

Water Development Office

6920 YELLOWTAIL ROAD

TELEPHONE: (307) 777-7626
FAX: (307) 777-6819

CHEYENNE, WY 82002

TECHNICAL MEMORANDUM

TO: Water Development Commission

DATE: August, 2009

FROM: Water Resources Data System

REFERENCE: Bear River Basin Plan Update, 2011

SUBJECT: Climate– *Tab X (2011)*

Contents

1.0 Introduction.....	1
2.0 Climate Data	2
2.1 Charts of Station-Level Monthly Precipitation.....	2
2.2 Charts of Station-Level Temperature Variability	2
2.3 Growing Season Statistics	2
2.4 Climate Division Temperature and Precipitation	2
2.5 Maps of Precipitation and Temperature Normals.....	3
2.6 Average Annual Precipitation (1971 – 2000).....	3
2.7 Bear River Basin Temperatures	4

1.0 Introduction

Recognizing the importance of sustainable water use and resource stewardship, the Wyoming Water Development Office (WWDO) is producing a series of River Basin Plans that address water use profiles, surface and ground water availability, water demand projections, and future water use opportunities in each of the state’s seven river basins. In the past these river basin plans have been criticized for not included detailed examinations of regional climate and for an apparent failure to link water resources to climate variability. However, these shortcomings were largely a product of available climate data being greatly limited in many river basins, as well as problems with stakeholder access to these data. As a result, the Water Resources Data System (WRDS) was charged with developing a comprehensive summary of climatic conditions across Wyoming’s river basins. This technical memorandum addresses the data, techniques and resulting products used to describe climate patterns within the Bear River Basin.

2.0 Climate Data

2.1 Charts of Station-Level Monthly Precipitation

Data from the National Climatic Data Center's Climatology of the United States No. 81; Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000 (CLIM81) were graphed to show the yearly distribution of monthly precipitation for select stations in the Bear River Basin. Graphs for National Weather Service Cooperative Observer stations from Evanston were included as a way to give the reader a representative look at the distribution of precipitation within the basin. Excel spreadsheets containing these data and the original charts are also included in the accompanying materials. Additional charts for all stations having 1971-2000 Normals for Precipitation may be found at http://www.wrds.uwyo.edu/sco/data/normals/1971-2000/crop_precip.html.

2.2 Charts of Station-Level Temperature Variability

Temperature data from the National Weather Service's Cooperative Observer Network stations were obtained from the Western Regional Climate Center (<http://www.wrcc.dri.edu>), and then summarized using standard techniques. These summaries show the distribution of maximum and minimum temperatures on a daily basis throughout the year. Mean values and the distribution of extremes (a.k.a. "records") were calculated using data from the station's entire period of record. Graphs of extreme maximum and minimum daily temperatures along with average maximum and minimum temperatures are provided for Evanston. Graphs showing monthly values and an Excel spreadsheet containing the original data values are also included.

2.3 Growing Season Statistics

Data related to the onset, character and duration of the growing season were obtained from both the High Plains Regional Climate Center (<http://www.hprcc.unl.edu/>) and Western Regional Climate Center (<http://www.wrcc.dri.edu/>). These data are presented as Excel tables for stations in the Bear River Basin. Stations were chosen for analysis based on the length, completeness and reliability of the records they provided. Days above or below critical temperature thresholds and growing degree days (based on a 50 F growing threshold) are included in these tables. First and last frost dates are also presented. Averages for the 1971-2000 period are given for numbers of days above/below critical thresholds, while all other averages values are based on the entire period record. Values for individual years through 2008 follow the average values.

2.4 Climate Division Temperature and Precipitation

Monthly climate-division temperature and precipitation data were obtained from the NOAA-National Climatic Data Center (<http://www.ncdc.noaa.gov/>), and these are provided as both graphs and Excel spreadsheets. Calendar year and water year averages are also provided for precipitation. Climate divisions are a basic unit of climate monitoring used by NOAA and NCDC, and in Wyoming each of the ten climate divisions roughly coincides with a major river drainage. Each monthly temperature/precipitation value is the product of an averaging procedure that includes station-level data from all available stations within a division. Climate divisions provide some of the longest (1895-present) and most complete precipitation and temperature datasets available because the impact of missing station-level data is minimized via the averaging procedure. The climate division that covers the Bear River basin also encompasses the Green River drainage. However, this actually improves the quality of the regional

representation because the additional stations within the Green River basin help to effectively infill portions of the record where reports from other stations are limited (e.g., pre-1920). Climate division graphs may be especially useful for depicting regional conditions since the last Bear River Basin plan was completed.

2.5 Maps of Precipitation and Temperature Normals

By documenting both precipitation and temperature normals through a series of maps, it is possible to examine climate trends across the entire basin. To create these maps, PRISM (Parameter-elevation Regressions on Independent Slopes Model)-based estimates of climate are used to supplement individual station records and to provide a platform for examining the spatio-temporal relationships between water and other natural resources.

