Evaluating Antecedent Precipitation Conditions for Assessing Wetland Hydrology

Using Climate Data Available in Minnesota

BWSR Technical Guidance, January 31, 2011

Contents

Introduction

The publications **Accessing and Using Meteorological Data to Evaluate Wetland Hydrology** (Sprecher and Warne, 2000), and **NRCS Engineering Field Handbook – Chapter 19 – Hydrology Tools for Wetland Determination** (NRCS, 1997), are important resources for nationwide application. They describe procedures for evaluating whether precipitation prior to a particular date was within the range of normal.

In Minnesota, we have the additional benefit of arguably the best state climatology office in the nation. The climate data and tools readily available via the web from the State Climatology Office (at http://climate.umn.edu) greatly enhance the application of these procedures. Together with the capabilities of spreadsheets (such as Microsoft Excel), the State Climatology Office data and tools make the procedures accessible and straightforward. This document describes procedures that can be used to evaluate antecedent precipitation utilizing State Climatology Office data and tools.

The first method uses monthly precipitation data and the WETS Tables (or their Minnesota-enhanced equivalents) and is derived from the method presented in Hydrology Tools for Wetland Determination (NRCS, 1997). The State Climatology Office web site has a built-in tool for applying this method. The second method evaluates daily precipitation data on the basis of 30-day rolling sums. These methods can also be combined as a 3rd "hybrid" method.

1. NRCS Method for Evaluating Antecedent Moisture Conditions

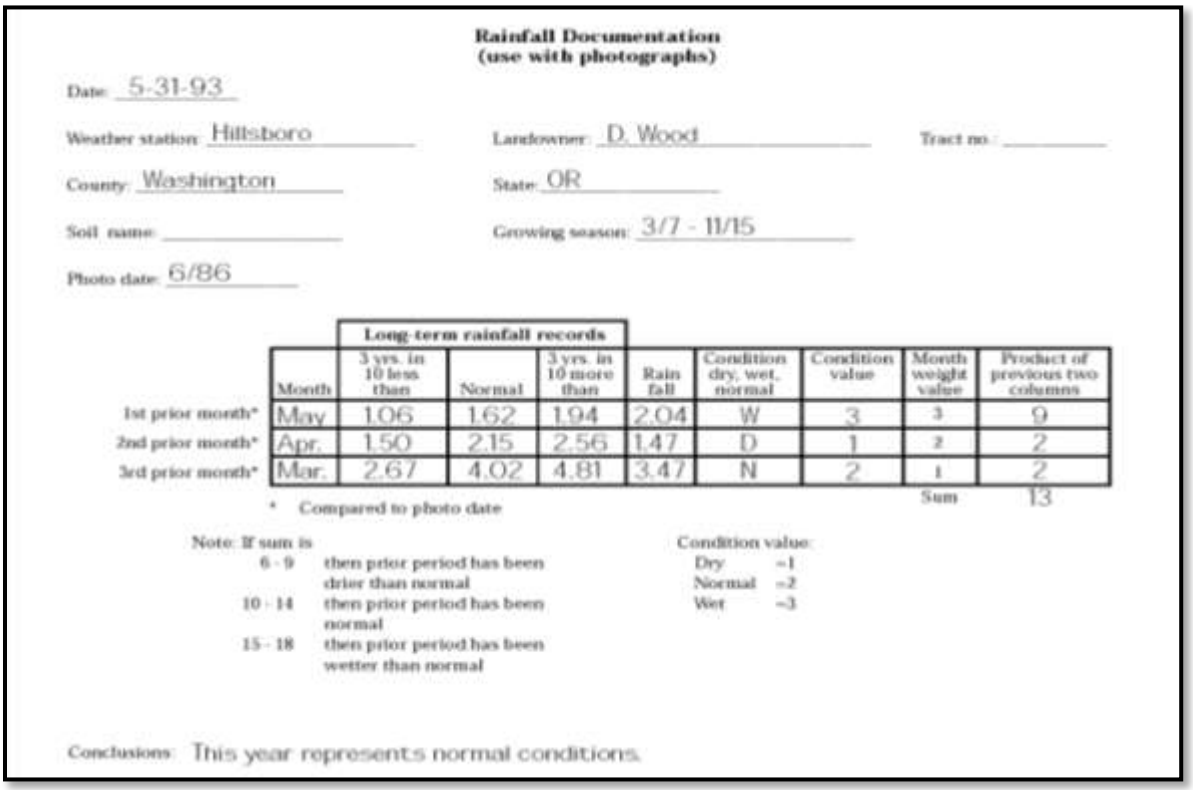
1.1. Background

This method has long been used for interpreting wetland signatures on air photos (Figure 1). The method considers precipitation data from the three months prior to the date of interest and weighs those data for length of time since the precipitation contributed to the water budget. Some of the assumptions to be aware of when using the method are that:

- Rain was evenly distributed for the month of observation.
- Three months is the proper length of time to evaluate antecedent precipitation even though hydrologic systems vary considerably in their "lag time."
- Snowmelt contributes to wetland hydrology the same as rainfall.

The method can be used in two ways:

- **With the tool** available on State Climatology Office web site. For older observation or photo dates, the procedure is completely automated on the web site. The tool populates a table like Figure 1. It uses geostatistical interpolation to derive precipitation data from surrounding gauge sites, thereby negating the need to select the "closest" gauging station; and
- **Without the tool** - manually or with a spreadsheet tool. There are several reasons you may need to do this - for example for recent hydrologic observation dates for which the appropriate monthly precipitation data have not yet been updated to the built-in tool. In this case you still make use of the data on the State Climatology Office web site, but you must put the data in a table yourself.



Rainfall Documentation
(use with photographs)

Date: 5-31-93

Weather station: Hillsboro Landowner: D. Wood Tract no.:

County: Washington State: OR

Soil name: Growing season: 3/7 - 11/15

Photo date: 6/86

	Long-term rainfall records							
Month	3 yrs. in 10 less than	Normal	3 yrs. in 10 more than	Rain fall	Condition dry, wet, normal	Condition value	Month weight value	Product of previous two columns
1st prior month* May	1.06	1.62	1.94	2.04	W	3	3	9
2nd prior month* Apr.	1.50	2.15	2.56	1.47	D	1	2	2
3rd prior month* Mar.	2.67	4.02	4.81	3.47	N	2	1	2
							Sum	13

* Compared to photo date

Note: If sum is
6 - 9 then prior period has been drier than normal
10 - 14 then prior period has been normal
15 - 18 then prior period has been wetter than normal

Condition value:
Dry =1
Normal =2
Wet =3

Conclusions: This year represents normal conditions.

Figure 1: Completed Rainfall Documentation Worksheet for NRCS Method, as Used For Photo Interpretation. From *Hydrology Tools for Wetland Determination* (NRCS, 1997).

1.2 NRCS method using State Climatology Office monthly precipitation data <u>with</u> the Wetland Delineation Data Retrieval web tool

1. Go to http://climate.umn.edu.

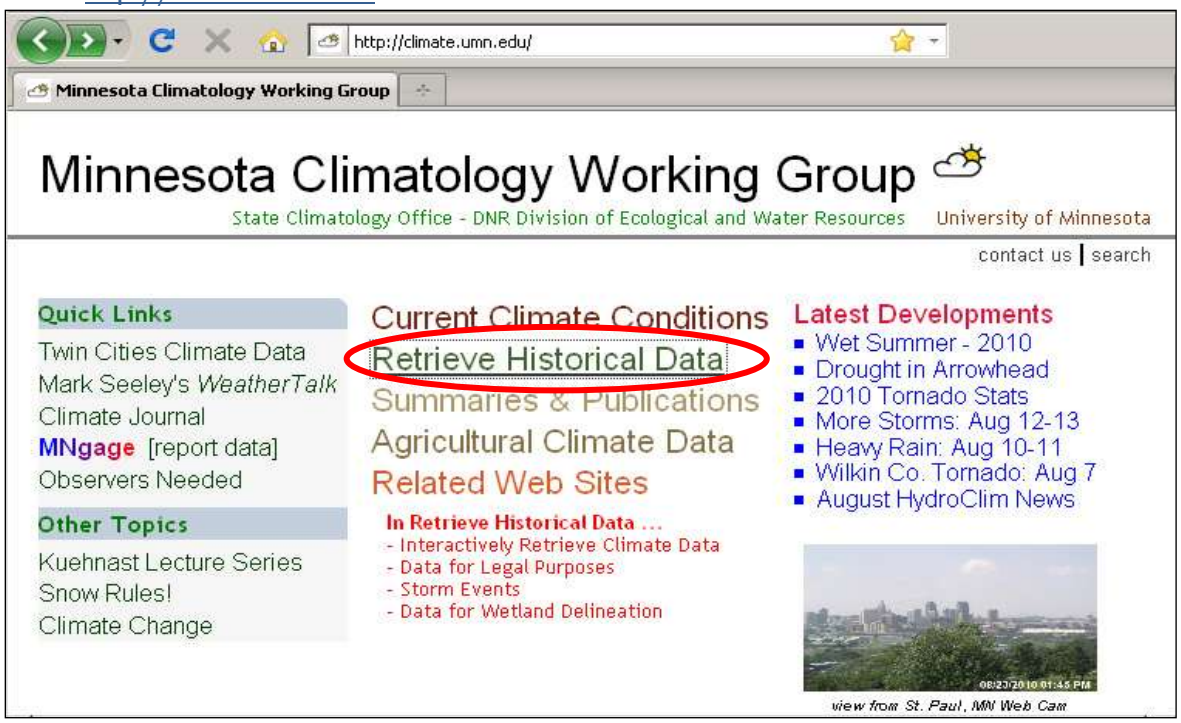


Figure 2

2. Under **Retrieve Historical Data**, go to Wetland Delineation Monthly Precipitation Data Retrieval from Gridded Database.

