Exercise 3 - WDM Utility





In order to successfully apply WinHSPF, meteorological data local to the area being studied are required. The current version of BASINS (after the Fall 2007 Update) contains meteorological data at more than 16,000 stations. These data are stored in the Watershed Data Management (WDM) format, which is used by both BASINS and HSPF. WDM files and the code library that manages them provide a powerful tool for managing and manipulating time-series data.

While the meteorological data update for BASINS 4.0 provides many additional stations not available in earlier version of BASINS, an HSPF user will still likely have additional local data to import and manipulate. To create and work with a WDM file requires a significant level of user education. BASINS users are greatly benefited by having a straightforward, easy-to-use tool that enables them to build and update WDM meteorological files without learning the detailed logistics of WDM operations. This tool is WDMUtil.

The WDMUtil program provides operational capabilities to allow users to import available meteorological data into WDM files and perform operations necessary (e.g., editing, aggregation/disaggregation, filling missing data, etc.) in order to create the input time-series data for WinHSPF. WDMUtil allows the user to add available local meteorological data to their study. In some instances, the examples of 'local' data in this exercise may now be available directly through the BASINS met data update, but the concepts of this exercise are important for any modeler applying HSPF and therefore, we will still go through the steps associated with building a *.wdm file from scratch.

Questions answered in this exercise:

- 1) How do I create a new WDM file to hold my local weather data?
- 2) How do I import local weather data using WDMUtil import scripts?
- 3) How do I import local weather data using WDMUtil by creating an import script?
- 4) How do I use the Compute/Disaggregate time series tool?

A. Creating a new WDM file with local weather data

QUESTION ANSWERED:

1) How do I create a new WDM file so I can import local weather data?

- 1. From the **Start** menu under **Programs**, select **Basins** and then **WDMUtil**.
- 2. From the **File** menu, select **New**.

- 3. Navigate to $c: \ Basins$.
- 4. Type "WEST_BREX" as the file name.
- 5. Click OPEN. The following message will appear:

WDMUtil File New 🛛 🔀					
?	WEST_ This fil	_BREX.wdm e does not ex	dist.		
Create the file?					
<u>Y</u> e	s	No			

- 6. Click YES.
 - **Note:** We just created a blank *.*wdm* file open into which we will import West Branch Patuxent weather data. Because of time constraints, we will not be importing all required time series; however, we will discuss the basics required to import all data types.

HSPF requires a unique data set for each meteorological parameter that will be imported. Data sets in WDM files are designated by a unique number and other relevant information, or "attributes", relating to the time series data fields into which the data are imported. The following table displays a convention for data set numbering and attribute naming that is used for the meteorological WDM files distributed with BASINS. For the example in the table, data sets are numbered from 11 to 206. Notice that all hourly information is listed in data fields 1 through 8. HSPF algorithms use these hourly values. The remaining data fields (9 - 16) contain daily time series data, as well as intermediate time series data used in the conversion of HSPF parameters (USEPA, 1998). This data set numbering scheme is not required, but is presented as a systematic approach to organizing your weather data timeseries.

Data set Fields	Data set	Data set Numbers	Description Parameter
1	PREC	(11,31,51,191)	hourly precipitation
2	EVAP	(12,32,52,192)	hourly evaporation
3	ATEM	(13,33,53,193)	hourly temperature
4	WIND	(14,34,54,194)	hourly windspeed
5	SOLR	(15,35,55,195)	hourly solar radiation
6	PEVT	(16,36,56,196)	hourly potential evapotranspiration
7	DEWP	(17,37,57,197)	hourly dewpoint temperature
8	CLOU	(18,38,58,198)	hourly cloud cover
9	TMAX	(19,39,59,199)	daily maximum temperature (optional)
10	TMIN	(20,40,60,200)	daily minimum temperature (optional)
11	DWND	(21,41,61,201)	daily windspeed (optional)
12	DCLO	(22,42,62,202)	daily cloud cover (optional)
13	DPTP	(23,43,63,203)	daily dewpoint temperature (optional)
14	DSOL	(24,44,64,204)	daily solar radiation (optional)
15	DEVT	(25,45,65,205)	daily evapotranspiration (optional)
16	DEVP	(26,46,66,206)	daily evaporation (optional)

Table 1. Data Set Numbering Convention for BASINS Meteorological WDM Files

Note: For the updated meteorological WDM files in BASINS 4.0, only data set fields 1 and 3-8 are distributed. The daily timeseries (data set fields 9-16) are not distributed because they are not used by HSPF, but may be added to wdm files in order to create the required hourly timeseries. Also, the hourly evaporation timeseries (data set field 2, "EVAP") is not included in the updated meteorological WDM files. The original database contained both this Pan Evaporation dataset and a computed Potential Evapotranspiration (PEVT) dataset. The PEVT dataset is appropriate as an input to the HSPF model for both potential evapotranspiration applied to the land surface and for lake evaporation applied to water surfaces.

In order to learn how to import data into the WDMUtil, we will enter a few different data sets. First we will import the hourly precipitation that is available through NOAA.

B. Importing local weather data into the WDMUtil

QUESTION ANSWERED: 2) How do I import local weather data using WDMUtil import scripts?

Generally, you would begin this exercise by downloading some precipitation data from the National Climatic Data Center (NCDC) for a weather station in the West Branch Patuxent area. However, there is a charge for the data, so the file is provided in the folder *c:\basins\extra training files*. This data has been downloaded from <u>www.ncdc.noaa.gov</u>, in the <u>"Hourly Precipitation Data (TD 3240)</u>" format. The output format was specified as "Delimited, with Station Name", with the output format delimiter set to "Comma." Remember that most of the hourly precipitation data available from NCDC has now been

incorporated into the new BASINS meteorological data, however, there may be other sources of hourly precipitation data that may need to be used for HSPF modeling.

