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A STUDY OF THE SPRING 1991 FLOODING IN THE WIND RIVER DRAINAGE

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1. Introduction

In June of 1991, the Big Wind River near Riverton, Wyoming, reached its highest water levels since 1935. Late spring snowfall coupled with heavy rain in parts of the Wind River Mountains resulted in flooding on many rivers and streams in the Wind River Basin. As a result of the cool, wet weather across the region, snowmelt was delayed. The delayed snowmelt contributed to the higher peak run-off and resulting flooding. Rivers and floodplains were closely monitored through June.

2. Data

Very little real-time data is received in west central Wyoming each day, especially in the Wind River Mountains. However, data from the Spring of 1991 was collected from Snowpack Telemetry Systems (SNOTEL), Data Collection Platforms (DCPs), and two river gages on the Big Wind River. Graphs representing the major flooding areas were generated from the data beginning on May 23, 1991 (Figures 1-6).

The east slopes of the Wind River Mountains require close monitoring during a wet season or year. Most of the water channels down into the Wind River Basin, either from snowmelt or a heavy precipitation event. The amount of precipitation is a factor to water flow in any event, no matter where the location. Precipitation totals for Lander, Wyoming in April and May were proportionally similar to many mountain sites to the west of Lander. Table 1 illustrates how wet the spring season was in April and May of 1991. Nonetheless, snowpack around 9,000 feet (msl) was much greater than in the lower elevations.

3. Locations and Occurrences

The southern end of the Wind River Mountains is located between South Pass and Togwotee Pass (Figure 7). During May, areas in the Northern Wind River Mountains received more snow and rain than the southern parts. SNOTEL sites from Dinwoody to Togwotee Pass recorded more precipitation and isolated heavy snow events. As shown in Table 1, Togwotee Pass had 6.3 inches of precipitation in May, compared to nearly 4.9 inches at South Pass.

TABLE 1

SITE	MONTH IN 1991	TOTAL PRECIPITATION
WSO Lander	April	2.8 inches
WSO Lander	May	4.5 inches
Christina Lake	April	5.7 inches
Christina Lake	May	4.9 inches
Hobbs Park	April	7.4 inches
Hobbs Park	May	5.7 inches
Togwotee Pass	April	5.6 inches
Togwotee Pass	May	6.3 inches
South Pass	April	6.4 inches
South Pass	May	4.9 inches
Little Warm	April	3.1 inches
Little Warm	May	4.9 inches

The pattern was reversed in April. South Pass received around 6.4 inches of precipitation for the month, compared to 5.7 inches at the Togwotee site. SNOTEL sites, north of Dinwoody had an increase of 1 to 2 inches of water content in the snowpack in May over April. Most sites to the south had a decrease of nearly 1 inch in May, as compared with the previous month. Also, the southern end of the Wind River Mountains were very dry until April of 1991. Much of the precipitation that fell in April percolated into the ground, so excessive runoff was limited. On the other hand, there was already a healthy snowpack in the Northern Wind River Mountains. Heavy precipitation occurred there in May, and was captured by this snowpack.

Water levels on rivers increased in May because of warmer temperatures and the wet weather in the Rockies. It was difficult to tell how much precipitation fell in areas outside the SNOTEL network, especially to the north where they are spaced far apart. However, SNOTEL locations provided important information between 8,500 feet and 10,000 feet above mean sea level. If the snow water equivalent (derived from sensors at each site) increases with precipitation, then the moisture falling is in the form of snow. Most of the moisture that fell above 8,500 feet, in April and May, was snow. A six-to-one ratio of snow water was used in the mountains to help approximate new snow depth.

4. Results

The additional precipitation in May, on the north and east slopes of the Wind River Mountains, pushed water levels up over time. The Big Wind River originates east of Togwotee Pass in the Northern Wind River Mountains (Figure 7). The Big Wind River is one of the largest rivers in west central Wyoming, and its tributaries played a big part in the flooding. Figure 7 also points out that most streams and creeks near the mountains have a north to northeast direction of flow before entering the upper part of the Big Wind. This favored better run-off by late May, especially since the northern slopes were receiving more sunshine. Figures 1-4 show the Wind River from around Crowheart, Wyoming down to Riverton was flowing fairly steady through the end of May.