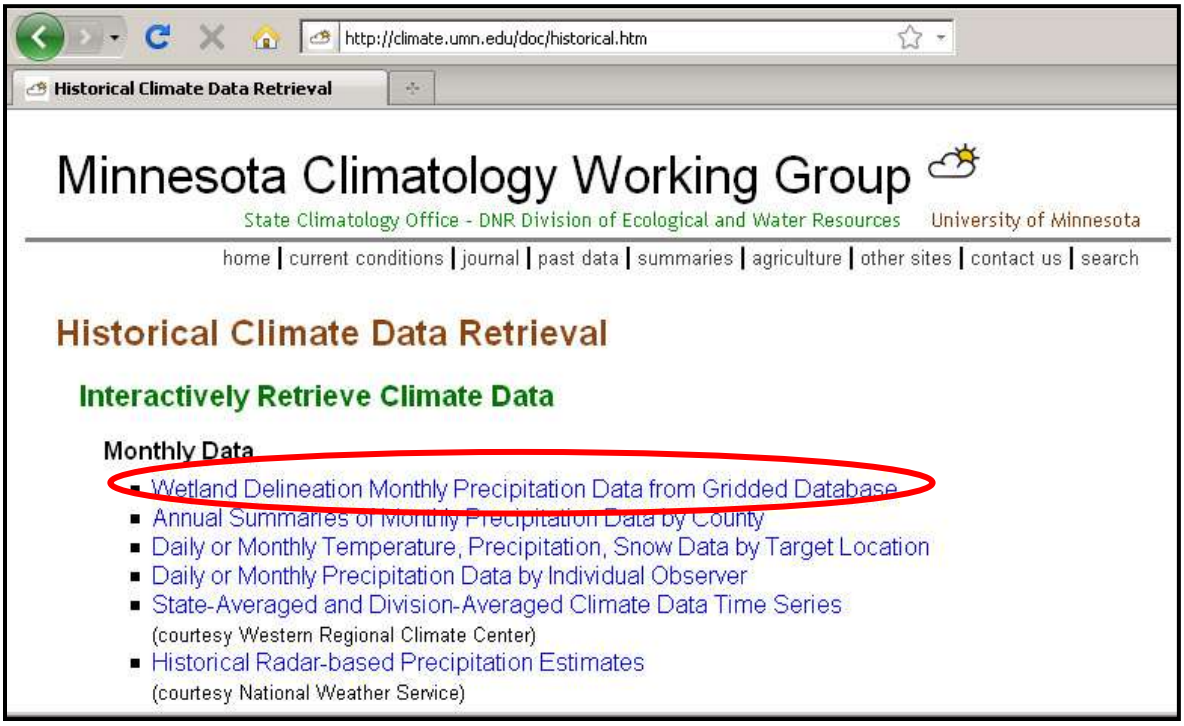
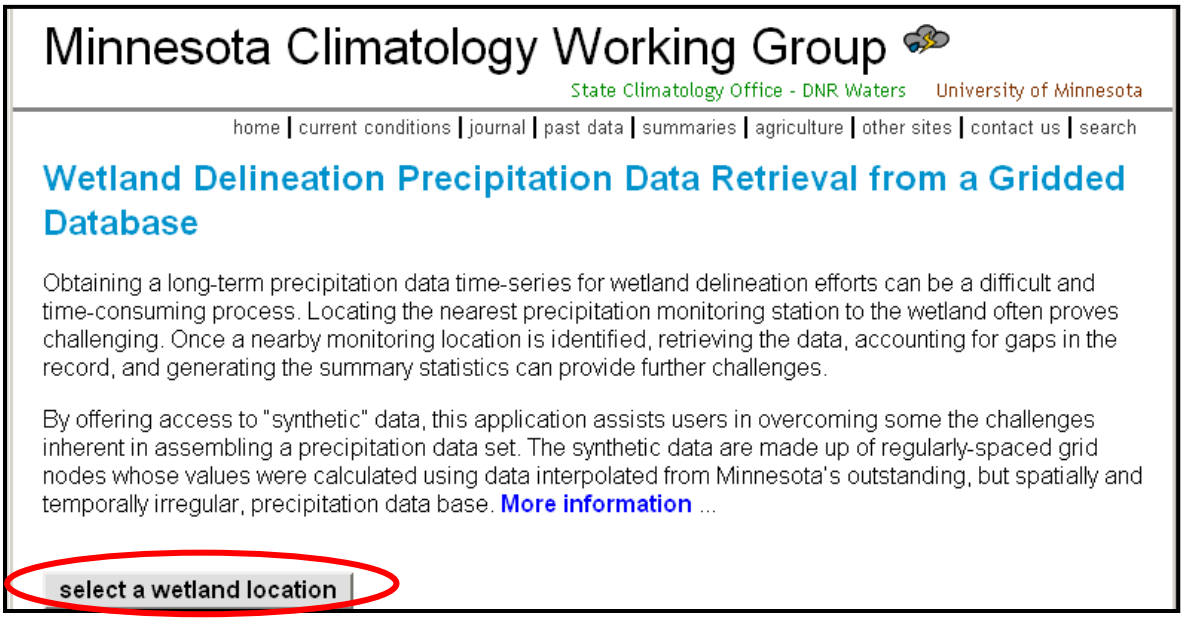


Figure 3

3. Click **select a wetland location**.



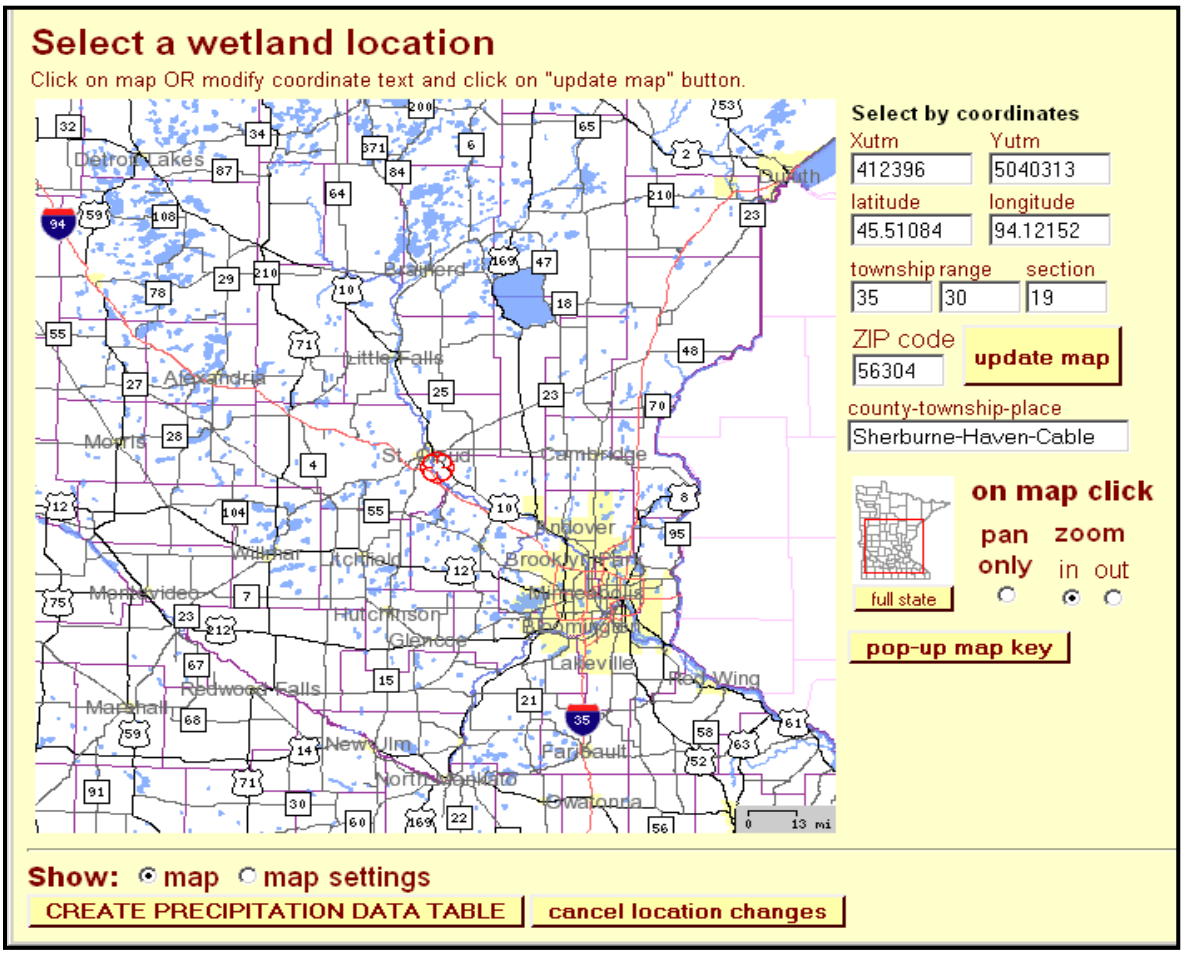


Figure 4

4. Click to continue to zoom in to your location. If desired, the map settings can be adjusted to display different background layers, including USGS 1:24K topo maps at appropriate scales.

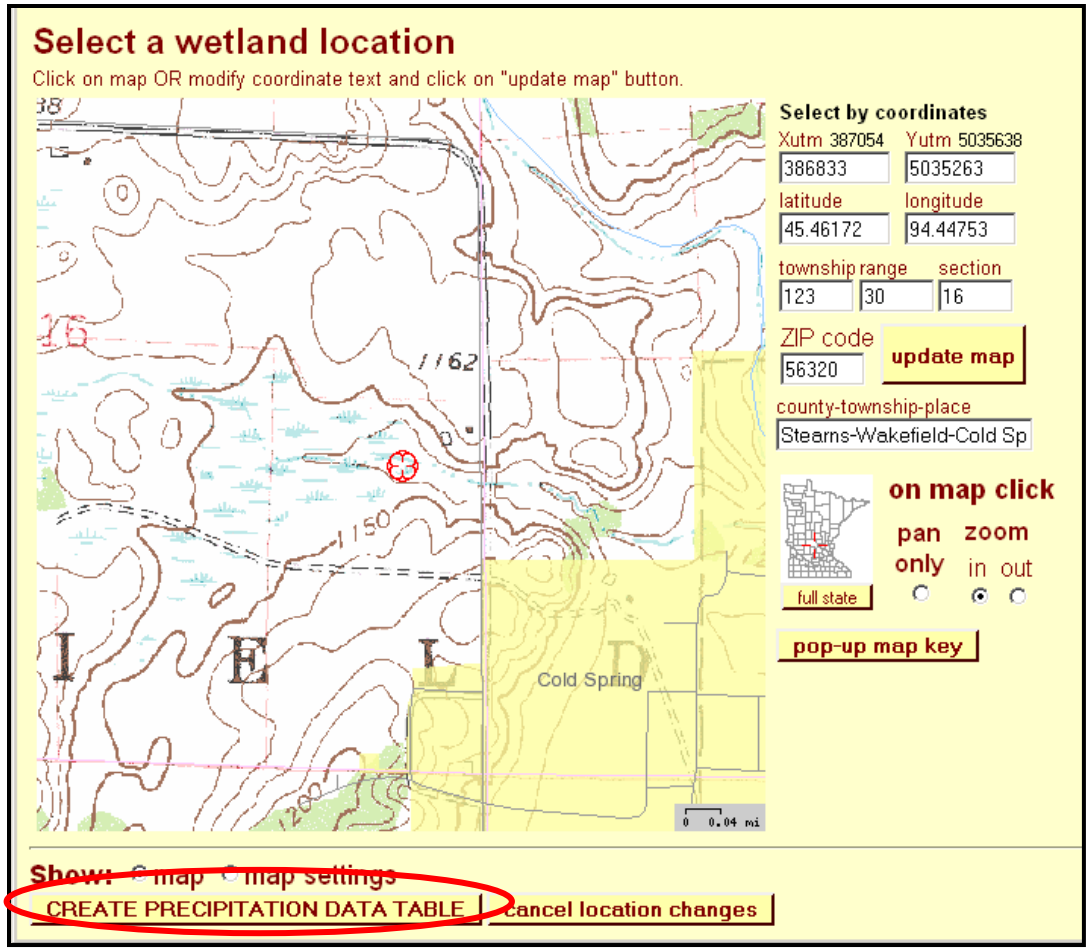
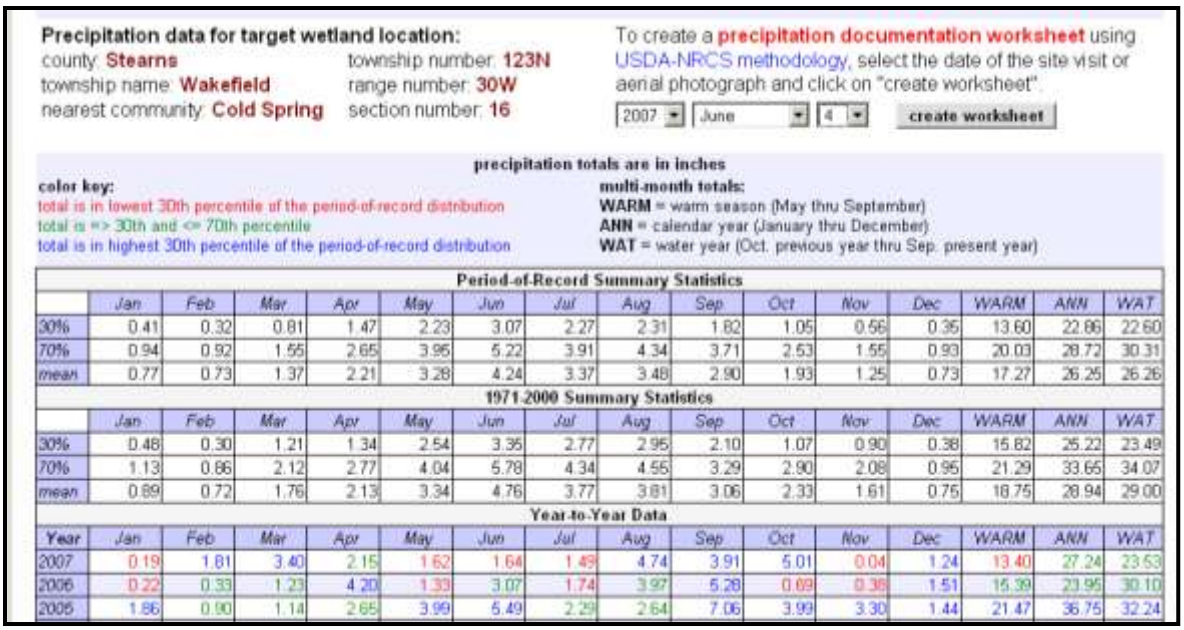


Figure 5

5. When you've zoomed in to the location, click **CREATE PRECIPITATION DATA TABLE**. The result will be tables showing the range of **normal monthly precipitation** for the site based on period-of-record statistics as well as 1971-20000 statistics. These are derived by geostatistical interpolation between precipitation data from surrounding gages. Below these is a year-to-year table of monthly precipitation data for the site. These are derived from precipitation data from surrounding gage sites, also using geostatistical interpolation techniques. They are color-coded for wet, normal, and dry months.