- 1. From the **File** menu in WDMUtil, select **Import**.
- 2. Navigate to *c:\Basins\Extra Training Files*.
- 3. Select "*beltsville_precip.txt*" and click OPEN.
- 4. Click OK if the following "No Scripts Found Yet" message box appears.

No Scripts Found Yet 🛛 🔀
Use the Find button to locate scripts. Look for the Scripts directory where this program is installed.
ОК

The following "Script Selection for Importing" window will appear:

Script Selection for importing C	:\BASINS\West Branch Weather Data\beltsville_precip.txt	_ D ×
Description Black Script	Script File	<u>B</u> un
Dank Scipe		<u>E</u> dit
		<u>F</u> ind
		Forget
		<u>D</u> ebug

- 5. Click FIND.
- 6. In the "Open Script File" window, navigate to *c:\basins\models\Hspf\WDMUtil\scripts.*
- 7. Select "*HPCP_NCDC_OL.ws*" and click OPEN.
- 8. Select "Hourly Precip, On-Line Format, NCDC TD-3240." The *c:\BASINS\models\HSPF\WDMUtil...* record will become highlighted in green (left) and blue (right).

Script Selection for importing C:\BASINS\West	t Branch Weather Data\beltsville_precip.txt	
Description	Script File	<u>R</u> un
Blank Script		
"Hourly Precip, On-Line Format, NCDC TD-3240"	C:\BASINS\models\HSPF\WDMUtil\scripts\HPCP_NCE	<u>E</u> dit
		<u> </u>

Note: The following table summarizes the data import scripts distributed with WDMUtil. Sample data files listed in the table are also distributed. (Hummel et al., 2001).

Script File Name	Description of Data Format Script Reads	Sample Data File
HPCP_NCDC_Arch.ws	Hourly Precip, Archive Format, TD-3240	Ithaca_prec.ncd, ncdc.ncd
HPCP_NCDC_OL.ws	Hourly Precip, On-Line Format, NCDC TD-3240	aberdeen.ncd
IdStMet_DLY.ws	Idaho State Climate Services Daily Format	fennrs.log
MultiCol7_Wid10_Mon.ws	Multi-Columns (7) of Width 10, Monthly Values	acpoint.prn
SimpDly_MDY.ws	Simple Daily Value Format-mm/dd/yyyy	usgsfecal.prn
SimpDly_YMD.ws	Simple Daily Value Format-yyyy/mm/dd	
SimpHrly_YMDH.ws	txtScriptDesc	
SOD_OL.ws	Summary of the Day TD-3210	Bing_SOD.ncd
SOD_OL_Coop.ws	Summary of the Day, On-Line, Coop	Amherst.ncd
SurfAir_Hrly_Arch.ws	Surface Airways Hourly Data, Archive Format, TD-3280	surface.ncd
UsgsDvWeb_MDY.WS	USGS Daily Web Values (mm/dd/yyyy)	hist_littleyellow.cgi
UsgsDvWeb_YMD.ws	USGS Daily Web Values (yyyy/mm/dd)	tendall.rdb
WDMUtil_Exp_Dly.ws	WDMUtil Export Format - Daily Values	tmax.exp
WDMUtil_Exp_Hrly.ws	WDMUtil Export Format - Hourly Values	prec.exp

9. Click RUN.

Note: A new record will appear in the "Time Series" frame.

WDMUtil: WEST_BREX						J	<u>_ </u>
Eile Tools Scenarios Location Scenarios O of 1 Mone OBSERVED	ns <u>C</u> onstitu Locati 0 of 1 18070	ents <u>T</u> im ons 0	e Series <u>H</u> e	elp ne Co O c	nstituents of 1 PCP	AII	None
Time Series - 1 of 1 availa	able time se	ries in li	st (1 not on	WDM fil	e); 0 selec	ted. —	
	+ 🥒	۵.				All	None
Type File DSN	Scenario	Location	Constituent	Start	End	Nval	Station
In-Memory <in memory=""> 1</in>	OBSERVED	180700	HPCP	1986/1/1	1988/12/24	26136	Hourly F

- **Note:** Notice in the Type column of the Time Series frame that it says "In-Memory." This means that the data was read in, but it has not been written to the WDM. We will need to write it to the WDM (this is similar to saving a file).
- 10. In the "Time Series" frame, click the newly added time series. It will turn blue.
- 11. In the "Tools" frame, click ^[11] (Write Time Series to WDM).
- 12. In the "Write to WDM" box, enter 31 as the Output DSN, change the constituent name to "PREC", and change the location name to "BELTSVILLE."

🕍 Write	to WDM								<u>_ 🗆 ×</u>
Specify Output Data-set Number(s); Select/Enter Scenario, Location, Constituent as needed; Data-set attributes may be updated if needed Click Write button to store data on WDM file.									
O Use	full period t	for each dat	a set	s, as denni	ea on main	TORM			
DSN/ID	Output DSN	Scenario	Location	Constituent	# Attributes	Attr. Space	# Data Pointers	Time Group	Base Year
1	31	OBSERVED	BELTSV	PREC	30	100	300	Years	1980
				<u>W</u> rite		<u>C</u> ancel]		

- **Note:** Notice that the four-letter abbreviation we used in the "Constituent" box is the abbreviation given in Table 1 on page 3. The name entered in the "Location" box must be **EXACTLY** the same each time you import/open a new data set into this wdm. For example, if you called the precipitation data location "BELTSVILLE" and then you called the hourly evaporation data location "Beltsville," they will be treated as two different locations in WDMUtil.
- 13. Click WRITE. The following message will appear:



14. Click OK.

Note: The new time series is no longer highlighted and the "Type" is now WDM.

