setup dialog. Note that river gage information cannot be computed for the FTMR models because the gage information is lost during creation of the new model. Also note that cp will be replaced by EOP for End of Permit evaluations.

- Shapefile of grid cell polygons showing head in layers 1 (SAS) and 3 (UFA), 5 (UFA) and 9 (LFA) for each stress period and the change in head for the drawdown scenarios listed in **Table 2**. This shapefile contains data for all layers and is called Head_AllStressPeriods_ecftx_cp_Permit.shp, where "permit" is the permit number entered on the setup dialog. Also note that cp will be replaced by EOP for End of Permit evaluations.

- Note that all shapefiles are exported in UTM meters, as defined in the project file: *C:\SJRWMDmodels\ECFTX_FTMR\work\NAD_1983_HARN_UTM_Zone_17N.prj*. If you move this file, you can inform GV of the new location using Edit|GIS Options.

Adding Lakes to Reports

Adding new lakes to the report of head changes requires two things. First, a head target is added to the model with the following characteristics:

- The target name is the name of the lake
- The target group number is the lake ID

The target can actually be anywhere in the model, however, it makes sense to put it in the actual lake location. The following csv file was used to add the most recent lakes to the ECFTX model. Note that there should be no spaces in lake names.

	A	B	C	D
1	**row**	**column**	**name**	**id**
2	188	304	LAKE_NELLIE_MFL	9010
3	169	304	Lake_Minnehaha_at_Clermont_MFL	9011
4	99	418	DAWSON_LAKE_MFL	9012
5	97	420	LAKE_COMO_MFL	9013
6	102	424	EAST_CRYSTAL_LAKE_MFL	9014

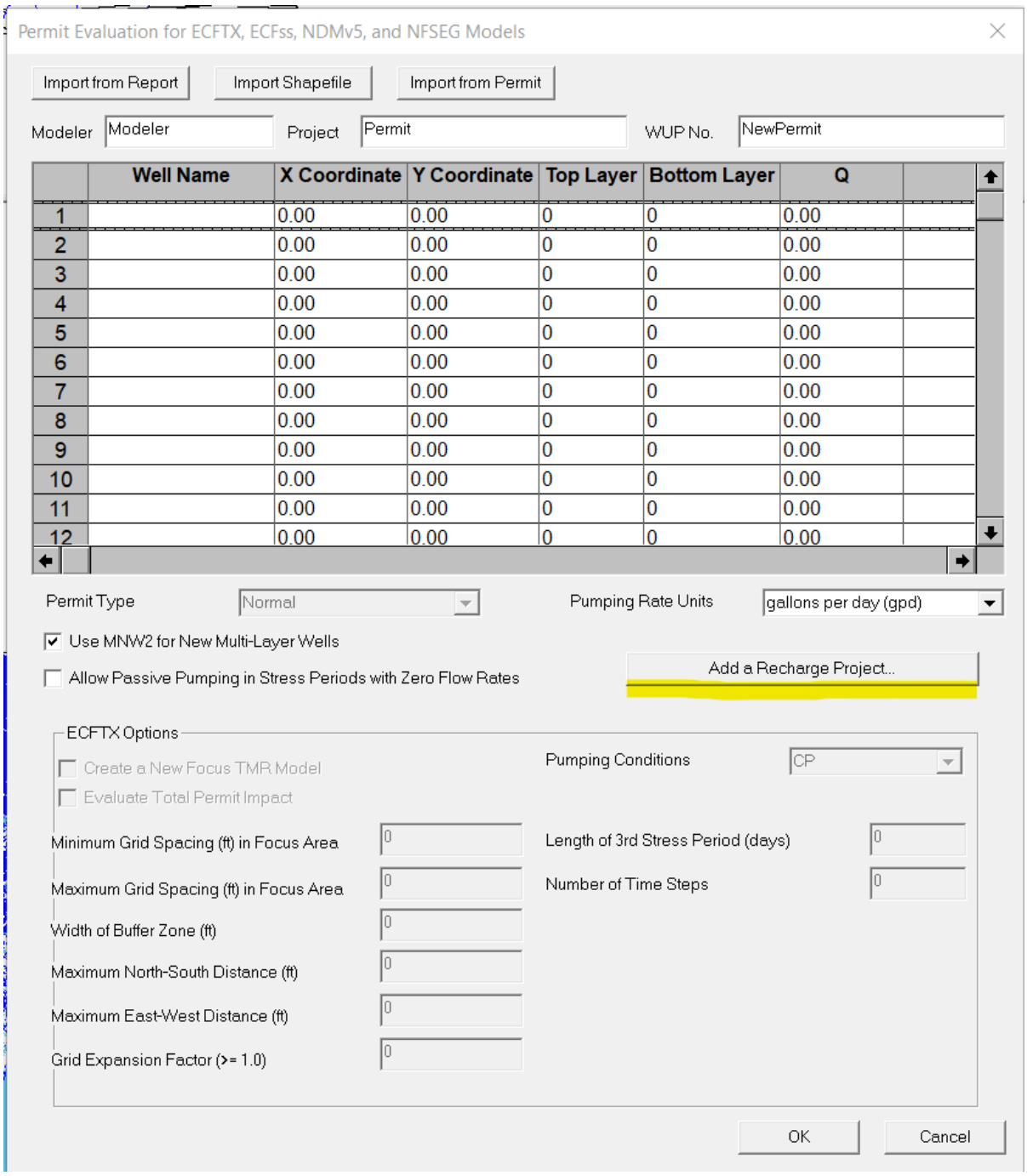
This file can be imported using the AE|Import|Target Text file menu item.