Precipitation data for target wetland location:

county: **Stearns** township number: **123N**
township name: **Wakefield** range number: **30W**
nearest community: **Cold Spring** section number: **16**

To create a **precipitation documentation worksheet** using USDA-NRCS methodology, select the date of the site visit or aerial photograph and click on "create worksheet".

2007 | June | 4 | create worksheet

precipitation totals are in inches

color key:
total is in lowest 30th percentile of the period-of-record distribution
total is => 30th and <= 70th percentile
total is in highest 30th percentile of the period-of-record distribution

multi-month totals:
WARM = warm season (May thru September)
ANN = calendar year (January thru December)
WAT = water year (Oct. previous year thru Sep. present year)

Period-of-Record Summary Statistics

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
30%	0.41	0.32	0.81	1.47	2.23	3.07	2.27	2.31	1.82	1.05	0.56	0.35	13.60	22.86	22.60
70%	0.94	0.92	1.55	2.65	3.95	5.22	3.91	4.34	3.71	2.53	1.55	0.93	20.03	28.72	30.31
mean	0.77	0.73	1.37	2.21	3.28	4.24	3.37	3.48	2.90	1.93	1.25	0.73	17.27	26.25	26.26

1971-2000 Summary Statistics

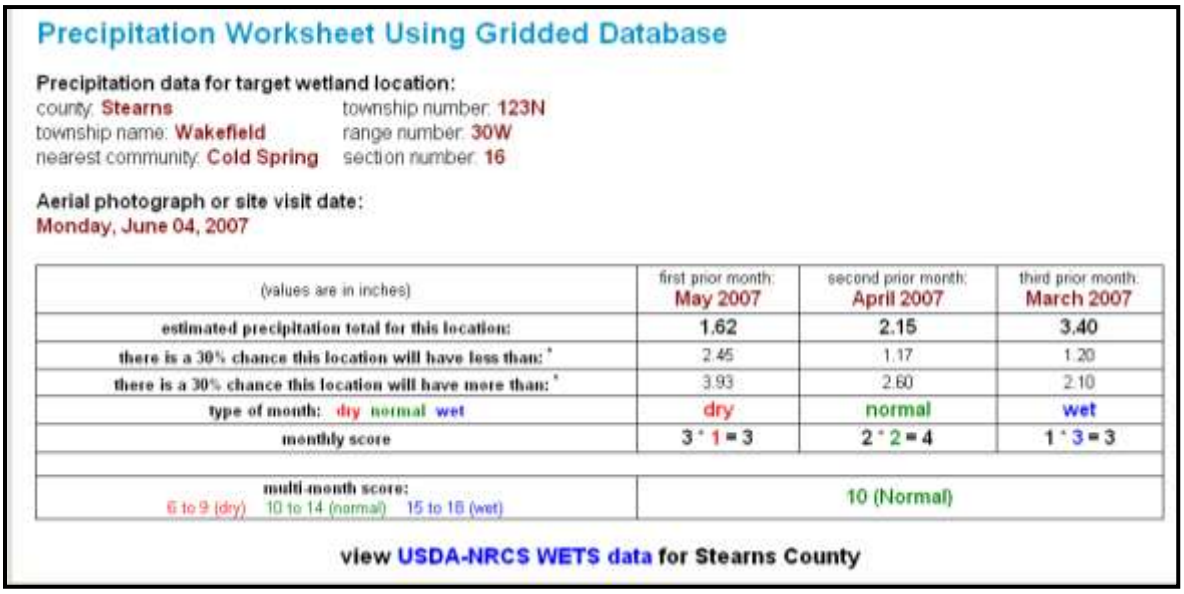
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
30%	0.48	0.30	1.21	1.34	2.54	3.35	2.77	2.95	2.10	1.07	0.90	0.38	15.82	25.22	23.49
70%	1.13	0.86	2.12	2.77	4.04	5.78	4.34	4.55	3.29	2.90	2.08	0.95	21.29	33.65	34.07
mean	0.89	0.72	1.76	2.13	3.34	4.76	3.77	3.81	3.06	2.33	1.61	0.75	18.75	28.94	29.00

Year-to-Year Data

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
2007	0.19	1.81	3.40	2.15	1.62	1.64	1.49	4.74	3.91	5.01	0.04	1.24	13.40	27.24	23.53
2006	0.22	0.33	1.23	4.20	1.39	3.07	1.74	3.97	5.28	0.69	0.38	1.51	15.39	23.95	30.10
2005	1.86	0.90	1.14	2.65	3.99	6.49	2.29	2.64	7.06	3.99	3.30	1.44	21.47	36.75	32.24

Figure 6

6. To generate a completed Rainfall Documentation Worksheet using the NRCS method, select the observation date and click on **create worksheet**. **Note:** there is a several-month delay in data entry for the monthly precipitation data. To evaluate recent months you may need to use the procedure described in Section 1.3 below.



Precipitation Worksheet Using Gridded Database

Precipitation data for target wetland location:

county: **Stearns** township number: **123N**
township name: **Wakefield** range number: **30W**
nearest community: **Cold Spring** section number: **16**

Aerial photograph or site visit date:
Monday, June 04, 2007

(values are in inches)	first prior month: May 2007	second prior month: April 2007	third prior month: March 2007
estimated precipitation total for this location:	1.62	2.15	3.40
there is a 30% chance this location will have less than: *	2.45	1.17	1.20
there is a 30% chance this location will have more than: *	3.93	2.60	2.10
type of month: dry normal wet	dry	normal	wet
monthly score	3 * 1 = 3	2 * 2 = 4	1 * 3 = 3
multi-month score: 6 to 9 (dry) 10 to 14 (normal) 15 to 18 (wet)	10 (Normal)		

view USDA-NRCS WETS data for Stearns County

Figure 7

1.3 NRCS method using State Climatology Office monthly precipitation data <u>without</u> the web tool: completing Rainfall Documentation Worksheet manually or with spreadsheet tool

You may need to do this for recent observations, or if you want instead to use the USDA-NRCS WETS data rather than the geostatistically-derived monthly normals.

1. Follow all the steps outlined in Section 1.2 above to get the normal monthly precipitation range information for the 3 months prior to the observation date. If you want instead to use the USDA-NRCS WETS data there is a convenient link (**view** USDA-NRCS WETS data) at the bottom of the worksheet (Figure 7).

2. Transfer the appropriate "normal range" numbers for the prior months to the appropriate boxes on a blank Rainfall Documentation Worksheet **–OR–** use the [**NRCS method**] sheet in the Excel spreadsheet tool (*NRCS & Hybrid method .xls*) included with this guidance.

3. For recent observations you will need to retrieve recent monthly precipitation data. Under **Retrieve Historical Data** go to: Daily or Monthly Temperature, Precipitation, Snow Data by Target Location.

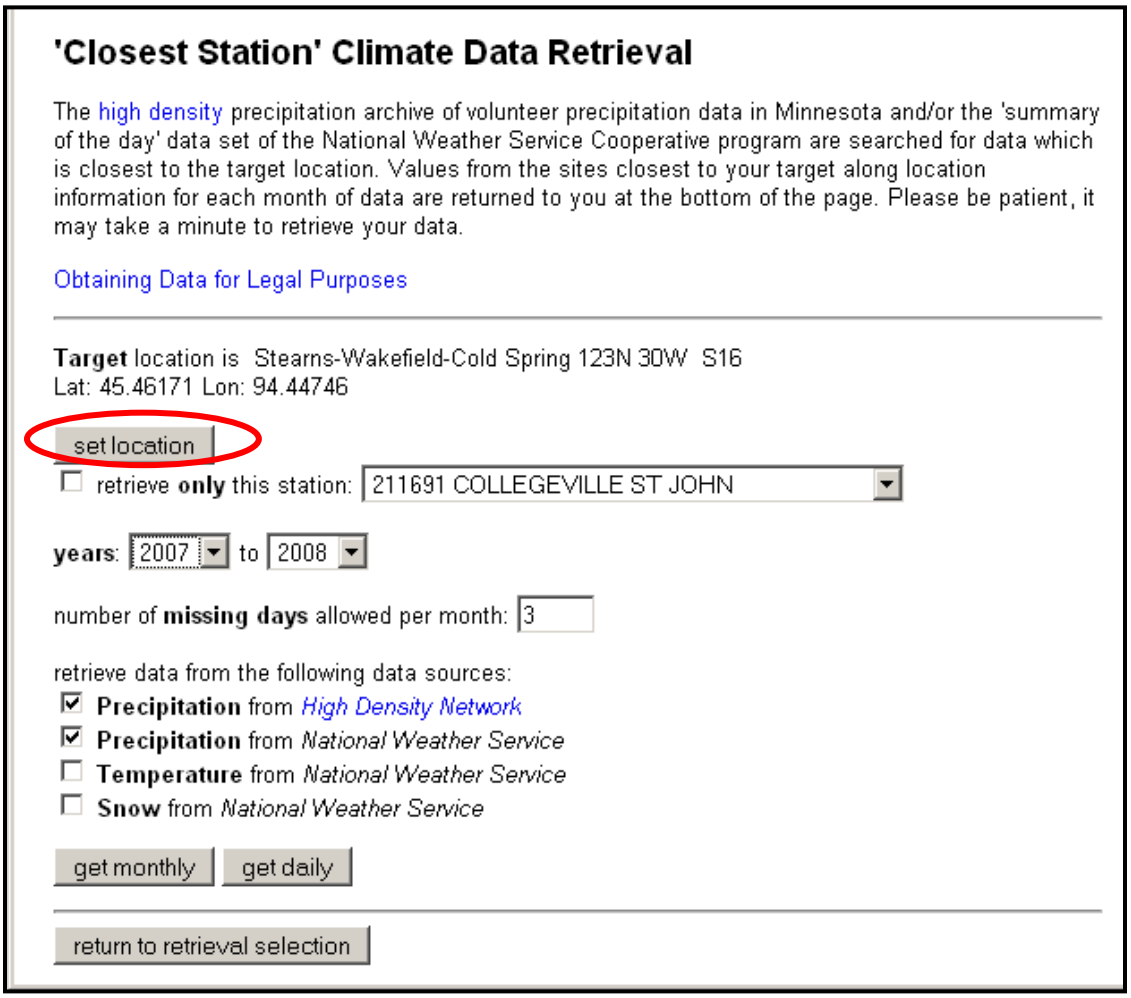


Figure 8

4. Click on **set location**. Zoom in to your site as described above. When you have the location in the cross-hairs, click on **DONE/return to application**. Choose the years and the precipitation data networks from which you want data.