Before we learn how to use other tools in the WDMUtil, we will learn how to import other types of data. In the following section, we will create our own import script to import time series data that were gathered from different locations (Marlboro, Maryland, and West Branch Patuxent).

C. Creating an Import Script

QUESTION ANSWERED:

3) How do I import local weather data using WDMUtil by creating an import script?

- 1. From the **File** menu, select **Import**.
- 2. Navigate to *c:\basins\West Branch Weather Data*.
- 3. From the "Files of type:" menu, select "All Files (*.*)" and select "marlboro_tmax."



4. Click OPEN.

To illustrate how you can create an import script, we will import daily maximum temperature data for the Upper Marlboro station. There are currently no import scripts available for this format (shown below), so we will create one.

🗾 n	narlbo	oro_tma	x.txt - Notepad	
Eile	<u>E</u> dit	F <u>o</u> rmat	<u>H</u> elp	
mon	th	day	year	Tmax
01		01	1986	48 .
01		02	1986	42
01		03	1986	53
01		04	1986	58
01		05	1986	45
01		06	1986	44
01		07	1986	48
01		08	1986	30
01		09	1986	32
01		10	1986	45
01		11	1096	55

5. In the "Description" column, click the "Blank Script" box. The corresponding "Script File" box will turn blue.

Script Selection for importing C:\BASINS\West		
Description	Script File	Bun
Blank Script		
"Hourly Precip, On-Line Format, NCDC TD-3240"	C:\BASINS\models\HSPF\WDMUtil\scripts\HPCP_NCE	Edit
"USGS Daily Web Values (mm/dd/yyyy) - 2001 Format"	C:\BASINS\models\HSPF\WDMUtil\scripts\UsgsDvWe	

6. Click **EDIT**. Notice that a sample of the data you are importing is shown in the bottom portion of the window.

Image: Pieter Properties Data File: C: \Documents and Settings\amber\Desktop\BASINS\West Branch Browse Description: btScriptDesc Browse Header Column Format Line Ending V Skip Citable Space Delimited CALF or CR C Stats With # Column Format C. GALF or CR CALF or CR C Stats With # Character: CASCII Char: [] CASCII Char: [] Lines 1 2 3 4 5 6 7 8 9 123455678901234	Script Creation Wizard	
1 2 3 4 5 6 7 8 9 12345678901286132	File Properties Data Mapping Data File: C:\Documents and Settings\amber\Desktop\BASINS\West Branch Browse Script File: Ending Browse Description: Column Format Line Ending Weader Column Format Line Ending © Stats With # © Space Delimited © CB/LF or CR C Lines 1 C Character: C Cline Length	
	1 2 3 4 5 6 7 8 123456789012986013 010050198601986014 0100701986018 0100901986032	2

- 7. In the "Header" frame, click the button beside "Lines."
- 8. Enter "1" in the box beside "Lines."

Note: This specifies that we have one line of headings in the file we are importing. Notice that the header line is no longer visible in the data window.

9. In the "Column Format" frame, make sure the "Fixed Width" button has been selected.

Note: This particular file is actually tab-delimited, but we are using the fixed width option to help you understand how this option works.

10. In the "Line Ending" frame, make sure that either the CR/LF or the CR button has been selected.

Note:

- CR = Carriage Return
- LF = Line Feed
- 11. Click the "Data Mapping" tab.

Note: The "Data Mapping" window requires user-specification of the data. The list at the top of the "Data Mapping" tab contains *Names* of various data elements used in importing data. The lower portion of the tab contains a display of the data file with column numbers across the top of it. These column numbers can be highlighted (by clicking and dragging with the mouse) to define the location of the data elements. Thus, to define the *Input Column* for a data element, click on that element and then click and drag on the column numbers in which the element is found. In some cases a data element's value will be constant (e.g., *Hour* and *Minute* for daily data). In such a case, the value for that element may be entered under the *Constant* column. The *Constant* column may also be used to apply a constant value to a data element. This is done by inserting the desired mathematical symbol in front of the constant value. For example, if the year values on a file were only the last two digits, entering +1900 in the *Constant* column would add 1900 to the 2-digit year values when processing the data.

Some data elements are general information about the data being processed. These elements may be stored as attributes of the time series. To indicate a data element as an attribute, a *yes* is entered under the *Attribute* column for that element. The values for these attributes may then be entered under the *Constant* column. It is important to enter values for the *Scenario*, *Location*, and *Constituent* attributes since this will make the new time series more recognizable by WDMUtil and other BASINS components.

Once the data elements have been defined as desired, SAVE SCRIPT may be used to write the script to a file for future use. READ DATA is used to try to process the data using the script defined in the wizard. CANCEL will close the Wizard and no data will be imported (Hummel et al., 2001).

Script Creation Wizard							<u> </u>
File Properties Data Mappir	ng						
Name	Attribute	Input Column	Co	nstant		Skip Values	
Value	no						
Year			19	00			
Month	no						
Day			1				
Hour			0				
Minute			0				
Scenario	yes						
Location	yes						
Constituent	yes						
Description	100						
1	2 3	4	5	6	7	8	9
123456789012345678	9012345678901:	2345678901234567	890123456	5789012345	5678901	12345678901234	567890
0100101986048							-
0100201986042							
0100301986053							
0100401986058							
0100501986045							
0100601986044							
0100701986048							
0100801986030							
 <u>R</u> ead D	ata <u>S</u> ave Sc	ript <u>C</u> ancel					

- 12. Click in the cell that corresponds with the "Input Column" and the "Value" row.
- 13. In the lower portion of the tab, highlight columns 12-14 by clicking and dragging with the mouse, to define the location of the data elements. Notice 12-14 show up in the cell selected earlier.