The second thing to do is put a separate csv file in the working directory for each lake. This csv file contains only two columns for row and column. There are no header rows. An example is shown below.

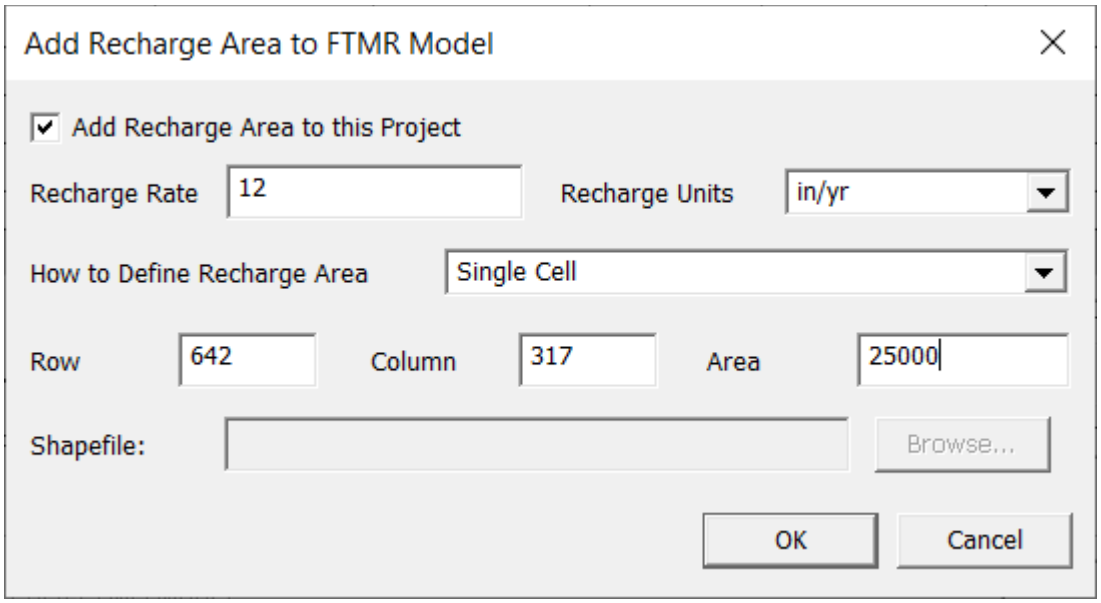
	A	B
1	102	424
2	101	424
3	100	424
4	102	425
5	101	425
6	100	425
7	99	425
8	98	425
9	101	426
10	100	426
11	99	426
12	98	426

Adding Recharge Area to Permit

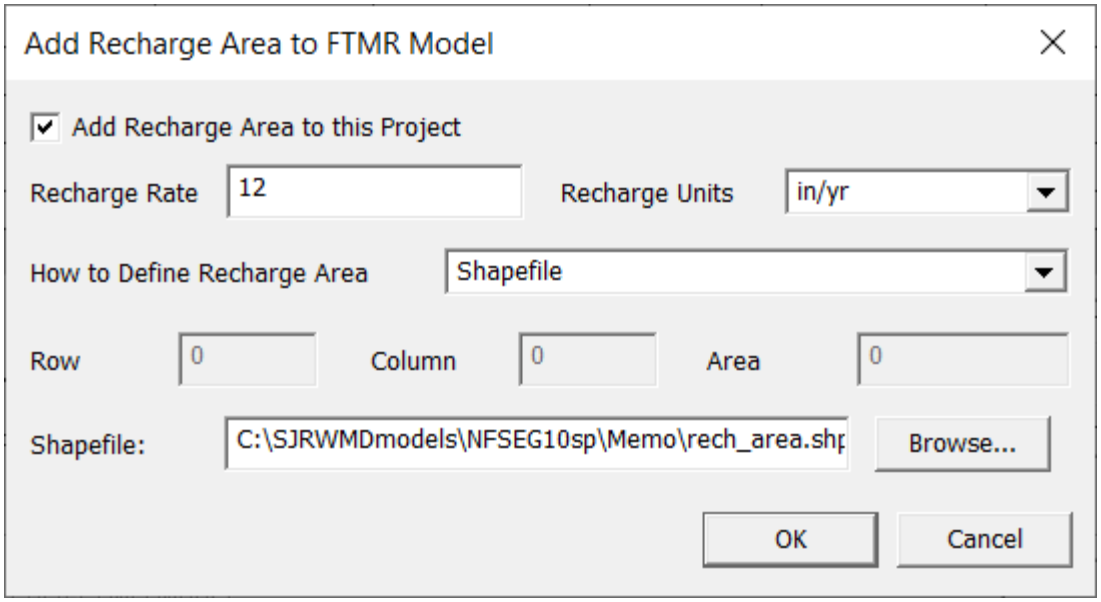
A new option has been added to add a recharge area to the permit evaluation. The recharge area can be a single cell or it can be defined by a polygon shapefile. Recharge in this area is added to the existing recharge in ECFTX for stress period 3 (where the applicant's new pumping rate is active). The Focus TMR dialog has been modified to add a button for this feature, as shown below.



