Appendix 5-C

Making a Watershed Model Run

The watershed model is one component of the COHYST integrated model. This guide has been developed to assist a user to create a run without using the GUI (what is known as a 'manual' run). This guide is intended to show the user how to set up a run directory and run the model.

This guide assumes that you have successfully retained or created each of the necessary input files described in Appendix 5-B: Watershed Model Programs and Files.

Setting up the Watershed Model

Step 1. Create the proper folder structure for a model run (Figure 1)

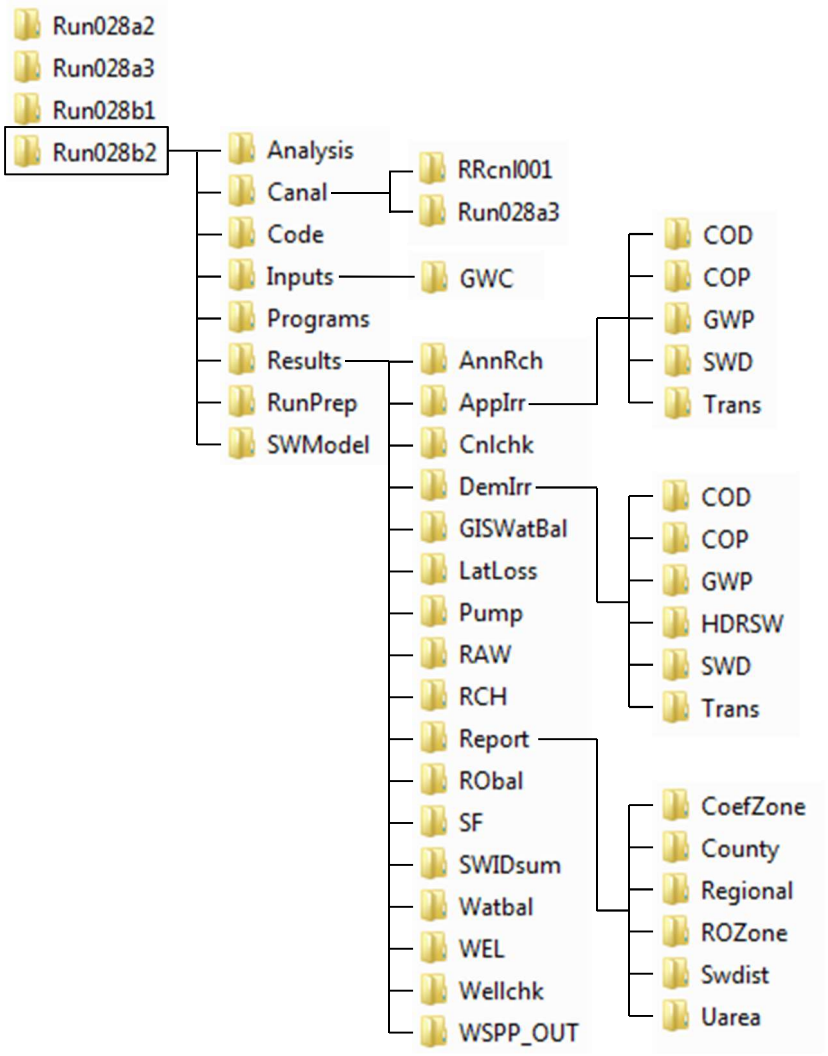

Figure 1. Watershed Model Run folder structure

Step 1.a. Choose the location to create your run

The watershed model takes a significant amount of time to run and creates a large amount of information. Choosing an appropriate place on your computer or network can save you time in the future if you need to copy or transfer files.

Choosing a suitable location will also allow you to organize your model run making them easy to find and access should you need to revisit your results in the future.

Keep in mind, the watershed model currently does not accommodate spaces in the file paths. If you cannot remove the spaces, you may consider mapping a network drive to bypass folders whose name includes spaces.

Step 1.b. Name your run and iteration.

Giving your run an appropriate name helps to give an initial summary description of both the specifics of the run and the general problem you are investigating. As with many types of modeling, the process can be iterative; developing good naming conventions will help with distinguishing between different runs and iterations when a project is inevitably revisited either by yourself or someone else.