Red Creek was one of the first to flood in the beginning of June (Figure 8a). Snow in areas of the mountains not detected by any measuring sites was also melting into rivers and streams near the Big Wind. In addition, most rivers and streams originating from around South Pass to west of Lander, at Hobbs Park, reported large rises in water levels during the first week of June. The three branches of the Popo-agie (po-po-sha) River did not have major flooding problems except where they approached the Little Wind River southwest of Riverton. Figure 8b shows the branches of the Popo-agie, from the Wind River Mountains, leading into the Wind River Basin. With this, the Little Wind also had a sudden rise in river stage by early June (Figure 6). This was not from just snowmelt.

5. The Final Factor

A significant storm system on the last day of May and the first few days of June 1991 was a big contributor to the flooding problems. The storm system moved into the area with Lander receiving 1.55 inches of rain over a 3-day period. The spring storm mainly affected areas southwest and west of Lander in and near the Wind River Mountains. The SNOTEL data to the west of Lander (Townsend Creek, Hobbs Park) collected three to four inches of precipitation in the 3-day period. There were possibly greater amounts in data void areas, especially around 8,500 feet. As a result of the heavy precipitation, waters reached flood stage on the Popo-agie and then the Little Wind River. Most of the precipitation was rain, which had fallen on an isothermal snowpack. This resulted in a higher meltout in the Wind River Range.

Very little precipitation from the storm fell in the northern parts of the Wind River Mountains. But again, melting snowpack from earlier storms, in that region, filled all tributaries leading into the Big Wind River. This was combined with the additional water from the north and middle forks of the Popo-agie River (area of heaviest precipitation from the early June storm), and other water channels that caused the flooding. By the second week of June, the Wind River at Riverton had peaked at 10½ feet (1½ feet over flood stage). At the same time, the Wind River was flooding in places near Dubois, Wyoming and downstream at Crowheart. The highest stage readings on the DCPs were noted during the late evenings and mornings. Lag time of the water flow from the mountains to parts of the basin made it possible to route the crests down the Wind River.

The middle of June finally had temperatures at or above normal in west central Wyoming. By that time, almost all SNOTEL locations, in the Wind River Mountains, reported little or no snow. The warm temperatures melted the bulk of snow up to 10,000 feet. However, the Big and Little Wind Rivers, near Riverton, were above flood stage on the 16th and 17th of June from the flood waters (Figures 2 and 6). This showed that the snow on the middle slopes of the Wind River Mountains (or from about 8,000 to 10,000 feet msl) had the largest impact on many full rivers and streams. It was not until the 18th of June when all rivers in the Wind River Basin fell below flood stage. Channels and intersections were no longer backed up, and flow returned to normal.

6. Conclusions and Remarks

This study explained the reasons behind the 1991 Spring flooding in the Wind River drainage, mainly on the Big Wind River near Riverton, Wyoming. Two to three foot rises in river stages during the first week of June created quick flooding problems that lasted through the middle of June. Heavy spring precipitation, both snow and rain, coupled with delayed runoff led to this sudden flooding along a stretch of rivers and streams in west central Wyoming. The SNOTEL Network represented the flood and water supply potential well, but these data networks were not dense enough to catch heavy pockets of snow. Furthermore, April and May were wet months in terms of precipitation. Rivers and streams flowing into the Big and Little Wind Rivers were running high when the additional precipitation fell across the region. In this situation, all guidance provided pointed to lowland flooding in areas of this study.

Although runoff from the Wind River Mountains is a prolonged occurrence in normal years, the rain that fell in parts of the mountains the last day of May to the early days of June changed that pattern. Flooding or high water is common when heavy rain is added to a deep snowpack. Further study into mountain snowpack and precipitation will help in the forecasting and timing of flood events such as the one in the Wind River drainage. But first, additional observing sites and Snowtels will be needed for more accurate data to help the forecasters and hydrologists.

7. References

October 1992: Conversation with a Hydrologist at WSFO Cheyenne, Wyoming.

October 1992: Guidance from Missouri Basin River Forecast Center, Pleasant Hill, Missouri.