Note: The columns are numbered using the following schematic:

1 2	3) 123456789012345	4 5 6789012345678901234	6 4567890123456789	7 8 01234567890123456	9 789012345678	10 11 90123456789012	234
14	26		54				
Script Creation	Wizard				<u>_ 🗆 ×</u>	[
File Properties Da	ata Mapping						
Name	Attribute	Input Column	Constant	Skip Values	▲		
Value	no	12-14	1000				
Year			1900				
Month	no		1				
Hour			0				
Minuto			0				
Scenario	Ves		U				
Location	ves						
Constituent	Ves						
Description	yes				_		
1	. 2	3	4 5	6			
123456789012	345678901234	567890123456789	9012345678901	2345678901234			
010010198604	8						
010020198604	2				=		
010030198605	3						
010040198605	8						
010050198604	5						
010060198604	4						
010070198604	8				-		
•					•		
	<u>R</u> ead Data	<u>S</u> ave Script	<u>C</u> ancel				

- 14. Click in the cell corresponding to "Input Column" and "Year."
- 15. Highlight columns 7-10 by clicking and dragging with the mouse.
- 16. Click in the cell that corresponds with the "Input Column" column and the "Month" row.
- 17. Highlight columns 1-2 by clicking and dragging with the mouse.
- 18. Click in the cell that corresponds with the "Input Column" column and the "Day" row.
- 19. Highlight columns 4-5 by clicking and dragging with the mouse.
- 20. In the cell that corresponds with the "Constant" column and "Hour" row, enter "24".

- **Note:** The "Hour" represents the hour the observations were made. To understand the importance the "Hour" being set correctly, let's consider daily precipitation values. If the observation were made at 8:00 am on 1/2/1985, the value would represent the precipitation that occurred during the previous 24-hour period, from 8 am on 1/1/1985 to 8 am on 1/2/1985. In the case of this exercise, it is assumed that daily maximum temperatures, daily minimum temperatures, and daily precipitation values were recorded at hour 24 (at the very end of the day) and therefore, represents data collected from midnight to midnight on the date corresponding to the daily value. Observation times can generally be obtained from the source of the data.
- 21. In the cell that corresponds with the "Constant" column and "Scenario" row, enter "OBSERVED" (in capitals).
- 22. In the cell that corresponds with the "Constant" column and "Location" row, enter "MARLBORO" (in capitals).
- 23. In the cell that corresponds with the "Constant" column and "Constituent" row, enter "TMAX."
- 24. In the cell that corresponds with the "Constant" column and "Description" row, enter "Daily Maximum Temperature." Your window should now look like the following.

riterric	Attribute	Input Column	Constant	Skip Values	
Value	no	12-14			
Year		7-10	1900		_
Month	no	1-2			
Day		4-5	1		
Hour			24		
Minute			0		
Scenario	yes		OBSERVED		_
Location	yes		MARLBORO		
Constituent	yes		TMAX		
Description	yes		Daily Maximum T	emp	
1	2	3	4 5	6	
2345678901234	45678901234	567890123456789	0123456789012	345678901234	
1010101986048	100,0001201	00,000120100,00	0120100/07012	0100/0901201	
					=
00201986042					
100201986042 100301986053					
LOO2O1986O42 LOO3O1986O53 LOO4O1986O58					
LOO2O1986O42 LOO3O1986O53 LOO4O1986O58 LOO5O1986O45					

- 25. Click READ DATA.
 - **Note:** Your screen should look like the following. Notice that there is another yellow time series that is in memory.

WDMUtil: west_brex
Jer Tools Scenarios Locations Constituents Time Series Help Scenarios 0 of 1 All None BELTSVILLE Constituents Constituents Constituents Constituents Constituents O of 2 Belt PREC
MARLBORO TMAX
Time Series - 2 of 2 available time series in list (1 not on WDM file); 0 selected.
Type File DSN Scenario Location Constituent Start SJDay End EJD
WDM west_brex 31 OBSERVED BELTSVILLE PREC 1986/1/1 46431 1988/12/24 4752
Dates Tools No Dates are available until Timeseries are Selected

- 26. The new record must be written to the WDM. In the "Time Series" frame, click on the newly added time series. It will turn blue.
- 27. In the Tools frame, click (Write Time Series to WDM).
- 28. In the "Write to WDM" box, enter 19 as the Output DSN.

Write to WDM Specify Output Data-set Num Select/Enter Scenario, Local Data-set attributes may be up Click Write button to store da Use common period for a C Use full period for each d	ber(s); ion, Constitu odated if nee ta on WDM f II data sets, a ata set	ent as neo ded ile. as defineo	eded; 1 on main f	orm			<u>_ ×</u>
DSN/IE Dutput DSN Scenario	Location	Constituen	# Attributes	Attr. Space	# Data Pointers	Time Group	Base Yea
1 19 OBSERVED	MARLBORC	TMAX	30	100	300	Years	1980
		<u>W</u> rite		ancel			

Note: The number "19" came from Table 1 on page 3 of this exercise, following the BASINS convention for numbering time series data sets. The data set number is arbitrary, but following this convention will help throughout this exercise. In addition, numbering hourly data sets according to this convention makes it easier for WinHSPF to find default data sets for each meteorologic constituent.

Note: DSN = Data Set Number

29. Click WRITE.

30. Click OK when a message appears telling you that the data set was successfully stored.

Note: The new time series is no longer highlighted and the "Type" is now WDM.

31. Follow steps 1-29 (in Section C) to import additional local data files *"marlboro_tmin.txt"* and *"marlboro_precip.txt."* Use "OBSERVED" as the scenario and "MARLBORO" as the location for each file. Use the following, from Table 1, as the constituent names and DSNs when creating scripts and writing to the WDM.