PRISM data sets contain spatially gridded average monthly and annual precipitation for the climatological period 1971-2000. Distribution of the point measurements to a spatial grid was accomplished using a series of algorithms developed by Dr. Christopher Daly at Oregon State University. The PRISM model uses point data, digital elevation models (DEM) and 30 year climatological averages (e.g. 1971- 2000 average) to generate gridded estimates of monthly and annual precipitation and temperature. The final data output for the PRISM model consist of 800 meter gridded data layers. These data sets are made available on the PRISM website in ArcInfo ASCII format for all base climate parameters.

In previous basin studies, discussion of climate was based upon data from individual stations from within the basin. Given the inconsistency in reporting and paucity of stations in some key areas around Wyoming (see State Climate Office website <http://www.wrds.uwyo.edu/sco/data/wtryr/wtryr.html> for an accounting of NWS Station reports), it is often beneficial to use data that are averaged or interpolated across the entirety of the basin and state, leaving fewer gaps not only on the landscape but also across time. PRISM Data supply a uniform coverage (with 800 meter to 4 kilometer resolution) of precipitation and temperature for the entire period of record, making it a better-quality climate data resource.

With these data, WRDS has created a series of maps that display Average Annual Precipitation (1971-2000), Monthly Average Precipitation (1971-2000), and Annual Temperatures (Average, Maximum, and Minimum)(1971-2000) for the entire Bear River Basin.

2.6 Average Annual Precipitation (1971 – 2000)

Figure 1 displays the average annual precipitation for the entire Bear River Basin and outlying areas. On average, the basin receives between 10 to 15 inches of precipitation annually with less than 9% of the basin receiving more than 25 inches (refer to Table 1). The higher elevations along the western slope of the Wind River Range, near Sheep Pass in the Commissary Range, receive the most precipitation annually. Lower elevations near the Towns of Evanston and Bear River receive the least amount of precipitation at approximately 11 inches per year. The agricultural lowlands of the Bear River Valley between the Town of Cokeville and Idaho border and between the Towns of Bear River and Evanston receive between 11 and 13 inches of precipitation annually. Precipitation in the basin tends to be highest in January through March and the lowest in June and July.

Table 1: Percent of Precipitation

Precipitation (inches)	% of Basin
<15	39.97
15-20	30.59
20-25	19.34
25-30	3.85
30-35	2.54
>35	1.92

2.7 Bear River Basin Temperatures

PRISM data are also used to map temperature trends in the basin. Figure 2 illustrates the average annual temperature, maximum annual temperature and minimum annual temperature for the basin. Temperatures tend to grade from cooler to warmer from the north to south with the majority of the basin having an average annual temperature of 39° F. Both the maximum and minimum average annual temperatures tend to occur in the Bear River Valley between Cokeville and Evanston.