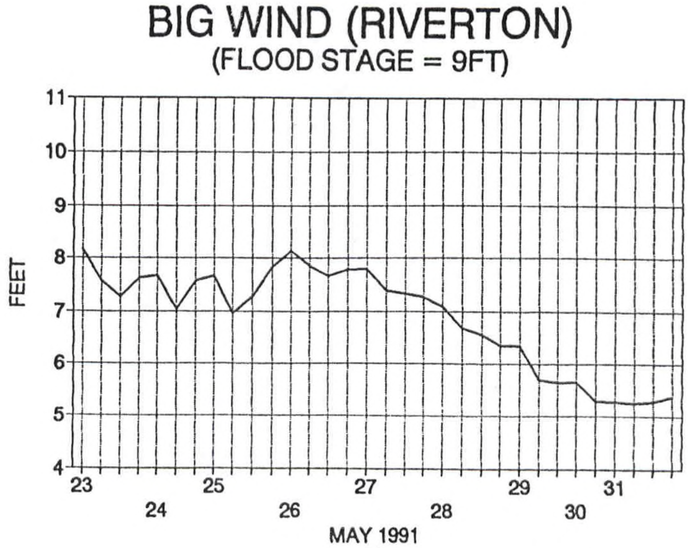

Figure 1. Water Height on the Big Wind River (Riverton) at the end of May.

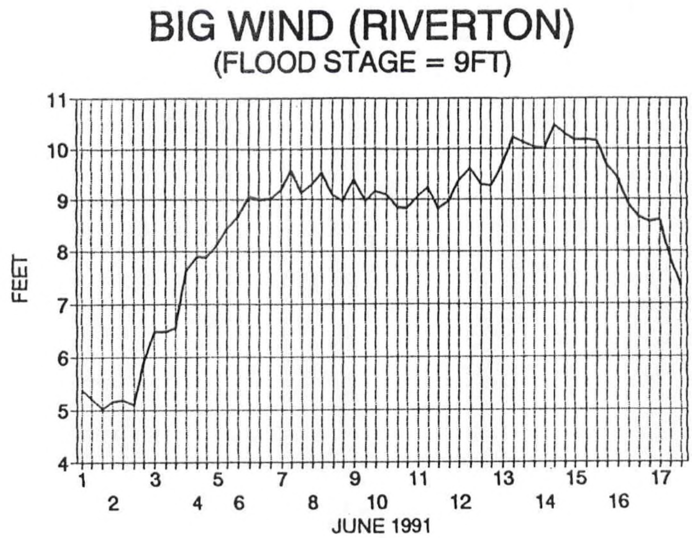

Figure 2. Increase in water levels on the Big Wind from the beginning of June through the middle of June 1991.

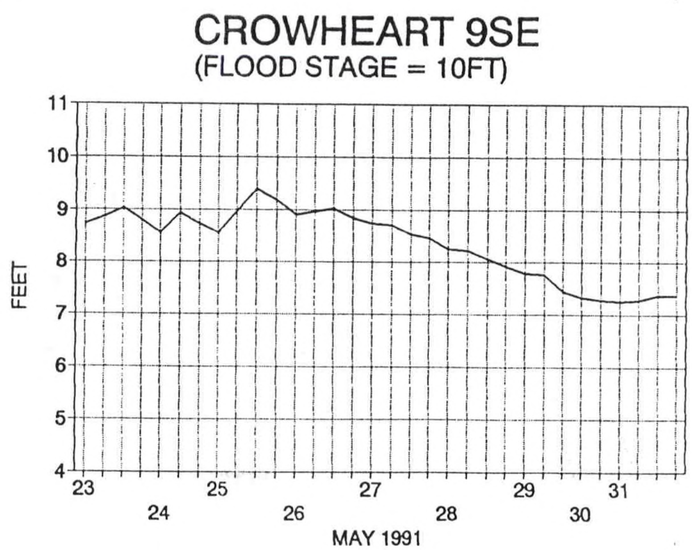

Figure 3. Water height upstream on the Big Wind River (Crowheart, Wyoming) at the end of May.