> *As illustrated in* **Figure** 1*, there were four iterations created for this model run. The highlighted model run,* ***Run028b2,*** *represents the 'Run' project. There have been 28 versions of the watershed model for this project. This was the second attempt of a supply run through the integrated model due to changes in the other models.*
>
> $$\underbrace{Run}_{Project}\quad\underbrace{028}_{Project\ Version}\quad\underbrace{b}_{Run\ Type}\quad\underbrace{2}_{Iteration}$$
>
> *Other examples include*
> *DACb001f84yr*
> *The run was created as part of the DAC project. It was important to point out that this was a baseline run of project version 1 iteration f. Finally, while the model wasn't modified over the original time period; it was repeated multiple times to create an 84-yearlong scenario, another defining characteristic of this particular run.*
>
> $$\underbrace{DAC}_{Project}\quad\underbrace{b}_{Baseline\ Qualifie}\quad\underbrace{001}_{Project\ Version}\quad\underbrace{f}_{Run\ Type}\quad\underbrace{84yr}_{Qualifier}$$

Developing a naming convention that works for you and your organization takes time and understanding of how you are going to use the model. There is no way to define a correct naming convention. Though one should keep in mind name length. The allowable character length has increased significantly, but over explaining within the names of runs and subsequent directories can cause string lengths within the model to be exceeded. Finally, one should refrain from using spaces. The current version of the model does not accommodate spaces in the run names or subsequent directories.

Create a Model Run Folder with your chosen run name.

Step 1.c. Create the first layer of folders inside the Model Run Folder

The only necessary folders are *Inputs* and *Results.* These folders need to be created within the Model Run Folder; but they don't necessarily need to bear these names, but simply match the file paths listed in the Master Input File. The input folder (Master Input File: INDIR) stores the general input files, while the results folder (Master Input File: OUTDIR) controls where the model results are written. As the modeler, you may find there are other folders that will be beneficial in organizing your process and maintaining reproducibility. Some examples and reasoning for folders used by Old Man Groff are as follows:

- *Analysis – This folder is used to keep post-processed items developed to visualize the modeled results. This includes maps, reports, and summaries of water balances.*
- *Canal – This folder is used to keep canal recharge data sets. Given the fluidity of the canal recharge from iteration to iteration, this folder allows the modeler to contain the datasets incorporated into the model in a local folder. Using the CanalDIR in the Master Input File, this folder can be located elsewhere; but, in either case, the folder needs to contain the canal recharge data sets specified in the Canal Master File.*
- *Code – When a manual run is created and the results shared with others the pieces of script used to create the results is copied into the code folder. Archiving this particular piece of script will allow future*

investigators to be able to reproduce the results or explain deviations as modifications are made to the model.

- *RunPrep – This folder is a localized work area. A primary function of the watershed model is to investigate 'What if' scenarios. The runprep folder is used to create the necessary changes which are limited to this scenario without having the newly created information populate a static folder despite never being intended to be used outside of the scenario.*
- *SWModel – The watershed model often receives inputs from the surface water operations model specifically for this iteration. This folder allows this information to be contained within the iteration for which it is intended.*

Step 1.d. Create the subfolders inside the results folder

The watershed model operates on monthly time but creates output files on an annual basis. Rather than populate the results folder with numerous individual files, the files are organized in sub-folders. The folder structure within the results folder needs to match Figure 1. Failure to include a sub-folder or changing the name[1] will cause one or more programs to fail.

Within the results folder there needs to be the following folders with no leading, following, or internal spaces:

1. AnnRch
2. Cnlchk
3. LatLoss
4. Pump
5. RAW
6. RCH
7. RObal
8. SF
9. SWIDsum
10. WEL
11. Wellchk
12. WSPP_OUT

Furthermore, the following folders should have the listed subfolders:

13. AppIrr
    a. COP
    b. COD
    c. GWP
    d. SWD
    e. Trans

14. DemIrr
    a. COP
    b. COD
    c. GWP
    d. SWD
    e. HDRSW
    f. Trans

[1] Capitalization is not important; a folder called 'RCH' is the same as a folder called 'rch'

15. Report
    a. Regional
    b. County
    c. Swdist
    d. CoefZone
    e. ROZone
    f. Uarea

Within your modeling process you may find it beneficial to add additional processing, or summarize results in another fashion. Additional folders can be added without affecting the functionality of the model.

To ensure you have all the appropriate folders and names you may consider creating a template Run Folder. This folder should be created with the appropriate folder structure, then copied and renamed for each model run.

Step 2. Load the general input files into the Input directory.