File	Constituent	Description	DSN
marlboro_tmin.txt	TMIN	Daily Minimum Temperature	20
marlboro_precip.txt	DPRC	Daily Precipitation	27

After these files are entered, the WDMUtil window should look like the following:

🕈 WDI	MUtil: west	t_bre	×						_ 🗆 ×
Eile T Scena Oof 1	ools <u>S</u> cena arios	arios All	Locations (Constituents Locations) of 2	Time Series	Help one	Constitu I of 4	ents All	None
OBSE	ERVED			BELTSVILLE MARLBORO			dprc prec TMAX TMIN		
Time	Series - 4	1 of 4 : ↑ ↓	available tin	ne series in li 🎕	st (O not on	WDM file	e); 0 sel	ected	None
Туре	File	DSN	Scenario	Location	Constituent	Start	SJDay	End	EJDay
WDM	west_brex	31	OBSERVED	BELTSVILLE	PREC	1986/1/1	46431	1988/12/24	47520
WDM	west_brex	19	OBSERVED	MARLBORO	TMAX	1986/1/1	46431	1988/12/31	47527
WDM	west_brex	20	OBSERVED	MARLBORO	TMIN	1986/1/1	46431	1988/12/31	47527
WDM	west_brex	27	OBSERVED	MARLBORO	DPRC	1986/1/1	46431	1988/12/31	47527
Dates							ols		
No Da	ates are av	ailab	le until Time	eseries are Se	elected		 ☆ :		1

We will use the above time series to calculate additional time series data using "Tools" within WDMUtil.

D. Computing and disaggregating data in WDMUtil

QUESTION ANSWERED:

4.) How do I use the Compute/Disaggregate time series tool?

1.

In this section, we will use the imported minimum temperature and maximum temperature to compute a time series for daily potential evapotranspiration. That time series can then be disaggregated into hourly potential evapotranspiration.



Click (Compute/Disaggregate Meteorological Time Series tool), or from the **Tools** menu, select **Compute**.

- 2. In the "Operation" frame, make sure the button beside "Compute" has been selected.
- 3. In the "Compute Functions" frame, select the button beside "Hamon PET."
- 4. In the "Timeseries" box, the "Output" section should already be filled in with the appropriate constituent abbreviation, location, and scenario. Enter 25 in the DSN textbox.

Note: As mentioned previously, the DSN corresponding to DEVT can be found in the Table 1.

5. In the "Additional Inputs" frame, enter the "Latitude" as 38, 52, and 00 and check that the "Fahrenheit" button is selected.

Your screen should look like the following:

🛠 WDMUtil Compute				×
Operation				
Compute	0	<u>D</u> isaggregate		
Compute Functions				
Solar Radiation	n	O Penman P	an Evaporation	
 Jensen PET Hamon PET 		 Wind Trav Percent Cl 	oud Cover	
Compute Daily PET series for min and n	(in) using monthl nax air temperatu	y coefficients, lati re (F or C).	tude (d,m,s) and ti	me
Timeseries —				
Output	Constituent	Location	Scenario	DSN
	DEVI	MARLBURU	COMPOTED	25
input(s):				
Min Air Temp:	TMIN	MARLBORO -	OBSERVED -	20 💌
Max Air Temp:	TMAX 💌	MARLBORO 🔻	OBSERVED 💌	19 🔻
Additional Inputs			Eahr	enheit
Latitude (d,m,	s): 38 52	00 Temperatu	re Units: O Cels	ius
Jan Feb Ma	ar Apr May Ju	un Jul Aug S	ep Oct Nov D	ec
0.005 0.005 0.	005 0.005 0.005 0.	.005 0.005 0.005 0	005 0.005 0.005 0.	005
Dates				
Reset Start		End		
Current 1986 1	1 0 0 0 to	1988 12 31 0 0		
Common 1986 1	1 0 0 0 to	1988 12 31 0 0	0	
[Perform Operati	on Close		

- 6. Click PERFORM OPERATION.
- 7. Click OK when a message opens informing you that the compute operation was successfully performed.



8. Click OK when a message appears informing you that the new data set number was successfully stored.

WDM Dat	a Set Add
٩	New data-set number 25 successfully stored on WDM fileC:\BASINS\models\HSPF\WDMUtil\WEST_BREX.wdm.
	<u> </u>

Note: Now that we have computed the daily Potential Evapotranspiration, we need to disaggregate it into hourly.

- 9. In the "Operation" frame, click the button beside "Disaggregate."
- 10. In the "Disaggregate Functions" box, select the button beside "Evapotranspiration."
- 11. We will need to look at our table and look up the corresponding DSN for PEVT. Enter 16 in the "DSN" text box.
- 12. In the "Additional Inputs" box, check that the "Latitude" is 38, 52, and 0.

🔍 WDMUtil Compute				×					
Operation									
C <u>C</u> ompute © <u>D</u> isaggregate									
-Disaggregate Func	tions								
C Solar Radiation	n	Evapotran	spiration						
C Temperature		O Wind Trav	rel						
O Dewpoint Temp	perature	O Precipitati	on						
Disaggregate Daily PET (in or cm) to Hourly (assumes a distribution based on latitude (d,m,s) and time of year).									
Timeseries									
	Constituent	Location	Scenario	DSN					
Output:	PEVT	MARLBORO	COMPUTED	16					
Input(s):									
Potential ET:	DEVT	MARLBORO -	COMPUTED -	25 💌					
Additional Inputs Latitude (d,m,s): 38 52 0									
Dates									
Reset Start		End							
Current 1986 1	1 0 0 0 to	1988 12 31 0 0) 0						
Common 1986 1	1 0 0 0 to	1988 12 31 0 0) 0						
	Perform Operati	ion Close							

- 13. Click PERFORM OPERATION.
- 14. Click OK on both of the subsequent screens.
- 15. Click CLOSE in the "WDMUtil Compute" window.