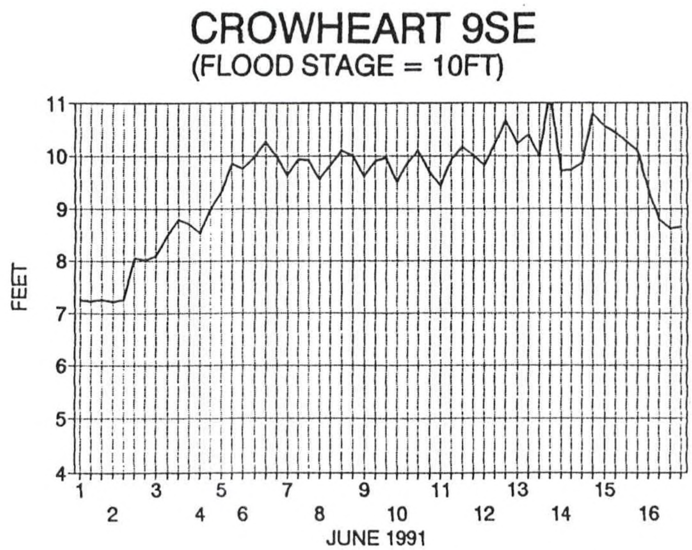

Figure 4. Similar trends to the Big Wind at Riverton with water increasing in the beginning of June. Levels remained high through the middle of June 1991.

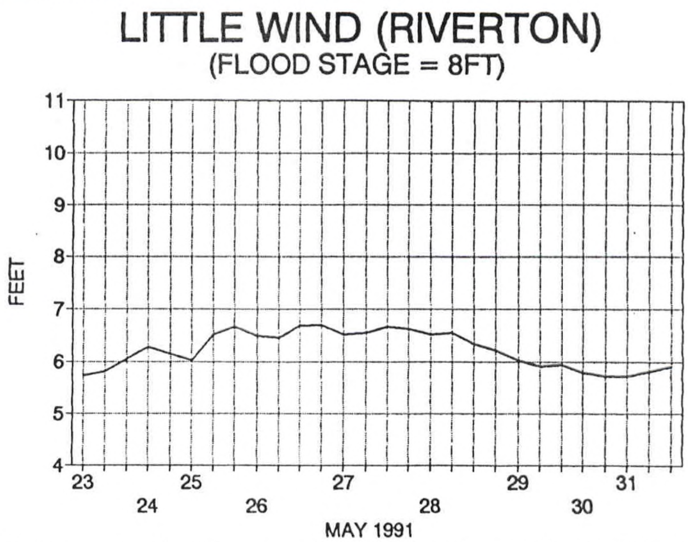

Figure 5. Water height on the Little Wind River (Riverton) at the end of May.

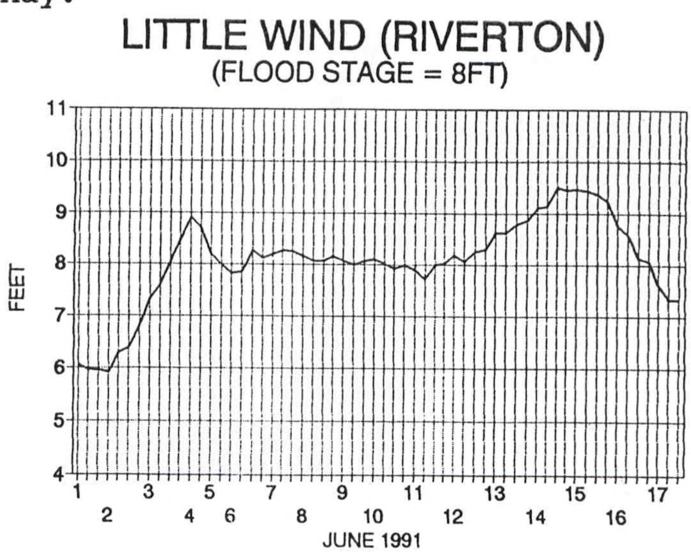

Figure 6. Rise in water levels on the Little Wind River beginning the 2nd of June, and continuing through the middle of June 1991.