Load the general input files into the input directory (Inputs). It is important when you are creating or modifying the input files to make sure they maintain the appropriate format and size. This guide assumes that this has been done; otherwise see Appendix 5-B: Guide to the Watershed Model Programs and files. The following files should be located within this folder:

1. Master Input File
2. Call year
3. Active Cell File
4. Application Efficiency File
5. Cell Location File
6. Coefficient Zone Coefficients File
7. Percent to Recharge File
8. Runoff Zone Coefficient File
9. Surface Water Irrigation District Index
10. The appropriate exogenous Pumping and Recharge Master Files
11. The appropriate Zone Definitions Files
    a. Cell County
    b. Uares.txt
    c. Subdist_cells.txt
12. The appropriate Index Files
    a. County ID

Furthermore, the set of groundwater concentration and lateral loss files should be located in a folder within the input directory.

Step 3. Update the Master Input File

The final process of the setup is to ensure the Master Input File has been updated to include the correct entries. When updating the Master Input File, take care to ensure that the order and line number of the

file remains in the proper format. Certain text editors have been known to wrap the line descriptions, polluting the format of the file.

At a minimum, the run name (MIF.2), input directory (MIF.4), and output directory (MIF.5) should be updated to reflect the location of the model run[2]. Furthermore, be sure to update the Master Input File for any changes specific to your run: changes to input file names, location of different static inputs, change in simulation period, …

How to create a manual watershed model: Demand Run

There are two types of model runs created with the watershed model; demand runs and supply runs. A demand run develops the irrigation demands for the surface water irrigation districts and provides this data to the surface water operations model. Next it is assumed that surface water supplies are sufficient to meet demands. These volumes are applied as irrigation to develop an initial estimate of recharge, pumping, and runoff contributions to stream flow. These estimates are provided to the groundwater model and surface water operations model to assist these models in developing initial estimates of the system.

The code for each of the programs has two modes of operation, GUI or not. Both modes are available for a manual run. The GUI mode prompts you for the file path to the Master Input File. The non-GUI method uses a hard-coded entry.

If you want to manually input the file path you can run the programs as either debugged script or an executable. The program will prompt you, if you are using the GUI. Type in 'y' or 'Y' into the command prompt. Hit return. The program will prompt you for the location of the master input file. Type in the file path of the Master input file, including file name and extension, directly into the command prompt.

Example: *W:\COHYST\COHYST\Inputs\MasterInput_v28.1g.txt*

The second method is to change the value of string within the script prior to debugging. The location of the master input file is controlled by two variables: the location of the folder containing the master input file (MasterDIR), and the name of the master input file (MasterFile). These variables represent the first two executable lines (non-blank or not starting with a '!' symbol). Simply update the values in between the apostrophe marks, build the program and then execute it.

Example:

```
DATA MasterDir /'W:\COHYST\COHYST\Inputs\'/
DATA MasterFile /'MasterInput_v28.1g.txt'/
```

Either methodology is acceptable for initiating a manual run, but will need to be repeated for each of the main programs. The guide will proceed under the assumption that the second method is the one being employed.

Setup the model run by completing Steps 1-3 above, along with any other modification to the model necessary for your scenario.

[2] The canal directory (MIF.8) will also probably need to be updated when using the guide's approach.

Step 4. Run the Irrigation Demand program

- Change the MasterDIR
- Change the MasterFile

Step 5. Run District Demand program

- Change the MasterDIR
- Change the MasterFile

Step 6. Move the demanded irrigation files into the applied irrigation folder

- Delete the subfolders in the AppIrr directory
- Manually copy the folders COD, COP, GWP, SWD, and Trans and all the files within them from the DemIrr folder to the AppIrr folder.

Step 7. Run WSPP program

- Change the MasterDIR
- Change the MasterFile

Step 8. Run WSPP Report program

- Change the MasterDIR
- Change the MasterFile
- This program takes a while to run. When planning to make a model run I would recommend starting this program just prior to the end of your work day and letting it run over night.

Step 9. Run Make Recharge program

- Change the MasterDIR
- Change the MasterFile

Step 10. Run Make Well program

- Change the MasterDIR
- Change the MasterFile

Step 11. Run Compile Recharge program

- Change the MasterDIR
- Change the MasterFile

Step 12. Run Compile Well program

- Change the MasterDIR
- Change the MasterFile

Step 13. Provide results to the surface water operation model and groundwater model

Four files are exchanged from the watershed model to the surface water operation model and groundwater model.

- District Demand
- Runoff Contributions to Stream Flow

- .WEL File
- .RCH File

How to create a manual watershed model: Supply Run

There are two types of model runs created with the watershed model; demand runs and supply runs. A supply run uses the results of the surface water operations model to quantify the volume of surface water that is applied to the fields. The applied volumes are used to estimate recharge, pumping, and runoff contributions to stream flow which are passed to the surface water operation model and the groundwater model. This integrated process can be repeated until the changes to the system from iteration to iteration become negligible.