5. Click on **get monthly**.

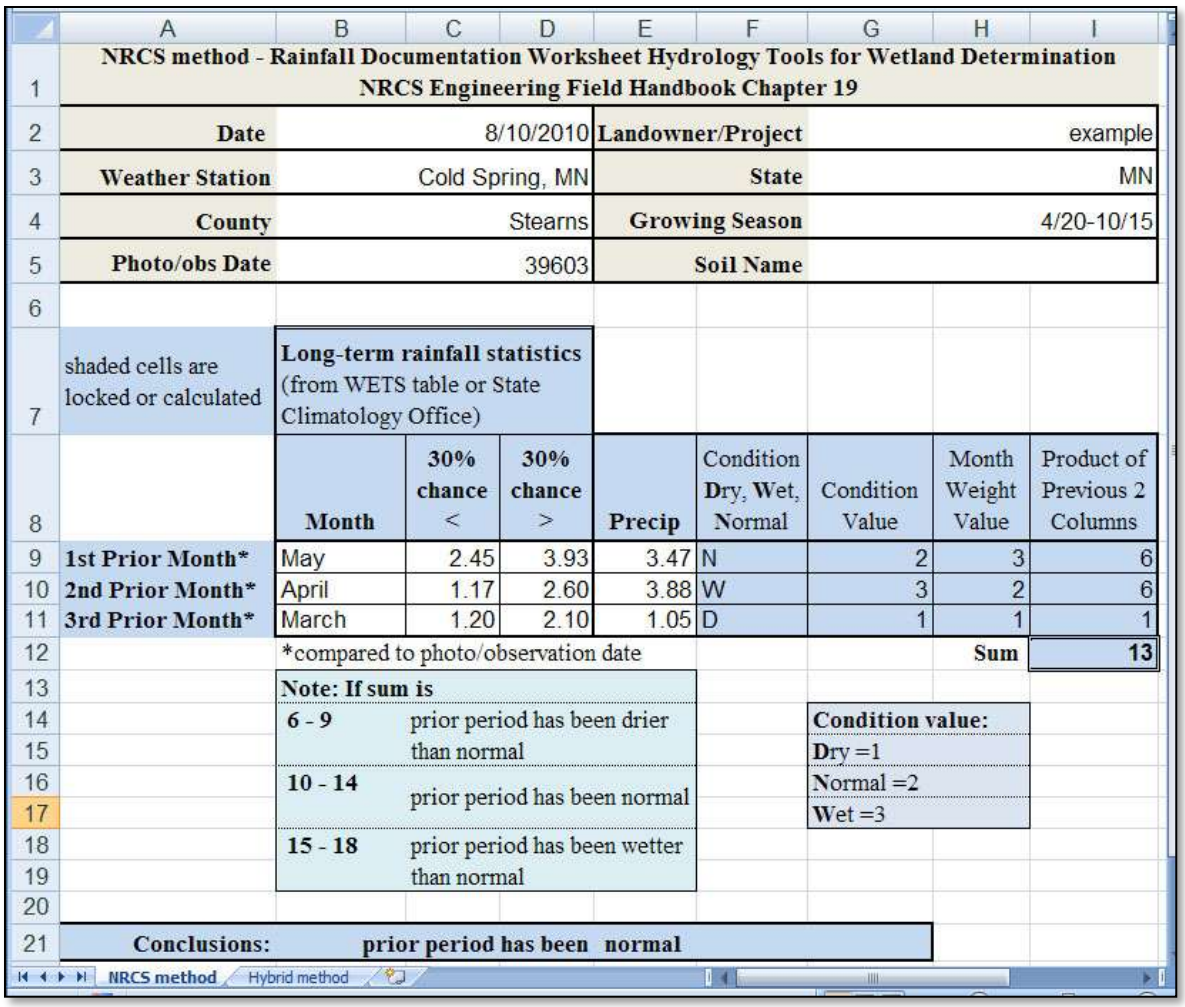
Target: lat 45.46192 lon 94.44789

mon	year	cc	tttN	rrW	ss	nnnn	oooooooo	pre
Jan	2007	73	123N	30W	15	SWCD		.22
Feb	2007	73	123N	30W	15	SWCD		1.62
Mar	2007	73	123N	30W	15	SWCD		3.15
Apr	2007	73	123N	30W	15	SWCD		2.15
May	2007	73	123N	30W	15	SWCD		1.51
Jun	2007	73	123N	30W	15	SWCD		1.63
Jul	2007	73	123N	30W	15	SWCD		1.25
Aug	2007	73	123N	30W	15	SWCD		4.82
Sep	2007	73	123N	30W	15	SWCD		4.06
Oct	2007	73	123N	30W	15	SWCD		5.09
Nov	2007	73	123N	30W	15	SWCD		.05
Dec	2007	73	123N	30W	15	SWCD		1.19
Jan	2008	73	123N	30W	15	SWCD		.02
Feb	2008	73	123N	30W	15	SWCD		.60
Mar	2008	73	123N	30W	15	SWCD		1.05
Apr	2008	73	123N	30W	15	SWCD		3.88
May	2008	73	123N	30W	15	SWCD		3.47
Jun	2008	73	123N	30W	15	SWCD		4.04
Jul	2008	73	123N	30W	15	SWCD		2.50
Aug	2008	73	123N	30W	15	SWCD		4.28
Sep	2008	73	123N	30W	15	SWCD		3.30
Oct	2008	73	123N	30W	15	SWCD		2.93
Nov	2008	73	123N	30W	15	SWCD		2.12
Dec	2008	73	123N	30W	15	SWCD		1.77

Where indicated: Missing values are shown as 'm'. Days on which precip accumulated in the gage are shown as '-'. 'TTTT RR SS' is the 'public land survey (PLS)' or 'legal' location of the observed data. Section values greater 36 are SECTIC 'TIC' locations plus 100. 'NWS ID' the National Weather Service Cooperative station number. Note that the 'PLS' will always be correct for precipitation data while the 'NWS ID' will always be correct for the temperature data. If no PLS info is supplied the 'NWS ID' number applies to all shown data.

Figure 9

6. Transfer the precipitation data from the prior months of interest to the appropriate boxes on a blank Rainfall Documentation Worksheet (Appendix).
   OR:
   Use the spreadsheet tool (*NRCS & Hybrid method .xls*) included with this guidance (Figure 10)



NRCS method - Rainfall Documentation Worksheet Hydrology Tools for Wetland Determination
NRCS Engineering Field Handbook Chapter 19

Date	8/10/2010	**Landowner/Project**	example
Weather Station	Cold Spring, MN	**State**	MN
County	Stearns	**Growing Season**	4/20-10/15
Photo/obs Date	39603	**Soil Name**	

shaded cells are locked or calculated

Long-term rainfall statistics (from WETS table or State Climatology Office)

	Month	30% chance <	30% chance >	Precip	Condition Dry, Wet, Normal	Condition Value	Month Weight Value	Product of Previous 2 Columns
1st Prior Month*	May	2.45	3.93	3.47	N	2	3	6
2nd Prior Month*	April	1.17	2.60	3.88	W	3	2	6
3rd Prior Month*	March	1.20	2.10	1.05	D	1	1	1
							Sum	**13**

*compared to photo/observation date

Note: If sum is

6 - 9	prior period has been drier than normal
10 - 14	prior period has been normal
15 - 18	prior period has been wetter than normal

Condition value:
Dry =1
Normal =2
Wet =3

Conclusions: **prior period has been normal**

NRCS method | Hybrid method

Figure 10: Example application of NRCS method using the Excel spreadsheet tool (NRCS & Hybrid method.xls).

2. Method of Rolling Totals

2.1 Background

The NRCS method compares actual precipitation with monthly ranges of normal. Precipitation patterns within a particular month are not reflected in monthly totals. Monthly totals are reset to zero at the beginning of each month and may not accurately reflect antecedent precipitation in the middle of the month. Because the period of continuous inundation required for wetland hydrology is less than a month, it is usually desirable to evaluate higher frequency (daily) precipitation data.

The **30-day rolling total** method is particularly useful. It involves summing the prior 30-day precipitation totals for each day and plotting this "rolling total" on a daily basis. By overlaying a plot of the normal precipitation range on the daily plot you can evaluate whether antecedent precipitation was greater or less than normal **throughout** a month rather than just at the beginning or end.

The method is especially easy using a spreadsheet software and data from the State Climatology office. An example Microsoft Excel spreadsheet (***30-day-rolling.xls***) is included with this guidance. A spreadsheet such as this can be used as a template by cutting and pasting data into the appropriate spreadsheet cells. This guidance is geared toward web-available data and Microsoft Excel. Other spreadsheet programs will work but the format of commands and formulas will be slightly different.

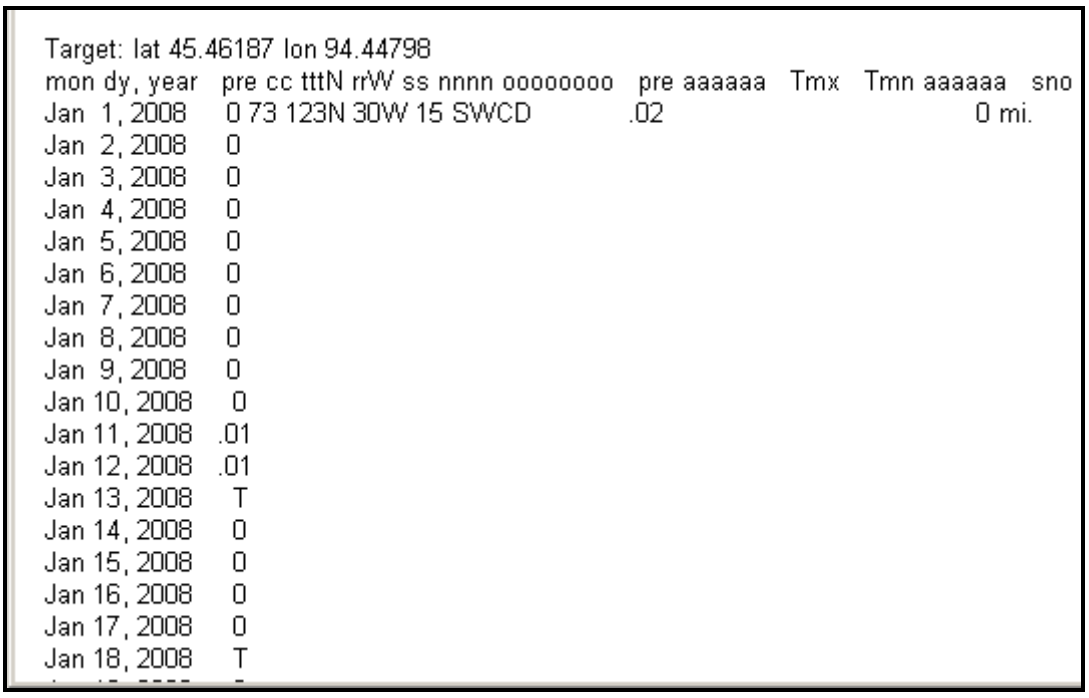
2.2 Procedure

The 30-day rolling totals procedure consists of these basic steps:

- Get daily precipitation data and monthly ranges of normal for your site from the State Climatology office.
- Put the data into appropriate places in a spreadsheet.
- Calculate and plot 30-day rolling totals for the time period of interest.
- Plot monthly ranges of normal on the plot of 30-day rolling totals.
- Compare the rolling 30-day sums to the monthly ranges of normal to determine whether antecedent precipitation was within the range of normal.