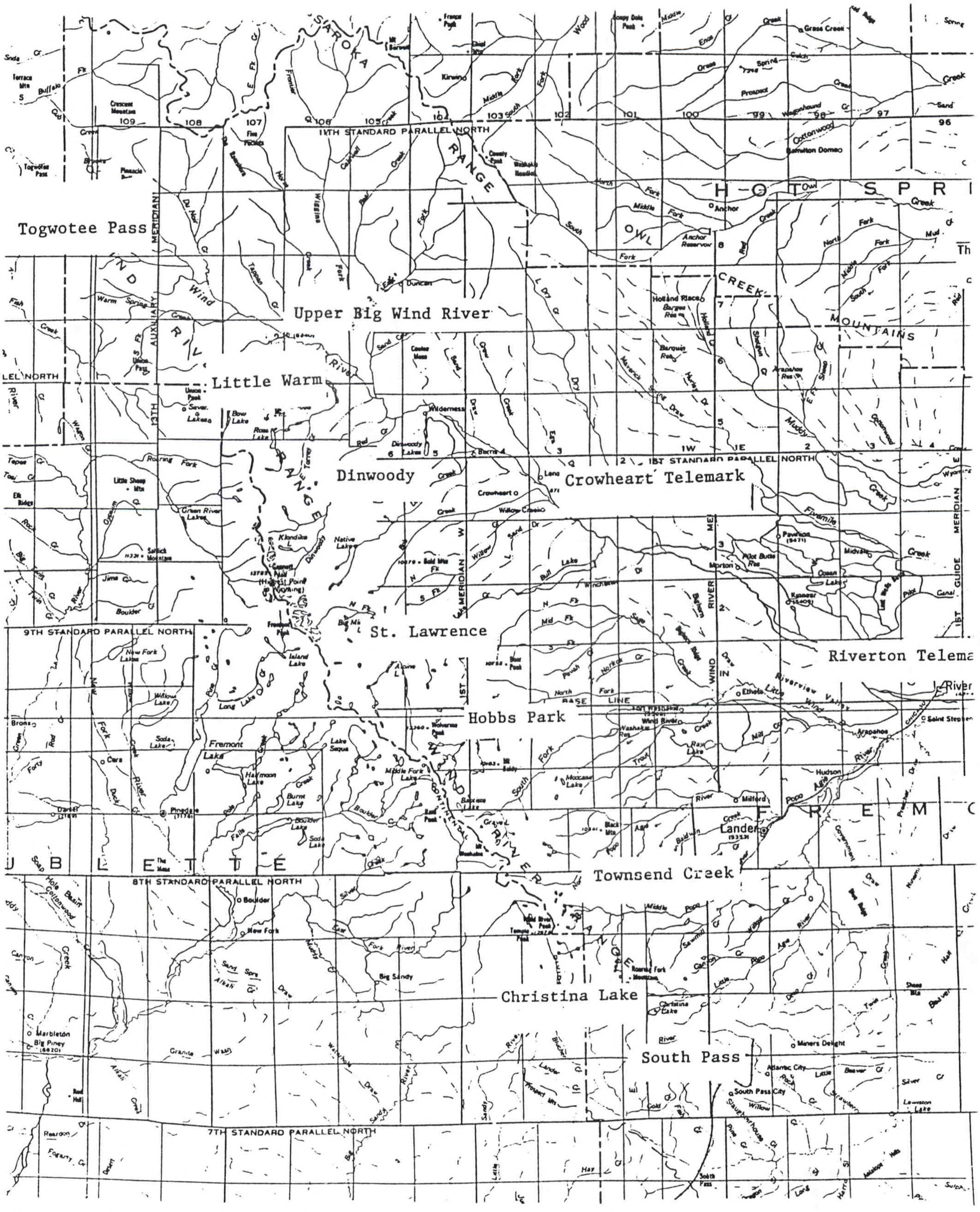

Figure 7. Map of West Central Wyoming, including SNOTEL Networks in the Wind River Mountains and the 2 Telemark Gages used for this study. All are printed near their respected locations.