The code for each of the programs has two modes of operation GUI or not. Both modes are available for a manual run. The GUI mode prompts you for the file path to the Master Input File. The non-GUI method uses a hard-coded entry.

If you want to manually input the file path you can run the programs as either debugged script or an executable. The program will prompt if you are using the GUI. Type in 'y' or 'Y' into the command prompt. Hit return. The program will prompt you for the location of the master input file. Type in the file path of the Master input file, including file name and extension, directly into the command prompt.

Example: *W:\COHYST\COHYST\Inputs\MasterInput_v28.1g.txt*

The second method is to change the value of string within the script prior to debugging. The location of the master input file is controlled by two variables: the location of the folder containing the master input file (MasterDIR), and the name of the master input file (MasterFile). These variables represent the first two executable lines (non-blank or not starting with a '!' symbol). Simply update the values in between the apostrophe marks, build the program and then execute it.

Example:

```
DATA MasterDir /'W:\COHYST\COHYST\Inputs\'/
DATA MasterFile /'MasterInput_v28.1g.txt'/
```

Either methodology is acceptable for initiating a manual run, but will need to be repeated for each of the main programs. The guide will proceed under the assumption that the second method is the one being employed.

Setup the model run by completing Steps 1-3 above, along with any other modification to the model necessary for your scenario.

Step 4. Run the Irrigation Demand program

- Change the MasterDIR
- Change the MasterFile

Step 5. Run District Demand program

- Change the MasterDIR

- Change the MasterFile

*Note: Step 4 & Step 5 can be avoided by copying the District demand file from the demand run into the same location within the current supply run's results structure.

Example[3]*:*

Copy:
DistDemand.txt

From:
W:\COHYST\COHYST\Run028a3\Results\DemIrr\HDRSW

To:
W:\COHYST\COHYST\Run028b2\Results\DemIrr\HDRSW

Step 6. Receive and process Canal Deliveries and Canal Seepage from the surface water operations model

Step 6.a. Process the Canal Deliveries

Canal deliveries are received in an excel sheet from the surface water operations model, which is then processed into a text file (.csv) prior to being combined with the non-surface water operation surface water district demand to create the District Deliveries file. The assumption for this step is that you will be using the SW_Del_HDR2TFG program to create the District Deliveries file. If you have another tool you prefer, use that tool and skip this step.

- The first step is to ensure that both header lines are present in the file. The first header contains the old COHYST surface water irrigation district ID for each of the canals in the surface water operations model. This header is occasionally omitted. If missing fill in the header using the appropriate values from the surface water irrigation district index file. Beginning in column D the header should have the following entries:

  SW District: 5 12 13 16 18 26 30 40 42 45 50 51 53 55

  Note that there is a space between 'SW' and 'District:'. This is important.

- Next examine column B. The format should general and no commas should be included. If a comma is present set the format to general.

- Next examine the values in columns E through R. These values should not include commas. They are often buried deep into the data set. The best bet is to examine column F CNPPID which tends to have the highest rates of diversion.

- Remove any excess lines or columns in the file. Occasionally values are placed in the wrong position within excels prior to be moved to the correct position. However, when this is done, it activates these cells which are then unwantedly written to the output '.csv'.

[3] Don't get tripped up by the naming convention. The example is correct, but mastering a naming convention is a never-ending battle.

To accomplish this, select column S, then press control + shift + right arrow. Next right click on a column header (not a file header within the excel table) and select delete. Simply hitting the delete button on the keyboard clears the contents of the cells but does not inactivate them. Now place the cursor in column A. Press control + down arrow. This will take you to the bottom of your data set. Highlight the bottom row (it is usually labeled 'Final') by clicking on the line number at the far left of the application. The entire row should be highlighted. Press control + shift + down arrow to select all the row below the data. Right click on the line number and select delete. Simply hitting the delete button on the keyboard clears the content of the cells but does not inactivate them. This process should delete the row with the term 'Final' in it. This is okay. The data is blank but the format of the file changes cause issues for the next formatting for the SW_del_HDR2TFG file program.

- Finally save the data as '.csv' file. I like to save the file in the SWModel folder as the surface water operation model's run name _CanalDel.csv. For the integrated model the watershed model is usually the first element to be run. Therefore, the irrigation supplies used in the watershed model's 'b' run are developed in the surface water operations model's 'a' run. This is an important distinction to recognize and maintain.