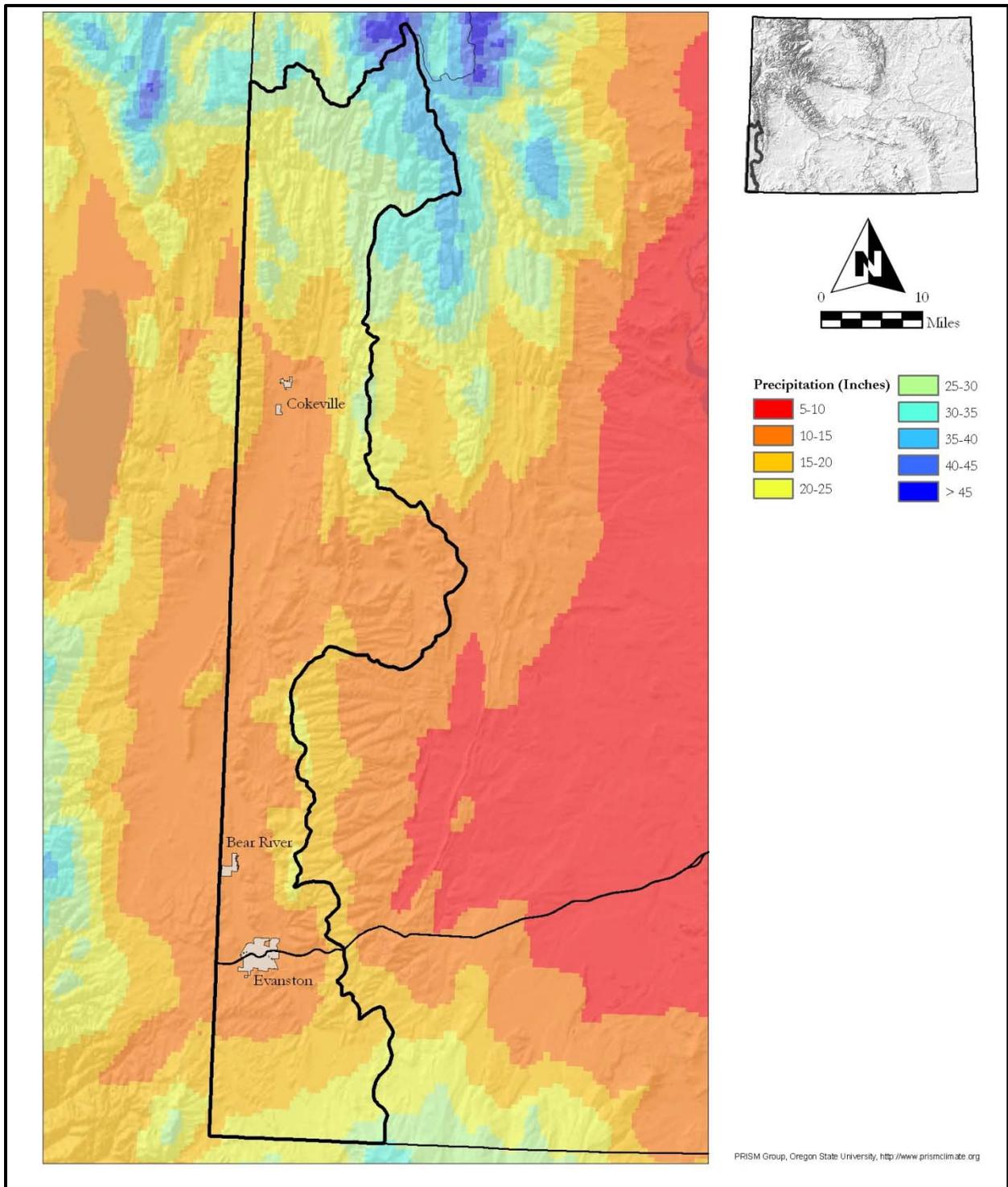


Figure 1: Average Annual Precipitation for the Bear River Basin (1971 – 2000)

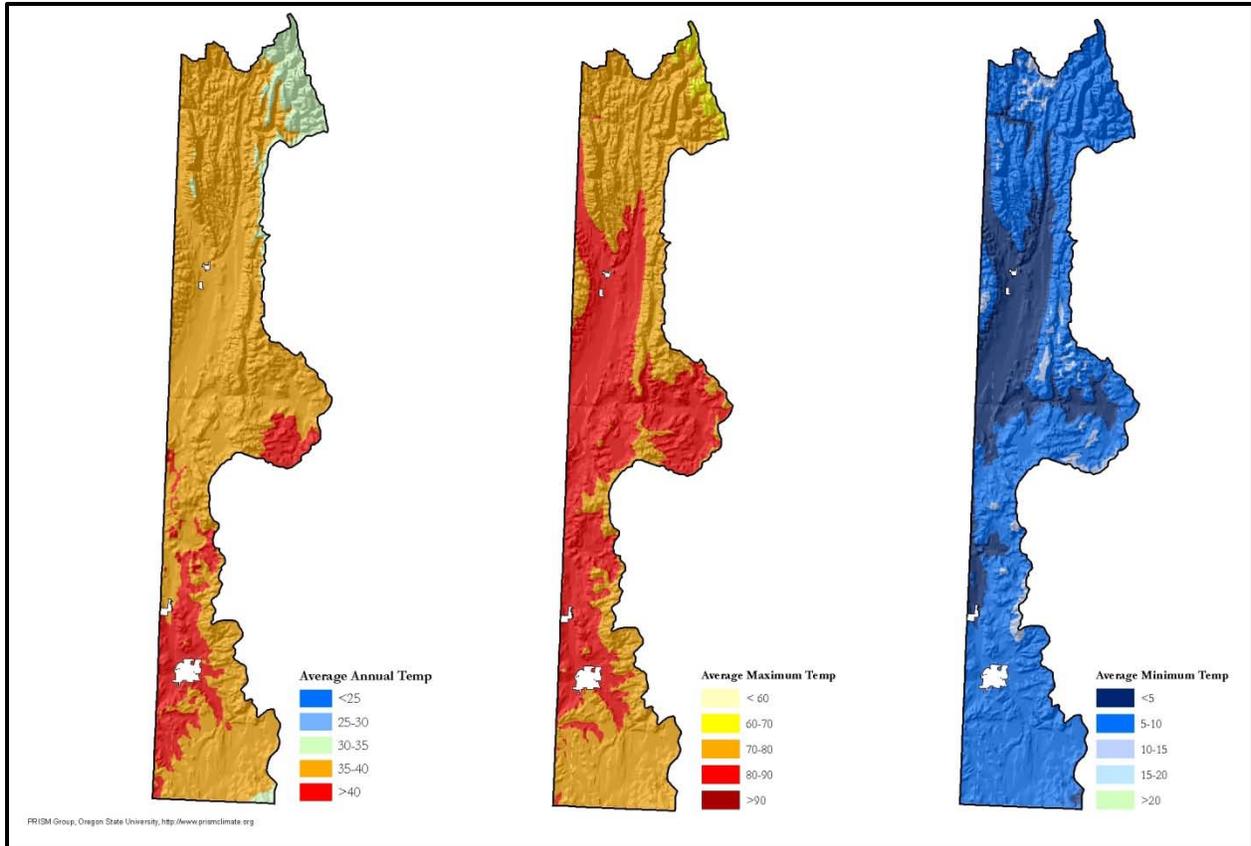


Figure 2: Temperature Normals for the Bear River Basin (1971 – 2000)