2.2.1 Get Precipitation Data

1. Go to http://climate.umn.edu.
2. Under **Retrieve Historical Data** go to: Retrieve Daily or Monthly Temperature, Precipitation, Snow Data by Target Location.
3. Click on **set location**. Zoom in to your site as described above (Figure 4, Figure 5). When you have the location in the cross-hairs, click on **DONE/return to application**. Choose the years and the precipitation data networks from which you want data. (No reason not to check both the High Density and NWS networks.)
4. Click on **get daily** (Figure 8).
5. The daily data will appear at the bottom of the screen (Figure 11).

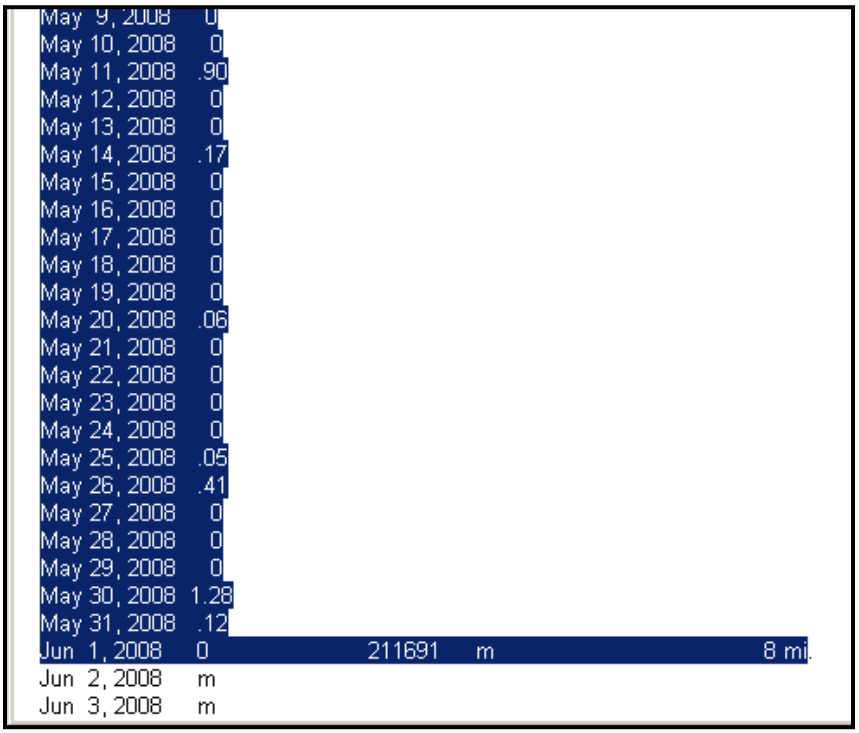


Target: lat 45.46187 lon 94.44798

mon dy, year	pre cc tttN rrWW ss nnnn oooooooo	pre aaaaaa	Tmx	Tmn aaaaaa	sno
Jan 1, 2008	0 73 123N 30W 15 SWCD	.02			0 mi.
Jan 2, 2008	0				
Jan 3, 2008	0				
Jan 4, 2008	0				
Jan 5, 2008	0				
Jan 6, 2008	0				
Jan 7, 2008	0				
Jan 8, 2008	0				
Jan 9, 2008	0				
Jan 10, 2008	0				
Jan 11, 2008	.01				
Jan 12, 2008	.01				
Jan 13, 2008	T				
Jan 14, 2008	0				
Jan 15, 2008	0				
Jan 16, 2008	0				
Jan 17, 2008	0				
Jan 18, 2008	T				

Figure 11

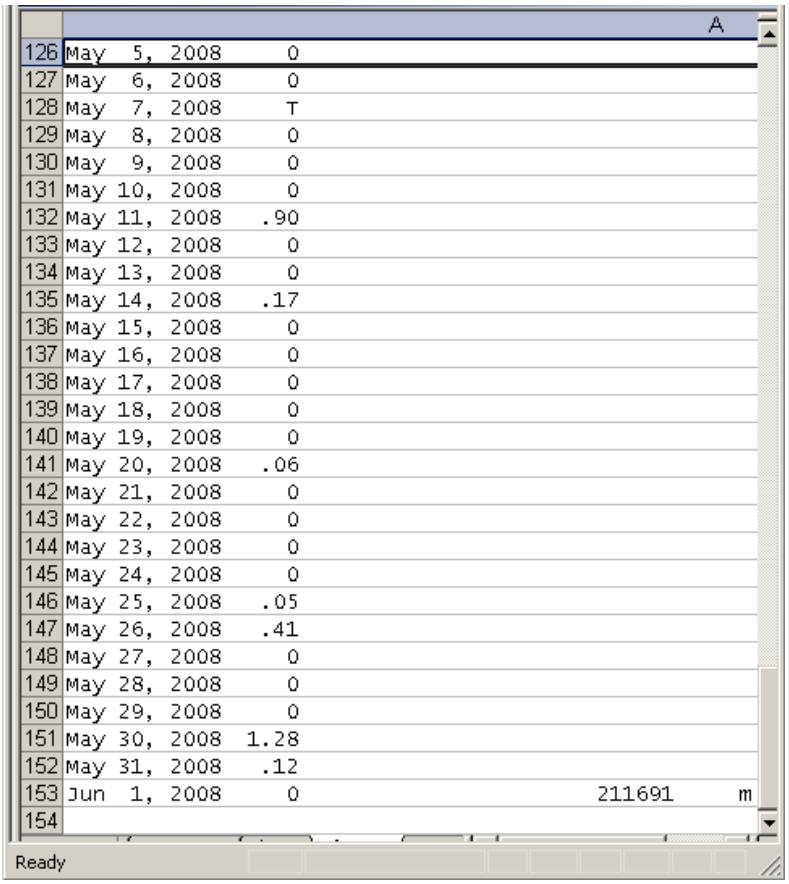
6. Highlight the data you want and copy.



May 9, 2008	0				
May 10, 2008	0				
May 11, 2008	.90				
May 12, 2008	0				
May 13, 2008	0				
May 14, 2008	.17				
May 15, 2008	0				
May 16, 2008	0				
May 17, 2008	0				
May 18, 2008	0				
May 19, 2008	0				
May 20, 2008	.06				
May 21, 2008	0				
May 22, 2008	0				
May 23, 2008	0				
May 24, 2008	0				
May 25, 2008	.05				
May 26, 2008	.41				
May 27, 2008	0				
May 28, 2008	0				
May 29, 2008	0				
May 30, 2008	1.28				
May 31, 2008	.12				
Jun 1, 2008	0	211691	m		8 mi.
Jun 2, 2008	m				
Jun 3, 2008	m				

Figure 12

7. Paste it into the spreadsheet.



	A	
126	May 5, 2008	0
127	May 6, 2008	0
128	May 7, 2008	T
129	May 8, 2008	0
130	May 9, 2008	0
131	May 10, 2008	0
132	May 11, 2008	.90
133	May 12, 2008	0
134	May 13, 2008	0
135	May 14, 2008	.17
136	May 15, 2008	0
137	May 16, 2008	0
138	May 17, 2008	0
139	May 18, 2008	0
140	May 19, 2008	0
141	May 20, 2008	.06
142	May 21, 2008	0
143	May 22, 2008	0
144	May 23, 2008	0
145	May 24, 2008	0
146	May 25, 2008	.05
147	May 26, 2008	.41
148	May 27, 2008	0
149	May 28, 2008	0
150	May 29, 2008	0
151	May 30, 2008	1.28
152	May 31, 2008	.12
153	Jun 1, 2008	0 211691 m
154		

Ready

Figure 13

8. Do a "text-to-columns" conversion. In Excel, highlight the entire column. Click "**Data**", then "**Text to Columns**". Choose "Fixed Width."

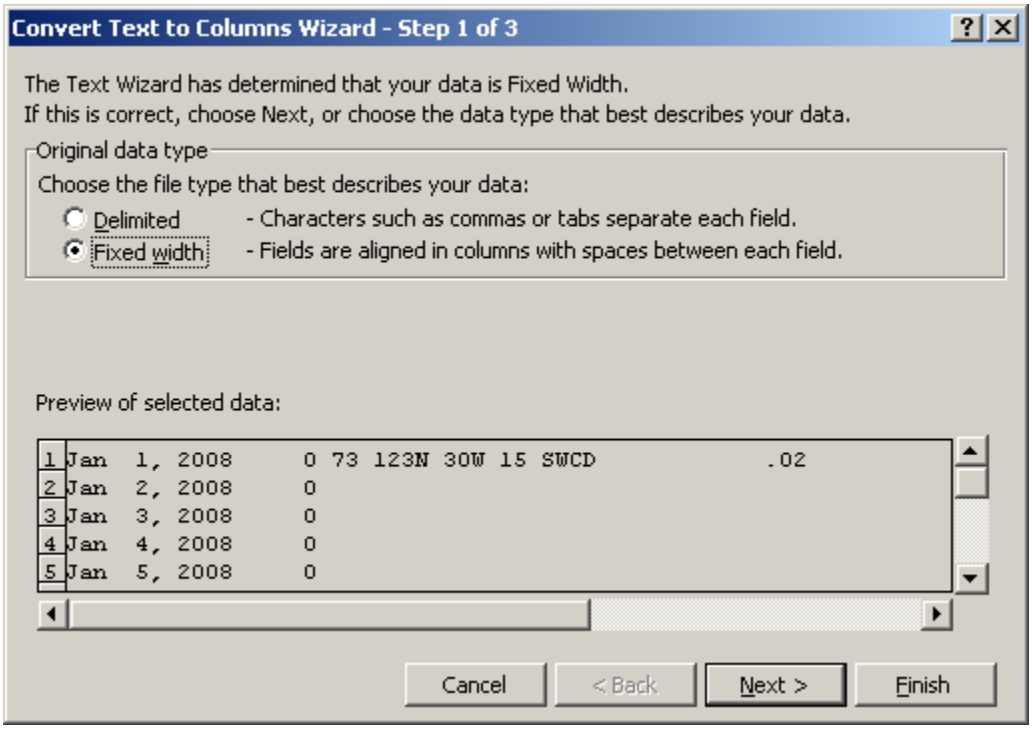


Figure 14

9. Delete break lines to delineate 2 columns, one for date and one for precipitation.

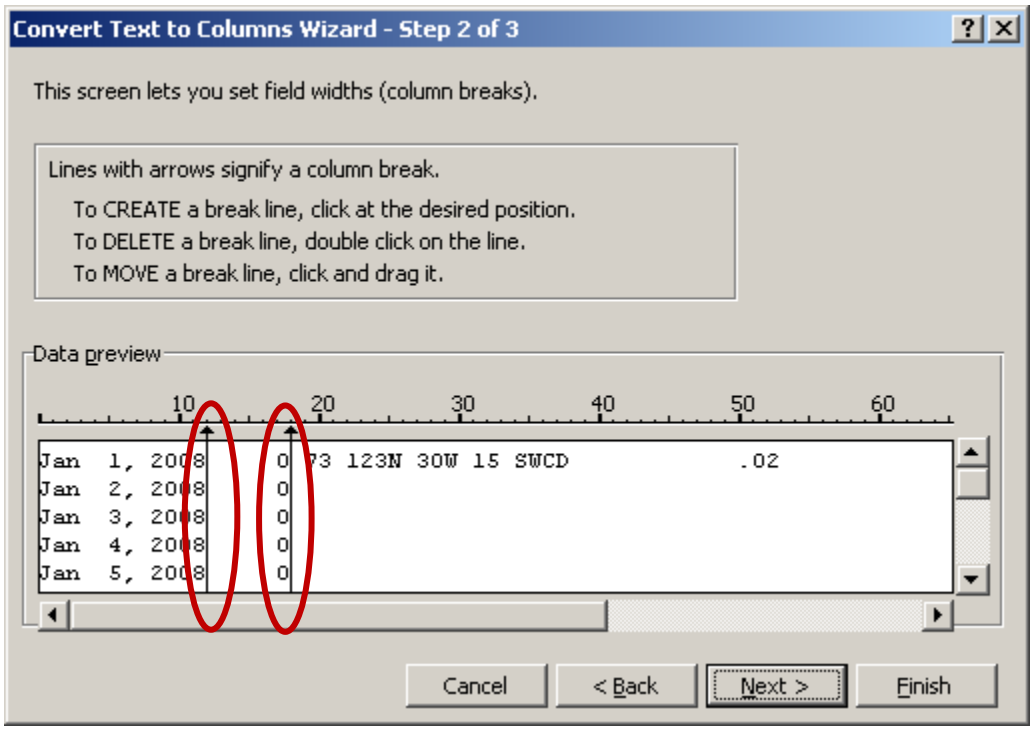


Figure 15

10. Change the "**Column data format**" for the date column to "**Date: MDY.**" The column data format for the data after the precipitation column can be set to "**skip.**"