  Example

$$\underbrace{Run028a3}_{SW\ model\ run}\ \underbrace{\_canalDel}_{Canal\ Delivery}\ \underbrace{.csv}_{extension}$$

Step 6.b. Next use the SW_del_HDR2TFG program.

This is a formatting file that combines the surface water deliveries file from the surface water operations model with the district demand file to create the district deliveries file. This program needs to be run by changing directories and file names in the code.

- Make sure that the starting year (line 16) and ending year (line 17) are consistent with the simulation period.
- Update the Input Directory (line 21)
- Update the file path (line 45) to the location of newly create '.csv' file
- Update the file path (line 63) to the location of the district demand file
- Update the file path (line 73) to the location to write the District delivery file. It should be in the AppIrr folder inside the results directory.

Before preceding to Step 6.c, consider whether you are including the canal recharge from the surface water operations model into the .RCH file through the watershed model. The official version of the integrated model uses the groundwater model to insert the canal recharge from the surface water operations model into the .RCH file. However, there are several projects which still include the canal recharge in the .RCH file developed by the watershed model. If this is the case proceed to Step 6.c otherwise skip to Step 7.

Step 6.c. Process the Canal Seepage

Canal seepage values are received in an excel sheet from the surface water operations model, which is then processed into a text file (.csv) prior to being converted into a Canal Recharge data set. The assumption for this step is that you will be using the Annualize Canal program to create the Canal Recharge data set. If you have another tool you prefer, use that tool and skip to Step 6.e.

- Examine the data to ensure that there are no commas in any of the data. If you find a comma this can be remedied by changing the number format of the cell to general.

- Remove any excess lines or columns in the file. Occasionally values are placed in the wrong position within excels prior to be moved to the correct position. However, when this is done, it activates these cells which are then unwantedly written to the output '.csv'.

  To accomplish this, select column E, then press control + shift + right arrow. Next right click on a column header (not a file header within the excel table) and select delete. Simply hitting the delete button on the keyboard clears the contents of the cells but does not inactivate them. Now place the cursor in column A. Press control + down arrow. This will take you to the bottom of your data set. Highlight the row below the bottom row of data by clicking on the line number at the far left of the application. The entire row should be highlighted. Press control + shift + down arrow to select all the row below the data. Right click on the line number and select delete. Simply hitting the delete button on the keyboard clears the content of the cells but does not inactivate them.

- Finally save the data as '.csv' file. I like to save the file in the SWModel folder as the surface water operation model's run name _CanalSeep.csv. For the integrated model the watershed model is usually the first element to be run. Therefore, the irrigation supplies used in the watershed model's 'b' run are developed in the surface water operations model's 'a' run. This is an important distinction to recognize and maintain.

  Example

$$\underbrace{Run028a3}_{SW\ model\ run}\ \underbrace{\_canalSeep}_{Canal\ Seepage}\ \underbrace{.csv}_{extension}$$

Step 6.d. Use the Annualize Canal program

This is a formatting file which reorganizes the canal seepage data into the canal seepage data set format. This program needs to be run by changing directories and file names in the code.

- Make sure that the starting year (line 17) and ending year (line 18) are consistent with the simulation period.
- Update the location of the directory containing the CanalSeep.csv file (line 31)
- Update the location of the directory where the canal seepage data set will be written (line 32)
- Update the name of the canal seepage data set file prefix (line 33)
- Update the name of the file name to match the name of the CanalSeep.csv file (line 34)

Step 6.e. Update the Canal Master File

- Update the canal master file to include the appropriate data set and file prefix

Step 7. Run Irrigation Supply program

- Change the MasterDIR
- Change the MasterFile

Step 8. Run WSPP program

- Change the MasterDIR

- Change the MasterFile

Step 9. Run WSPP Report Program

- Change the MasterDIR
- Change the MasterFile
- This program takes a while to run. When planning to make a model run I would recommend starting this program just prior to the end of your work day and letting it run over night.

Step 10. Run Make Recharge program

- Change the MasterDIR
- Change the MasterFile

Step 11. Run Make Well program

- Change the MasterDIR
- Change the MasterFile

Step 12. Run Compile Recharge program

- Change the MasterDIR
- Change the MasterFile

Step 13. Run Compile Well program

- Change the MasterDIR
- Change the MasterFile

Step 14. Provide results to the surface water operation model and groundwater model

Three files are exchanged from the watershed model to the surface water operation model and groundwater model.

- Runoff Contributions to Stream Flow
- .WEL File
- .RCH File