Another powerful function of WDMUtil is the ability to disaggregate daily precipitation into hourly values based on hourly time series from nearby stations. WDMUtil uses values from the secondary hourly station with daily total closest to the daily value of the station in question. If there is not a daily total from a secondary station within a user-specified tolerance of the daily value, hourly values are obtained from a triangular distribution of the daily value with a peak at the middle of the day. (Hummel et al., 2001).

In this section, we will obtain hourly precipitation data for Marlboro. We already imported the Marlboro daily precipitation time series. We will use the Beltsville hourly precipitation data, which we imported earlier, along with hourly precipitation time series from two other nearby stations, Baltimore and Washington, as secondary station data. These data were previously downloaded from NCDC.

- 16. From the **File** menu select **Import.**
- 17. Navigate to *c:\basins\west branch weather data* and select "*baltimore_precip.txt*." Click **Open**.
- 18. In the "Description" column, click the "Hourly Precip, On-Line Format, NCDC TD-3240" box. The corresponding "Script File" box will turn blue. Click RUN.
 - **Note:** This is the same script we used to import the NCDC Beltsville Hourly Precipitation Data.

🐨 WDMUt	il: west_brex	:						_	
WDMUtil: west_brex X Ele Tools Scenarios Locations Constituents Time Series Help Scenarios 0 of 2 All None 0 of 3 COMPUTED 0 of 3 OBSERVED 180465 BELTSVILLE DEVT MARLBORO PEVT PREC TMAX									
Time Ser	ies - 7 of 7 a ▲ ▲ ↓ ↓	ivaila 	ble time seri	es in list (1 n	ot on WDM	file); 0 s	elected	d. All N	one
	west brev	19		MARI BORO	TMAX	1986/1/1	46431	1988/12/31	<u> </u>
WDM	west brex	20	OBSERVED	MARLBORO	TMIN	1986/1/1	46431	1988/12/31	2
WDM	west brex	27	OBSERVED	MARLBORO	DPBC	1986/1/1	46431	1988/12/31	2
WDM	west brex	25	COMPUTED	MARLBORO	DEVT	1986/1/1	46431	1988/12/31	2
WDM	west brex	16	COMPUTED	MARLBORO	PEVT	1986/1/1	46431	1988/12/31	4
In-Memory	<in memory=""></in>	1	OBSERVED	180465	HPCP	1986/1/1	46431	1988/12/28	
	-								•
– Dates – No Dates	are availabl	e unti	l Timeseries	are Selecte	b	Tools			s Y

- 19. As with the Beltsville time series, this data set must be written to the WDM. In the "Time Series" frame, select the newly added time series. It will turn blue.
- 20. In the "Tools" frame, click [1] (Write Time Series to WDM).
- 21. In the "Write to WDM" box, enter 51 as the Output DSN, change the constituent name to "PREC", and change the location name to "BALTIMORE."

📓 Write to WDM	×
Specify Output Data-set Number(s); Select/Enter Scenario, Location, Constituent as needed; Data-set attributes may be updated if needed Click Write button to store data on WDM file. © Use common period for all data sets, as defined on main form © Use full period for each data set	
DSN/IC)Jutput DSN Scenario Location Constituen #Attributes Attr. Space #Data Pointer: Time Group Base Yea	
1 51 OBSERVEL BALTIMORE PREC 30 100 300 Years 1980	
<u>W</u> rite <u>C</u> ancel	

Note: Each time series must have a unique DSN. Although the constituent for this time series is the same as the Beltsville time series, we use a different DSN because it is a different location. This is done using the pattern on Table 1. For example, 11, 31, 51, 71 ... are all acceptable DSNs for Hourly Precipitation, but are usually organized by location or source.

- 22. Click WRITE.
- 23. Click OK.
- 24. Follow steps 16-23 for "*washington_precip.txt*" using 71 as the Output DSN and "WASHINGTON" as the location name. The WDMUtil window should look like this:

🗂 wdi	MUtil: wes	t_bre	x						_ 🗆 ×	
File Tools Scenarios Locations Constituents Time Series Help Scenarios 0 of 2 All None 0 of 4 All None COMPUTED 0 of 4 All None DEVT DPRC DBSERVED MARLBORO WASHINGTON DEVT DRC										
-Time	Series - 1	Bof8 ▲ ↓	available tir	ne series in list 10 continu	t (O not on V	WDM file)); O sele	ected.	None	
туре		21	Scenario	DELTON		5tan	15JDay 40401	1000/10/04	EJDay 47500	
	west_brex	31	OBSERVED	BELISVILLE	PREC	1966/1/1	46431	1988/12/24	47520	
	west_prex	19	OBSERVED	MARLBURU	THAN	1000/1/1	46431	1900/12/31	47527	
	west_brex	20	OBSERVED	MARLBURU		1966/1/1	46431	1988/12/31	47527	
	west_prex	27	OBSERVED	MARLBURU	DPRC	1000/1/1	46431	1900/12/31	47527	
	west_brex	25	COMPUTED	MARLBURU		1986/1/1	46431	1988/12/31	47527	
	west_prex	10			PEVI	1006/1/1	46401	1000/12/01	47527	
	west_brev	71	OBSERVED	WASHINGTON	PREC	1006/1/1	40431	1000/12/20	47524	
-Dates No Da	WDM west_brex 71 OBSERVED WASHINGTON PREC 1986/1/1 46431 1988/12/28 47524 Dates No Dates are available until Timeseries are Selected									

- 25. In the "Tools" frame, click on (Compute/Disaggregate Meteorological Time Series).
- 26. In the "Operation" frame, select the button beside "Disaggregate." In the "Disaggregate Functions" frame, select the button beside "Precipitation."