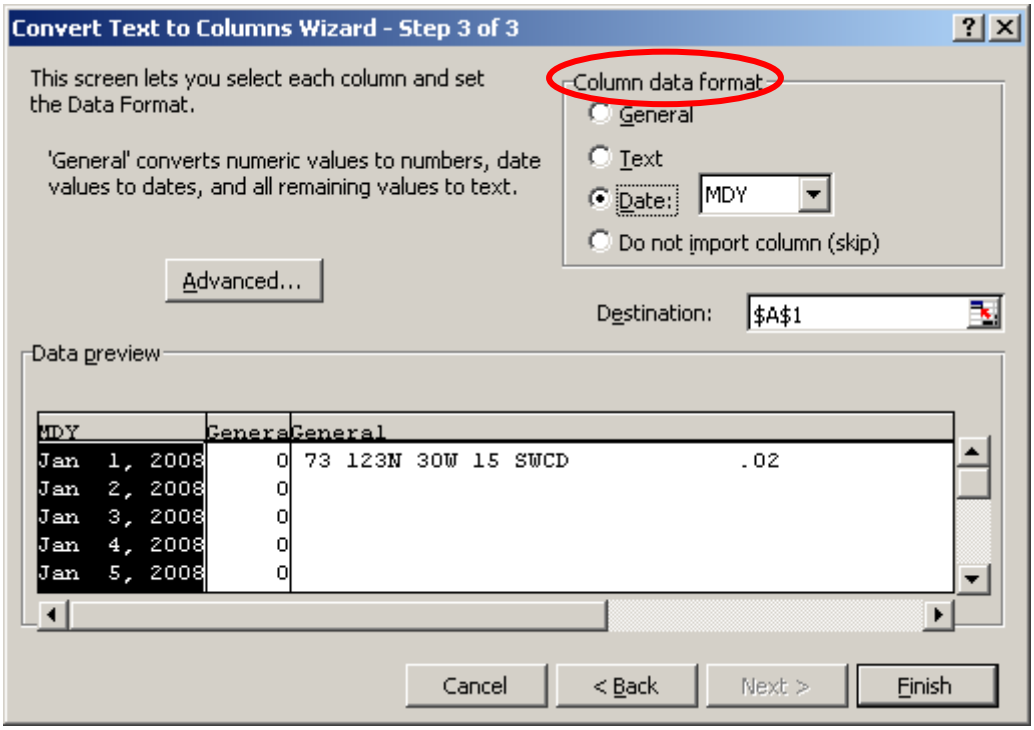
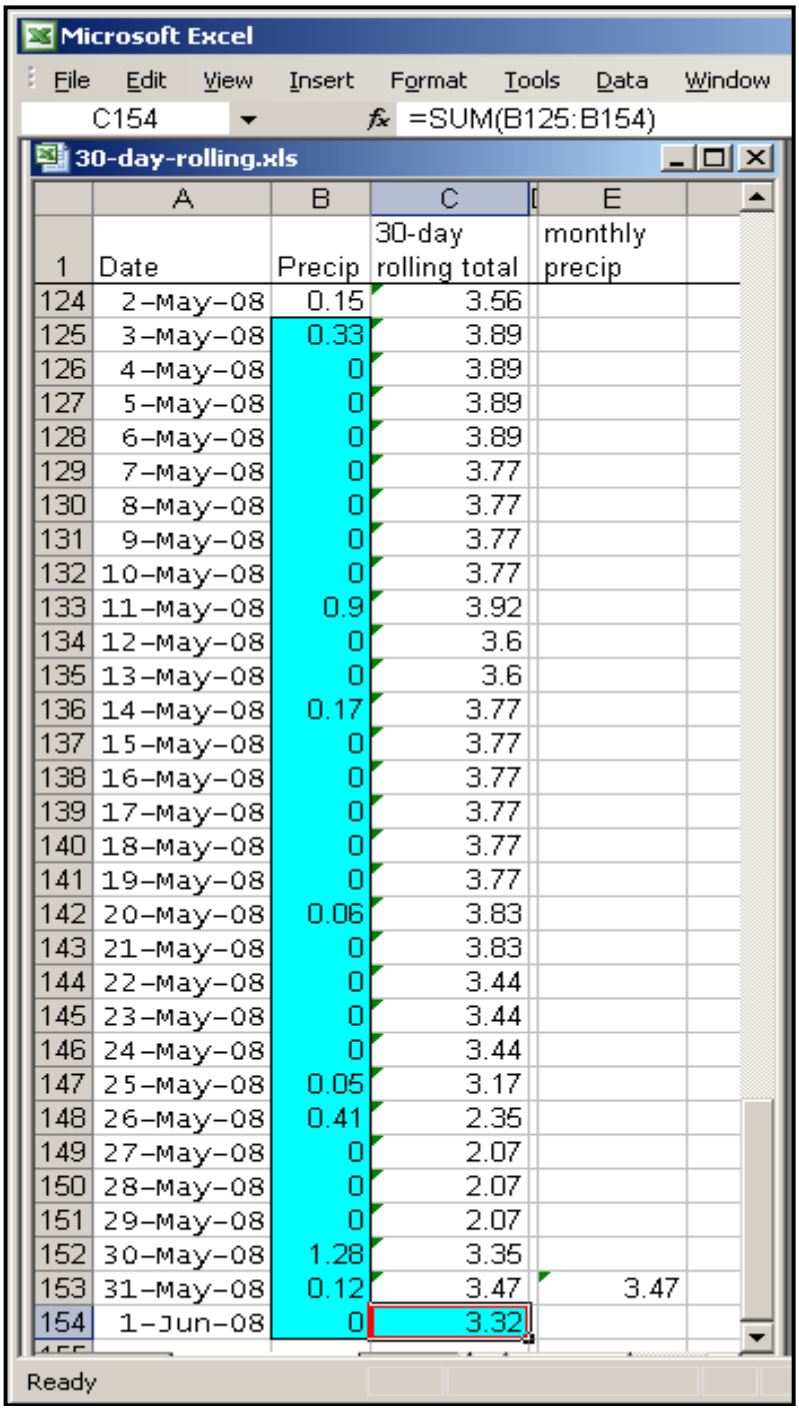


Figure 16

11. You now have a two-column spreadsheet. For ease of use, insert a new row at the top and label the columns. Then go to the 1st column, 2nd row and click "**Window**" > "**Freeze panes.**" Also, use "**Edit-Find-Replace**" to replace all the 'T' values in the precipitation column with zeros. Create a third column and label it "**30-day rolling total**". The value in this column for each day will be the sum of the precipitation amounts for that day and the preceding 29 days. The calculation is easily automated in the spreadsheet by copying and pasting the first instance of the formula into the other rows of the third column. An example Microsoft Excel formula is **=SUM(B125:B154).** It is also helpful to create a monthly total precipitation column by totaling the daily precipitation values for each month (Figure 17).

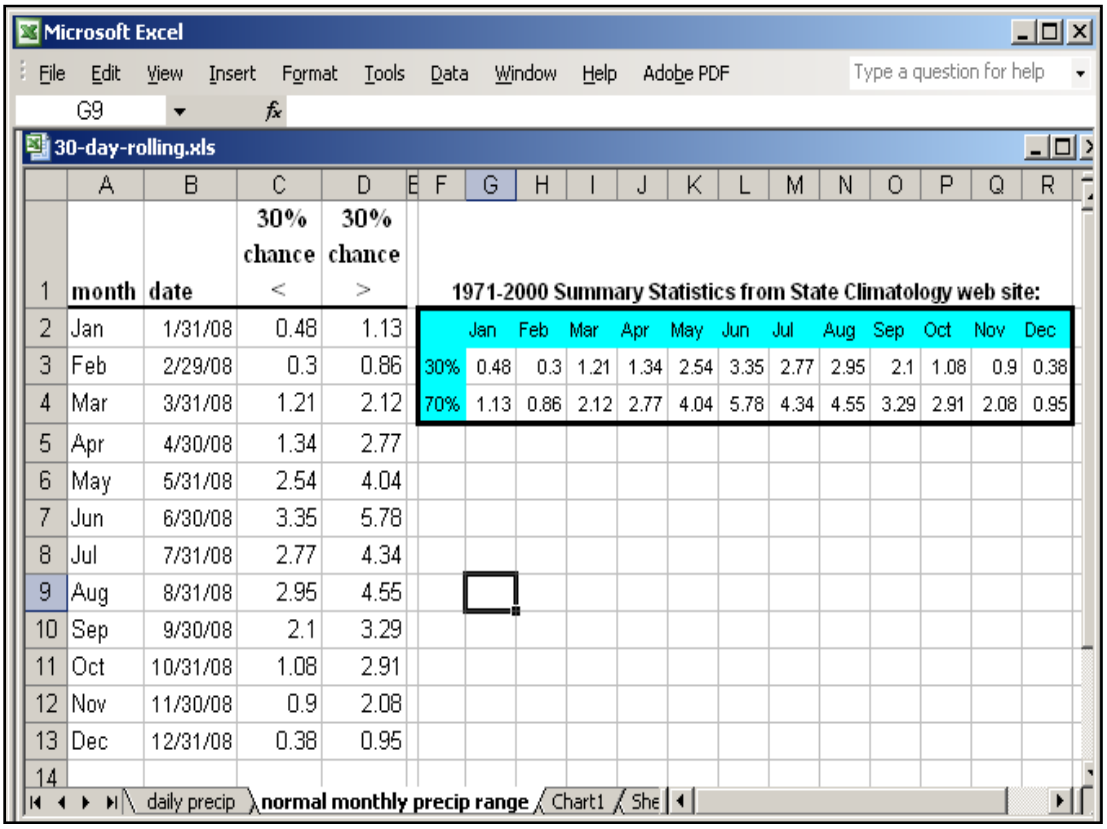


	A	B	C	E
1	Date	Precip	30-day rolling total	monthly precip
124	2-May-08	0.15	3.56	
125	3-May-08	0.33	3.89	
126	4-May-08	0	3.89	
127	5-May-08	0	3.89	
128	6-May-08	0	3.89	
129	7-May-08	0	3.77	
130	8-May-08	0	3.77	
131	9-May-08	0	3.77	
132	10-May-08	0	3.77	
133	11-May-08	0.9	3.92	
134	12-May-08	0	3.6	
135	13-May-08	0	3.6	
136	14-May-08	0.17	3.77	
137	15-May-08	0	3.77	
138	16-May-08	0	3.77	
139	17-May-08	0	3.77	
140	18-May-08	0	3.77	
141	19-May-08	0	3.77	
142	20-May-08	0.06	3.83	
143	21-May-08	0	3.83	
144	22-May-08	0	3.44	
145	23-May-08	0	3.44	
146	24-May-08	0	3.44	
147	25-May-08	0.05	3.17	
148	26-May-08	0.41	2.35	
149	27-May-08	0	2.07	
150	28-May-08	0	2.07	
151	29-May-08	0	2.07	
152	30-May-08	1.28	3.35	
153	31-May-08	0.12	3.47	3.47
154	1-Jun-08	0	3.32	

Figure 17

2.2.2 Get Normal Monthly Precipitation Range Data

1. Follow all the steps outlined in Section 1.2 above to get the normal precipitation range information for the location (Figure 6). If you want instead to use the USDA-NRCS WETS data, use the link (**view** USDA-NRCS WETS data) at the bottom of the precipitation worksheet (Figure 7).
2. Transfer the appropriate "normal range" values for the months of interest to the spreadsheet. For ease of use put the data in a new spreadsheet tab. Create another column with the last dates of the month for the months of interest. Why the last dates? We will be plotting the ranges of normal for each month at the end of that particular month, rather than the beginning or middle, because the range of normal is for the preceding 28/29, 30, or 31 days of the month (Figure 18).