Click on this button to supply the necessary data for the recharge area. The data required depends on the option chosen. For a single cell enter the recharge rate, recharge area (in square feet), recharge units, row, and column of the recharge area, as shown below. Also be sure to check the first box on the dialog to use these data in the next simulation.



When using a shapefile, row, column, and area are not needed. Instead click the browse button to find the shapefile containing one or more polygons. The recharge rate on the dialog is applied equally to all polygons included in the shapefile.

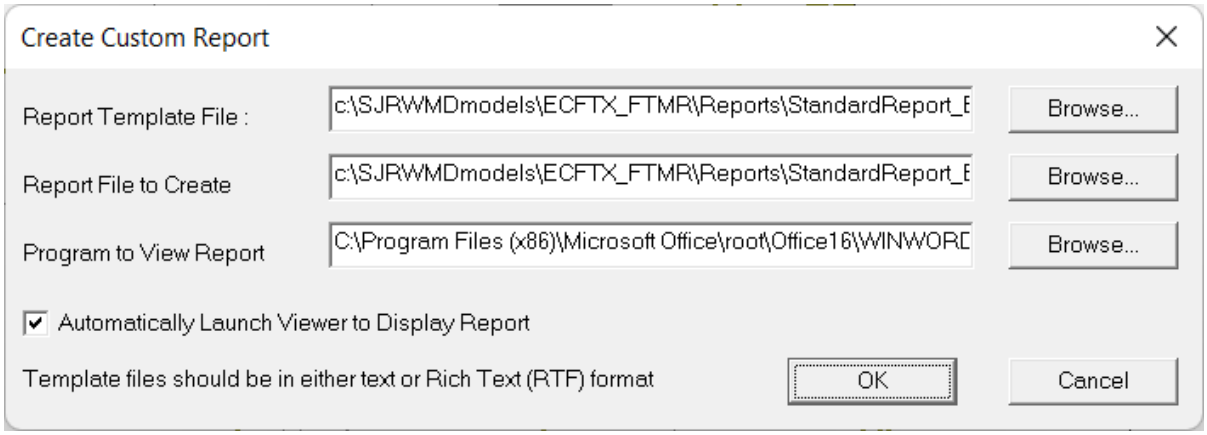


For both options, the new total recharge for a particular model cell or group of cells is additive. That is, it includes natural recharge rate plus the added recharge rate over the added recharge area.

Groundwater Vistas will also write a text file in the Reports folder summarizing the recharge option chosen and the resulting recharge rate applied to stress period 3. The file name is RechargeProject_root.txt, where root is the root file name of the simulation.

Creating a Standardized Report for ECFTX Simulations

After setting up the permit evaluation in Groundwater Vistas, the model is automatically confiured to create a standardized report using Reports|Custom Report.



The template file is called c:\SJRWMDmodels\ECFTX_FTMR\Reports\StandardReport_ECFTX.rtf. This file is used to create a new report which has the same name with the addition of the permit number. To create this report, GV8 assumes that you have imported results for stress period 3 (this is the default case so you do not need to browse to find any other stress period) and that you have created the spreadsheets and shapefiles for the permit (i.e., you answered Yes after importing results).

All drawdowns and fluxes presented in the report are for the difference between stress period 2 and 3. Wetlands are assumed to be any drain cell in layer 1. Drawdowns contoured in Groundwater Vistas are likewise for the difference between these two stress periods.

Deleting Lakes from the Simulation

Lakes in the ECFTX model are simulated using the river boundary conditions. If there is drawdown beneath one of these river cells, it is possible to introduce more induced recharge than is reasonable. To be conservative, the user can remove these river cells from the model.

These river cells can be removed by first selecting BCs|Rivers and then using BCs|Delete|Reach and entering 99. Reach number 99 was coded in these river boundaries that represent lakes. This command removes them all. The user can also just remove them in a smaller area by using BCs|Delete|Window. Drag a window around the area where lakes should be removed. GV will then ask if only lakes are to be removed. Answer Yes to this prompt.