🗶 WDMUtil Compute				×		
Operation						
C <u>C</u> ompute © <u>D</u> isaggregate						
Disaggregate Functions Solar Radiation Temperature Wind Travel Dewpoint Temperature Disaggregate Daily Precipitation using anywhere from 1 to 5 hourly precipitation						
data sets.						
Timeseries Output:	Constituent PREC	Location MARLBORO	Scenario COMPUTED	DSN		
Input(s): Daily Precip:	DPRC •	MARLBORO -	OBSERVED -	27 💌		
Hourly Precip:	PREC -	mult 💌	OBSERVED V	mult 💌		
Hourly Precip:	PREC PREC	mult v	OBSERVED V	mult 💌		
Hourly Precip: Hourly Precip:	PREC PREC	mult 💌	OBSERVED V	mult 💌		
Additional Inputs Observation Hour: 24 Data Tolerance (%):						
Disagg.sum						
Dates Reset Start Current 1986 1	Dates End Reset Start End Current 1986 1 1 0 0 to					
Common 1986 1 1 0 0 0 to 1988 12 31 0 0 0						
Perform Operation Close						

In the "Time Series" frame notice that the "Output" is specified as PREC (hourly precipitation) at Marlboro and that the daily precipitation input is specified as the Marlboro time series. The user must specify the hourly precipitation inputs.

- 27. In the first "Hourly Precip:" input row, select "BELTSVILLE" in the "Location" menu. Because there is only one time series associated with that location, no further specification is necessary.
- 28. In the second "Hourly Precip:" input row, select "BALTIMORE" as the location, and in the third row, select "WASHINGTON" as the location. The WDMUtil Compute window should look like the following:

🗶 WDMUtil Compute				×		
Operation O Compute I Disaggregate						
Disaggregate Functions O Solar Radiation C Evapotranspiration C Temperature C Wind Travel C Dewpoint Temperature Precipitation Disaggregate Daily Precipitation using anywhere from 1 to 5 hourly precipitation data sets.						
-Timeseries						
Output:	Constituent PREC	Location MARLBORO	Scenario COMPUTED	DSN		
Input(s):						
Daily Precip:	DPRC 🔻	MARLBORO 🔻	OBSERVED V	27 💌		
Hourly Precip:	PREC 💌	BELTSVILLE	OBSERVED 💌	31 💌		
Hourly Precip:	Hourly Precip: PREC		OBSERVED 🔻	51 💌		
Hourly Precip: PREC V		WASHINGT(-	OBSERVED -	71 💌		
Hourly Precip: PREC V		mult 💌	OBSERVED -	mult 👻		
Hourly Precip: PREC		mult 💌	OBSERVED V	mult 💌		
Additional Inputs Observation Hour: 24 Data Tolerance (%):						
Summary Outp	Summary Output File: Disagg.sum					
Dates Reset Start End						
Current 1986 1	1 0 0 0 to	1988 12 31 0 0	0			
Common 1986 1 1 0 0 0 to 1988 12 31 0 0 0						
Perform Operation Close						

- 29. In the blank DSN box in the "Timeseries" frame, enter "11."
- 30. In the "Additional Inputs" frame, enter "90" in the Data Tolerance (%) box.
 - **Note:** As mentioned previously, WDMUtil uses a triangular distribution to disaggregate values outside of the data tolerance. Because triangular distribution is quite inaccurate, the data tolerance is set high in order to increase the acceptable range of daily totals and to minimize use of triangular distribution.
- 31. In the "Additional Inputs" frame, name the Summary Output File "*Disagg_Marlboro.sum*." This file can be examined to determine exactly which files were used when and when triangular distribution was employed. The WDMUtil Compute window should look like the following:

🕅 WDMUtil Compute	2			×		
Operation						
C <u>C</u> ompute © <u>D</u> isaggregate						
Disaggregate Fun	ctions					
C Solar Radiatio	on	C Evapotrar	spiration			
 I emperature Dewnoint Terr 	noraturo	 Wind I rav Precipitation 	rel on			
Disaggregate Dail data sets.	y Precipitation usi	ng anywhere from	1 to 5 hourly preci	pitation		
Timeseries						
	Constituent	Location	Scenario	DSN		
Output:	PREC	MARLBORO	COMPUTED	11		
Input(s):						
Daily Precip:	DPRC -	MARLBORO -	OBSERVED -	27 💌		
Hourly Precip:	PREC 💌	BELTSVILLE	0BSERVED -	31 💌		
Hourly Precip:	PREC 💌	BALTIMORE -	OBSERVED -	51 💌		
Hourly Precip:	PREC 💌	WASHINGT(-	OBSERVED -	71 💌		
Hourly Precip:	PREC 💌	mult 💌	OBSERVED -	mult 💌		
Hourly Precip:	PREC -	mult 💌	OBSERVED -	mult 💌		
Additional Inputs –						
Observation	Hour: 24	Data Tole	rance (%): 90			
Summary Output File: Disagg_Marlboro.sum						
Dates						
Reset Start End						
Current 1986 1 1 0 0 0 to 1988 12 31 0 0 0						
Common 1986 1 1 0 0 0 to 1988 12 31 0 0 0						
	Perform Operati	on Close				

- 32. Click Perform Operation.
- 33. Click OK when the WDMUtil Compute window appears telling you that the disaggregation was successful. Notice that Triangular Distribution was used 142 times.



34. Click OK.

۷	VDM Dat	a Set Add
	•	New data-set number 11 successfully stored on WDM fileC:\BASINS\models\H5PF\WDMUtil\WEST_BREX.wdm.