	A	B	C	D
1	month	date	30% chance <	30% chance >
2	Jan	1/31/08	0.48	1.13
3	Feb	2/29/08	0.3	0.86
4	Mar	3/31/08	1.21	2.12
5	Apr	4/30/08	1.34	2.77
6	May	5/31/08	2.54	4.04
7	Jun	6/30/08	3.35	5.78
8	Jul	7/31/08	2.77	4.34
9	Aug	8/31/08	2.95	4.55
10	Sep	9/30/08	2.1	3.29
11	Oct	10/31/08	1.08	2.91
12	Nov	11/30/08	0.9	2.08
13	Dec	12/31/08	0.38	0.95
14				

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30%	0.48	0.3	1.21	1.34	2.54	3.35	2.77	2.95	2.1	1.08	0.9	0.38
70%	1.13	0.86	2.12	2.77	4.04	5.78	4.34	4.55	3.29	2.91	2.08	0.95

Figure 18

2.2.3 Plot the Data

There are many options for graphs in Excel and many ways to approach formatting dates, curves, axes, etc. Here are the basics, assuming some familiarity with how to create graphs using spreadsheet software.

1. Create an X-Y (Scatter) plot with date as the X-axis and precipitation as the Y.
2. The source data series will be:
   - 30-day rolling total plotted as a curve (column 'C' against column 'A', Figure 17)
   - Upper and lower boundaries of the range of normal, plotted at the end of each month as lines (Columns 'C' and 'D' against column 'B' in Figure 18).

   It is also helpful to plot:

   - Daily precipitation "spike graph" to provide details of the distribution of rainfall within the months of interest (column 'B' against column 'A', Figure 17).
   - Monthly precipitation totals as points (column 'E' against column 'A', Figure 17).

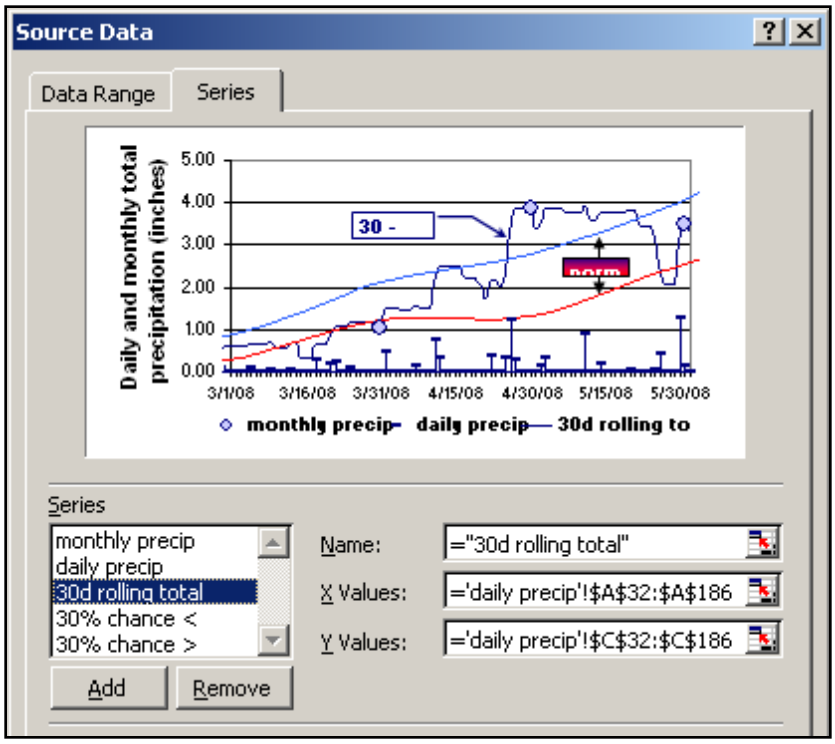


Figure 19: Specifying source data series for plot.

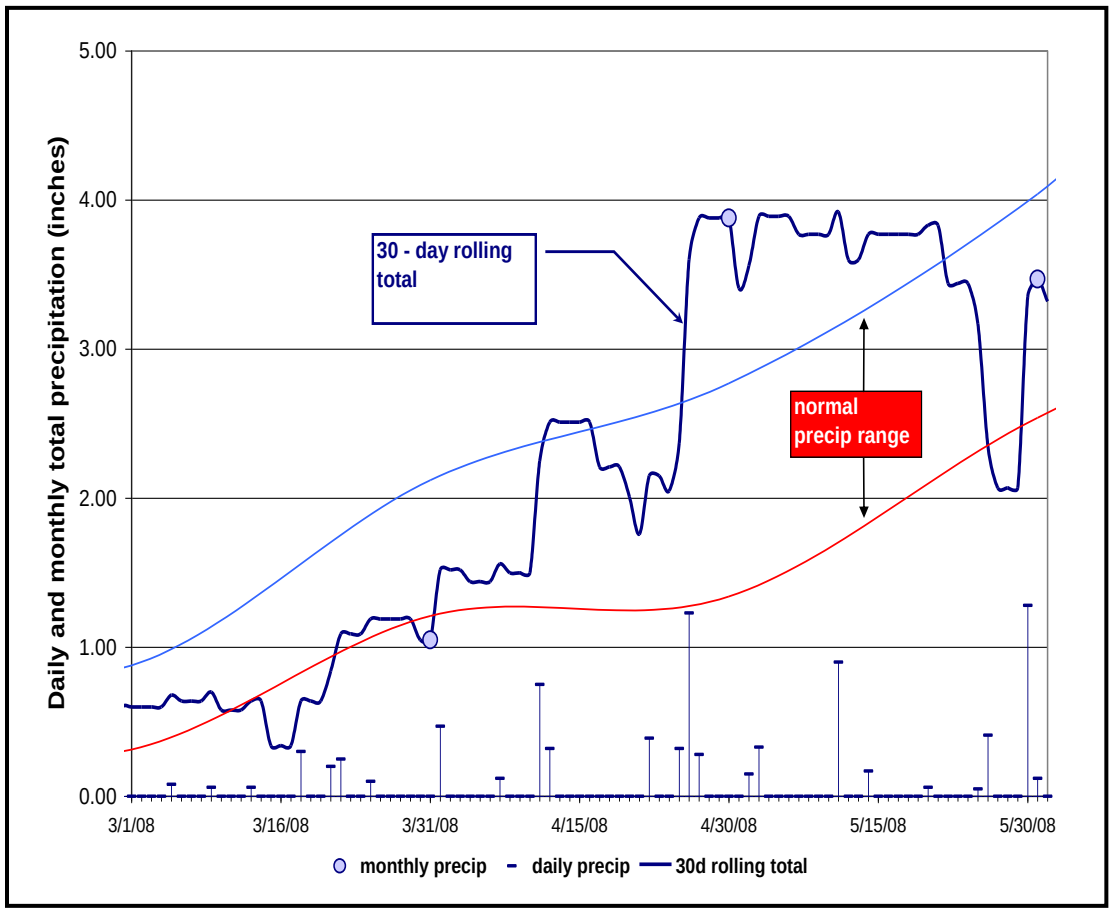


Figure 20: 30-Day Rolling Totals of Precipitation at Cold Spring, MN Overlaid on Graph of Daily Precipitation, Monthly Precipitation, and Range of Normal.

2.2.4 Determine Whether Precipitation Was Within Range of Normal

Deviation from the range of normal precipitation is determined by using the superimposed plots of 30-day rolling totals and ranges of normal precipitation for the period of interest (Figure 20). Including daily precipitation data on the plot helps show how the 30-day rolling totals evolved.

In our example, we see that in 2008 at Cold Spring, MN, March and April precipitation levels were largely within the range of normal, with only a slight dip below normal in mid-March. Rainfall events at the end of April caused the 30-day total to rise above the range of normal.

The strength of the method of 30-day rolling totals can be seen by comparing it to the monthly totals. The monthly totals indicate that April was significantly wetter than normal. However, the more detailed method of 30-day rolling totals detected that the heavy rains did not occur until the middle and, especially, the end of April. Detailed knowledge of rainfall distributions in early- to mid-April could have been important as that is at the beginning of the regulatory growing season (Sprecher and Warne, 2000).

2.3 Remarks on the Method

The method of 30-day rolling totals provides a more accurate assessment of antecedent moisture conditions at a site than do monthly averages, which artificially zero rainfall totals at the beginning of each month. However, the method of rolling sums also artificially zeroes rainfall after 30 days (Sprecher and Warne, 2000).

Note in Figure 20 that 30-day rolling precipitation totals were much above normal for most of May despite the fact that daily rainfall records show much of May was dry. The antecedent precipitation levels, as measured by the 30-day rolling total, fell from much above normal to well below normal within a space of five days in late May. This is a direct consequence of the method of calculating a 30-day rolling sum. A large input remains within the rolling sum for exactly 30 days, and then abruptly drops out of the rolling total.

In loamy and finer textured soils, changes in water tables are unlikely to be so abrupt.

Rolling totals are often used to track the influence of antecedent precipitation on water levels in monitoring wells. This works because each well reading can be compared to an updated tally of antecedent precipitation (Sprecher and Warne, 2000).

3. Combining the 30-Day Rolling Total and NRCS Method

The methods can be effectively combined. This is useful when precipitation influences site hydrology for two to three months.