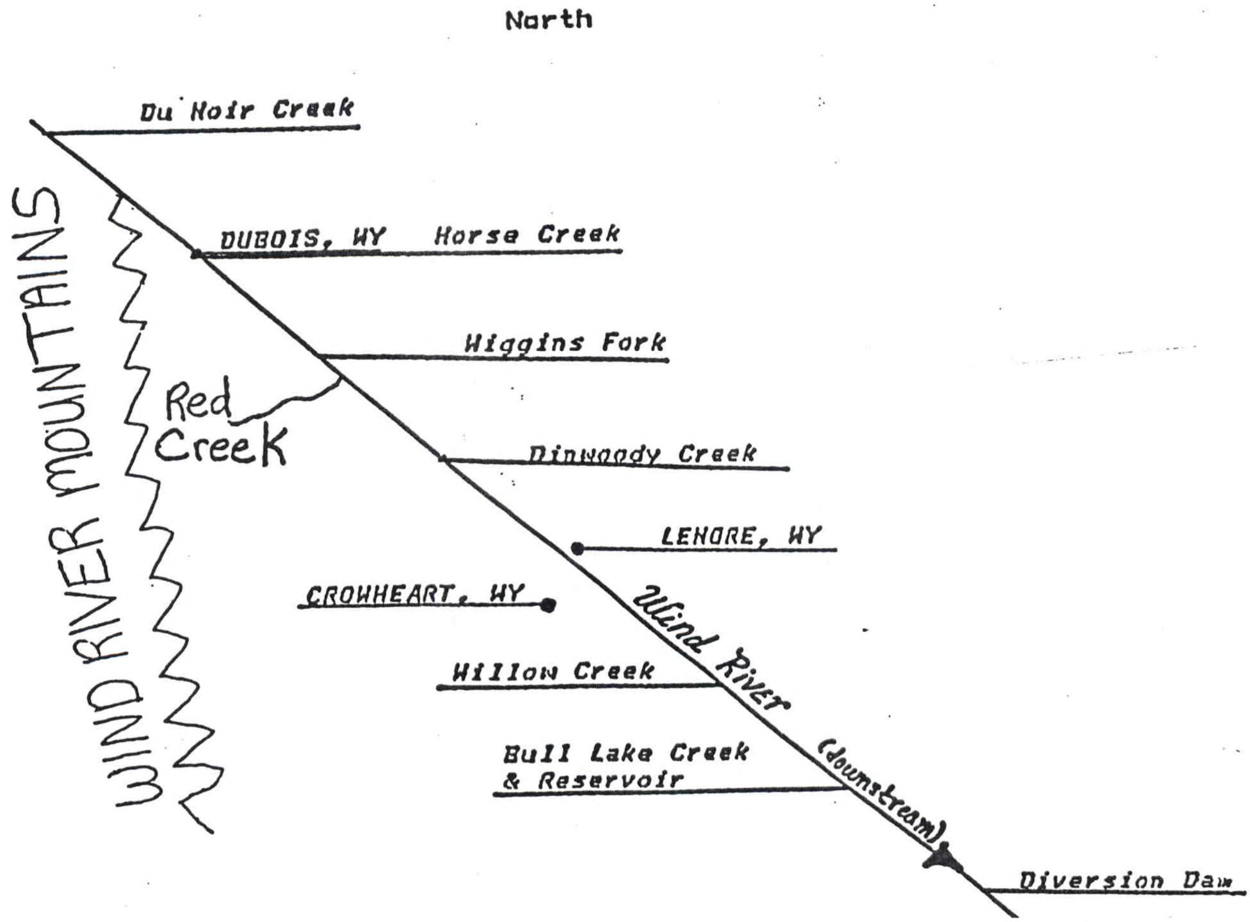

Figure 8a.

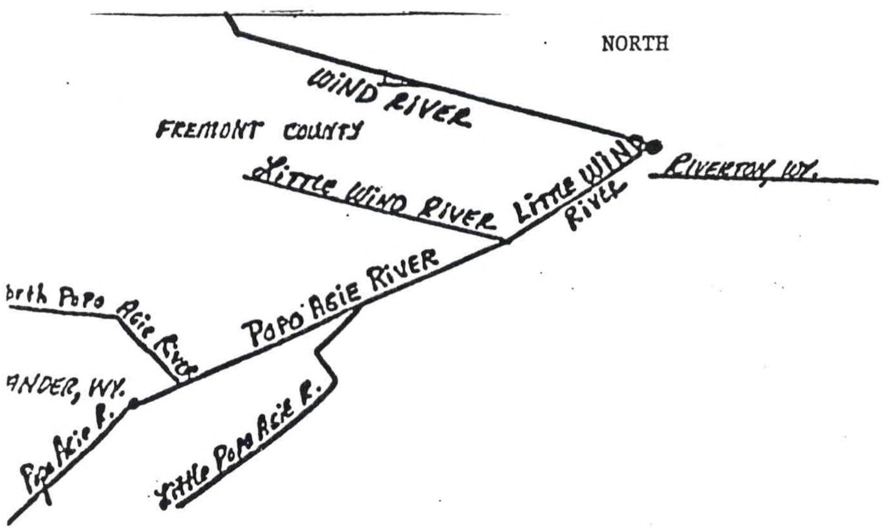

Figure 8b. This is the outline of the rivers flowing into the Little Wind River near Riverton. Major flooding was noted just southwest of Riverton.