- 35. Click CLOSE in the "WDMUtil Compute" window.
 - **Note:** Notice the new time series in the "WDMUtil" window. If you wish, you can view this using the List/Edit tool.

🐺 WDMUtil: west	_bre	×						_ 🗆 🗙
<u>File Tools S</u> cena	arios	Locations	<u>C</u> onstituents]]me Series	Help			
Scenarios			Locations —		C	onstitue	ents	
0 of 2 A	ai T	None	0 of 4	All No	nel 0	of 6	All	None
COMPUTED			BALTIMORE			DEVT		
OBSERVED			MARI BORO			PRC FVT		
			WASHINGTO	N	P	REC		
				-	T	MAX		
			<u> </u>		т	MIN		
-Time Series - 9	of 9	availahle ti	me series in lis	t (0 not on V	WDM file)	r 1 sela	ected ——	
			കി			, 1 000		Need
			9 %					None
Type File	DSN	Scenario	Location	Constituent	Start	SJDay	End	EJDa; 🔺
WDM west_brex	20	OBSERVED	MARLBORO	TMIN	1986/1/1	46431	1988/12/31	47527
WDM west_brex	27	OBSERVED	MARLBORO	DPRC	1986/1/1	46431	1988/12/31	47527
WDM west_brex	25	COMPUTED	MARLBORO	DEVT	1986/1/1	46431	1988/12/31	47527
WDM west_brex	16	COMPUTED	MARLBORO	PEVT	1986/1/1	46431	1988/12/31	47527
WDM west_brex	51	OBSERVED	BALTIMORE	PREC	1986/1/1	46431	1988/12/28	47524
WDM west_brex	71	OBSERVED	WASHINGTON	I PREC	1986/1/1	46431	1988/12/28	47524
WDM west_brex	11	COMPUTED	MARLBORO	PREC	1986/1/1	46431	1988/12/31	47527 👻 🛛
Dates					Too	ols ——		
Reset Start		📫 End	TStep	Units,	1			
Current 1986	1 1	1988	12 31				222	
Current [1300]	1	10 1300	12 31			51		1
Common 1986	1 1	to 1988	12 31 Native	-		£ 1	× 1	×
,	,	,	,					

- 36. In order to examine the disaggregation summary output file, click (View a File) in the "Tools" frame.
- 37. Navigate to *c:\basins\West Branch Weather Data* and select "*Disagg_Marlboro.sum*." Click OPEN.

WDMUtil File View of Disagg_Marlboro.sum	_ 🗆 🗙
"Distributing Daily Data for 1986/1/1: Value is 0.04"	
*** No hourly total within tolerance - 0.04 distributed using triangular distribution ***"	
"Distributing Daily Data for 1986/1/2: Value is 0"	
"Distributing Daily Data for 1986/1/3: Value is 0.05"	
" Using Data-set Number: 51, daily sum = 0.09"	
Distributing Daily Data for 1966/1/4: Value 18 0"	
"Distributing Daily Data for 1960/1/3: Value is 0"	
"Distributing Daily Data for 1960/1/6: Value is 0"	
"Distributing Daily Data for 1960/1/: Value is 0"	
Distributing Daily Data for 1960/1/6: Value is 0	
Distributing Daily Data for 1960/1/3. Value is 0	
"Distributing Daily Data for 1960/1/10. Value is 0	
"Distributing Data for 1960/1/12. Value is 0	
"Distributing Daily Data for 1986/1/12: Value is 0	
"Distributing Daily Data for 1986/1/14: Value is 0"	
"Distributing Daily Data for 1986/1/15: Value is 0.02"	
" *** No hourly total within tolerance = 0.02 distributed using triangular distribution ***"	
"Distributing Daily Data for 1986/1/16: Value is 0"	
"Distributing Daily Data for 1986/1/17: Value is 0"	
"Distributing Daily Data for 1986/1/18: Value is 0"	
"Distributing Daily Data for 1986/1/19: Value is 0.07"	
" Using Data-set Number: 31, daily sum = 0.5"	
"Distributing Daily Data for 1986/1/20: Value is 0.32"	
*** No hourly total within tolerance - 0.32 distributed using triangular distribution ***"	
"Distributing Daily Data for 1986/1/21: Value is 0.02"	
*** No hourly total within tolerance - 0.02 distributed using triangular distribution ***"	
"Distributing Daily Data for 1986/1/22: Value is 0"	
"Distributing Daily Data for 1986/1/23: Value is 0"	
बि	- b
<< < 1 > >> of 47 Plain Text V Close Print Find	

- **Note:** This file shows the occurrences of triangular distribution use, as well as which data set was used for hourly data on a given day.
- 38. Examine the file and click "Close" when done.
- 39. Close the WDMUtil window by clicking the "X" in the upper right hand corner.
 - **Note:** There are many other tools and functions within WDMUtil that could be addressed; however, due to time constraints, only the main tools necessary for creating a *.*wdm* file with local data have been discussed in this exercise. Please refer to the WDMUtil Manual for further explanation.

References:

Hummel, P., J. Kittle, Jr., M. Gray. <u>WDMUtil Version 2.0, A Tool for Managing Watershed</u> <u>Modeling Time-Series Data User's Manual</u>, Contract No. 68-C-98-010, Work Assignment No. 2-05, Aqua Terra Consultants, Decatur, GA, 2001.

USEPA, <u>Users Manual: Better Assessment Science Integrating Point and Nonpoint Sources:</u> <u>BASINS Version 2.0</u>, EPA-823-B-98-006, U.S. Environmental Protection Agency, Washington, D.C., 1998.

USEPA, <u>WDMUtil Version 1.0 (BETA)</u>, A Tool for Managing Watershed Modeling Time-Series Data User's Manual, EPA-823-C-99-001, U.S. Environmental Protection Agency, Washington, D.C., 1999.