1. On the plot of 30-day rolling totals mark off 30-day blocks starting backward from the date of interest (Figure 21).

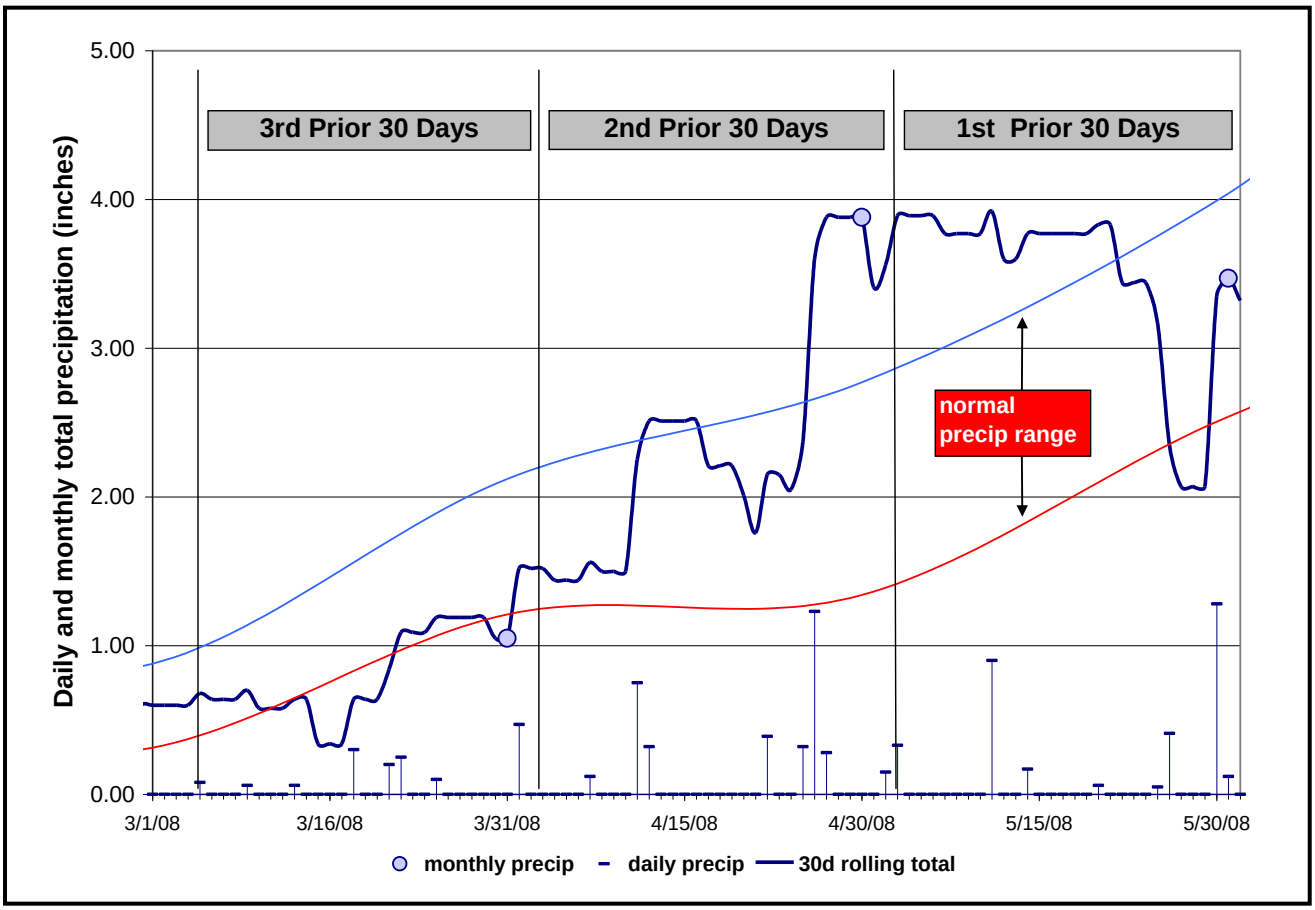
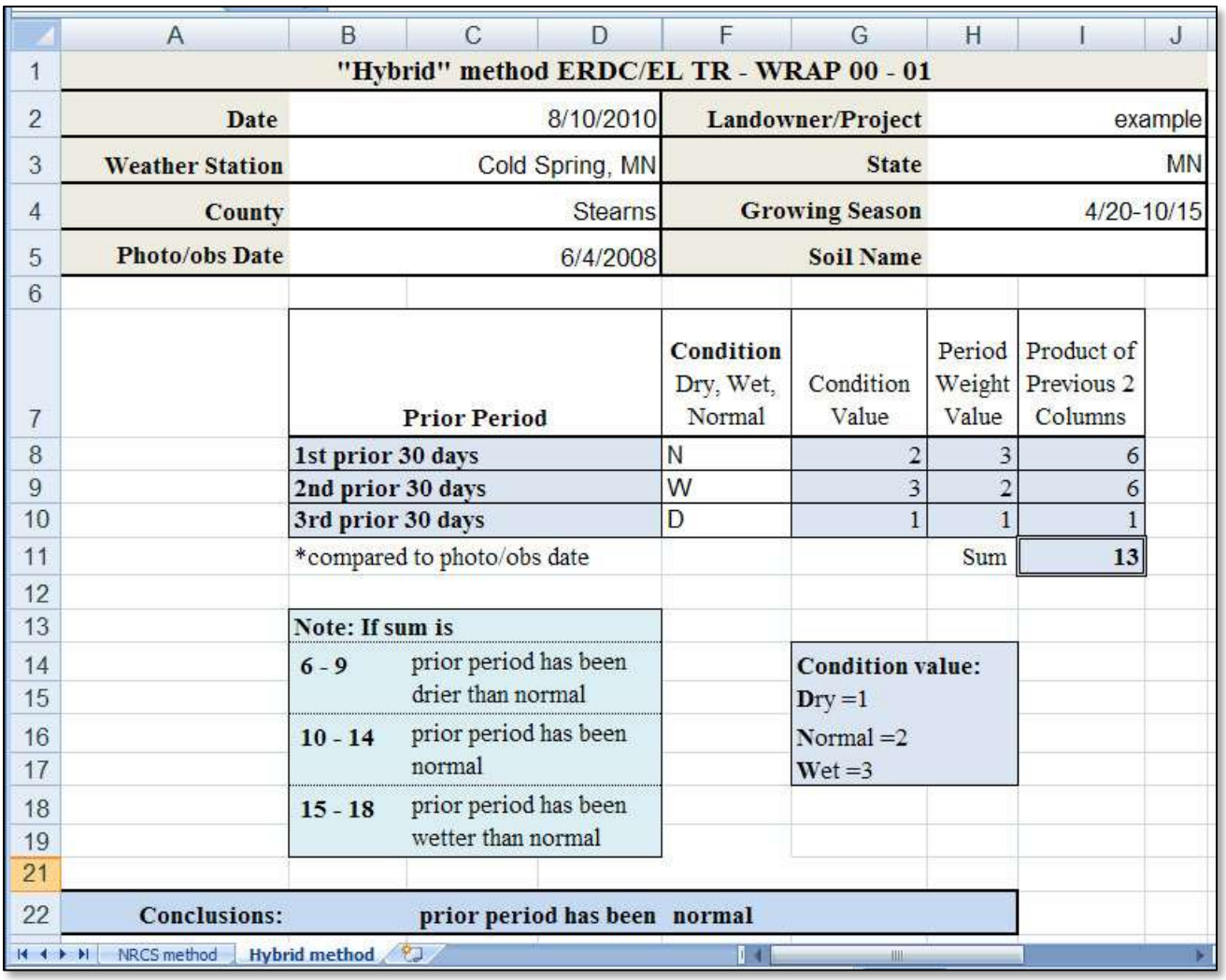


Figure 21: Three 30-Day Periods Prior to June 1, Added to Figure 20, Assuming an Observation Date of June 1, Cold Spring, MN.

2. Decide whether the 30-day blocks reflect normal, drier than normal, or wetter than normal precipitation by comparing the 30-day rolling totals with the ranges of monthly normal. This will require professional judgment!

3. Record your decisions for the 30-day blocks in the Rainfall Documentation Worksheet in the column labeled "Condition dry, wet, normal" (Figure 1). Use these decisions to complete the NRCS method as described above. The [**Hybrid method**] sheet in the Excel spreadsheet (*NRCS & Hybrid method .xls or .xlsx* included with this guidance) automates the calculation- requiring inputs to the "Condition dry, wet, normal" column for the 3 prior 30-day periods (Figure 22 below).



"Hybrid" method ERDC/EL TR - WRAP 00 - 01

Date	8/10/2010	**Landowner/Project**	example
Weather Station	Cold Spring, MN	**State**	MN
County	Stearns	**Growing Season**	4/20-10/15
Photo/obs Date	6/4/2008	**Soil Name**	

Prior Period	Condition Dry, Wet, Normal	Condition Value	Period Weight Value	Product of Previous 2 Columns
1st prior 30 days	N	2	3	6
2nd prior 30 days	W	3	2	6
3rd prior 30 days	D	1	1	1
*compared to photo/obs date			Sum	**13**

Note: If sum is	
6 - 9	prior period has been drier than normal
10 - 14	prior period has been normal
15 - 18	prior period has been wetter than normal

Condition value:
Dry =1
Normal =2
Wet =3

Conclusions: **prior period has been normal**

NRCS method | Hybrid method

Figure 22: Example Application of Hybrid Method Using the Excel Spreadsheet Tool (NRCS & Hybrid method.xlsx).

The hybrid method may rate the three-months' precipitation prior to the observation date differently than the NRCS method, depending on professional judgment. The difference is the ability to calculate 30-day increments starting on any date rather than only at the beginning of the calendar month.

4. Observation on Assessments of Antecedent Precipitation (Sprecher and Warne, 2000)

- Using the Normal Monthly Precipitation Range data alone is quickest and OK for simple generalizations about long-term trends.
- The simple method of 30-day rolling totals is readily used with long sets of monitoring well data because of ease of plotting information. These plots, when superimposed on a daily precipitation spike graph, provide a powerful tool for explaining water well fluctuations.
- The combined method is useful for making decisions regarding individual dates of observation at a site. Whenever feasible, the monthly analyses should be interpreted using the daily data from which the monthly summaries were aggregated.
- The NRCS and rolling totals methods can be used in conjunction with indices of longer term hydrologic input, such as the Palmer drought indices.
- The Normal Monthly Precipitation Range data evaluate the range of normal precipitation in monthly increments. Antecedent precipitation probably does not affect wetland hydrology in monthly or 30-day increments.
- Antecedent precipitation is only one part of the water budget. The other parts of the water budget need to be considered when interpreting observed levels of ground or surface water.
- The duration of impact of antecedent precipitation typically varies with the seasons. In the early spring, when evapotranspiration (ET) is low, there is probably a longer duration impact of prior precipitation than later in the summer when ET is high.
- The duration of influence of antecedent precipitation on wetland hydrology does not seem to have been studied. The NRCS hydrologists chose three months as a reasonable length of time to evaluate antecedent precipitation for Food Security Act programs. In the absence of site-specific information to the contrary, three months preceding a date of site monitoring seems to be a reasonable length of time to evaluate whether precipitation was within the range of normal.
- There is no way to remove professional judgment in borderline situations. The limits of the range of normal (30th and 70th percentiles) are themselves professional judgments. Moreover, when antecedent precipitation levels are close to thresholds of normal, uncertainties about other parts of the water budget become major considerations.

5. References

Sprecher, S.W. and Andrew G. Warne, A.G., 2000. ***Accessing and Using Meteorological Data to Evaluate Wetland Hydrology***. WRAP Technical Notes Collection, ERDC/EL TR-WRAP-00-1. U.S. Army Engineer Research and Development Center, Vicksburg, MS. (http://el.erdc.usace.army.mil/elpubs/pdf/wrap00-1/wrap00-1.pdf)

Natural Resources Conservation Service, 1997. ***Hydrology tools for wetland determination***. Chapter 19, Engineering field handbook. D. E. Woodward, ed. USDA-NRCS, Fort Worth, TX. (http://www.info.usda.gov/CED/ftp/CED/EFH-Ch19.pdf)

BWSR Guidance, January 31, 2011

The primary author of this guidance is Eric Mohring, BWSR Hydrologist.

This document is available on the BWSR website and may be revised periodically. Check the website for the most current version. www.bwsr.state.mn.us/wetlands

Contact your Local Government Unit or BWSR Wetland Specialist for additional information.

Appendix: Rainfall Documentation Worksheet for NRCS Method

Date: _____

Weather station: _____ Landowner: _____ Tract no.: _____

County: _____ State: _____

Soil name: _____ Growing season: _____

Photo date: _____

		Long-term rainfall records							
	Month	3 yrs. in 10 less than	Normal	3 yrs. in 10 more than	Rain fall	Condition dry, wet, normal	Condition value	Month weight value	Product of previous two columns
1st prior month*								3	
2nd prior month*								2	
3rd prior month*								1	
								Sum	

* Compared to photo date

Note: If sum is

- 6 - 9 then prior period has been drier than normal
- 10 - 14 then prior period has been normal
- 15 - 18 then prior period has been wetter than normal

Condition value:

- Dry =1
- Normal =2
- Wet =3

Conclusions: