The Oxbow
FROM THE NORTH DAKOTA STATE WATER COMMISSION

THE 2013 FLOOD: THE FLOOD THAT WASN'T

By Michael Noone

Flooding in North Dakota has been distressingly common over the last two decades, and in recent years serious floods have occurred on a more regular basis. In the spring of 2013, experienced flood prediction professionals were very concerned that a serious, perhaps record-breaking flood was looming, especially in the Red River Valley, and though that is not what ultimately occurred, it is important to understand why there was so much concern about flooding. This article will look at the conditions prior to the 2009 and 2011 floods, how flood forecasts are made, review the extremes experienced in the winter of 2012-2013, and the lessons that have been taken away from what actually occurred.

The 2009 Flood

The fall of 2008 and winter of 2009 were what people have come to think of as a "typical" flood year; heavy rains in the fall saturating the soil, a significant amount of snow over the winter, and then a rainstorm during the spring melt. The results of these conditions were floods of record for Fargo, Valley City, and 21 of the rivers, streams, and lakes in North Dakota. (For a more detailed overview of the flood of 2009, please see the 2009 Special Edition of North Dakota Water magazine.)

The 2011 Flood

Like the 2009 flood, much has been written about the flooding in 2011, which was especially catastrophic in northern and western North Dakota (please see the "Historic Floods of 2011" Special Edition of North Dakota Water magazine). As in 2009, the Red River Valley saw a wet fall and significant snowfall, but was spared significant spring rainfall. The spring runoff was relatively late in the year, with a Red River crest at Fargo on April 9. In other areas of the state, such as Minot, the combination of a wet fall, heavy snow, and record-shattering spring rains over a watershed with nearly full reservoirs resulted in widespread devastation.

Flood Forecasting

To heavily summarize how flood forecasting is done, experts in the necessary disciplines first collect accurate data on the topography of the area being examined, the amount of moisture in the soil, on the ground, and in the waterbodies. Then they look at the period of record for which we have meteorological information, find the years that most closely resemble the year we are currently experiencing, and lastly use complex mathematical models in order to see what may occur under a range of conditions, such as more snow, a late spring, a big rainstorm, etc…

This brings to light a potential problem: What if the weather or conditions you have, are drastically different from anything that has occurred during the period of record? In that case, your predictions of what is going to occur may be drastically different as well.

The Winter of 2012-2013

For the majority of 2012, North Dakota was in a fairly serious drought. The effects of lower than average precipitation were eased somewhat by the significant amount of moisture contained within the soil after nearly two decades of a wet cycle, but entering into the winter of 2012-2013, the soil's moisture had been effectively tapped. October represented a change in the dry pattern, with

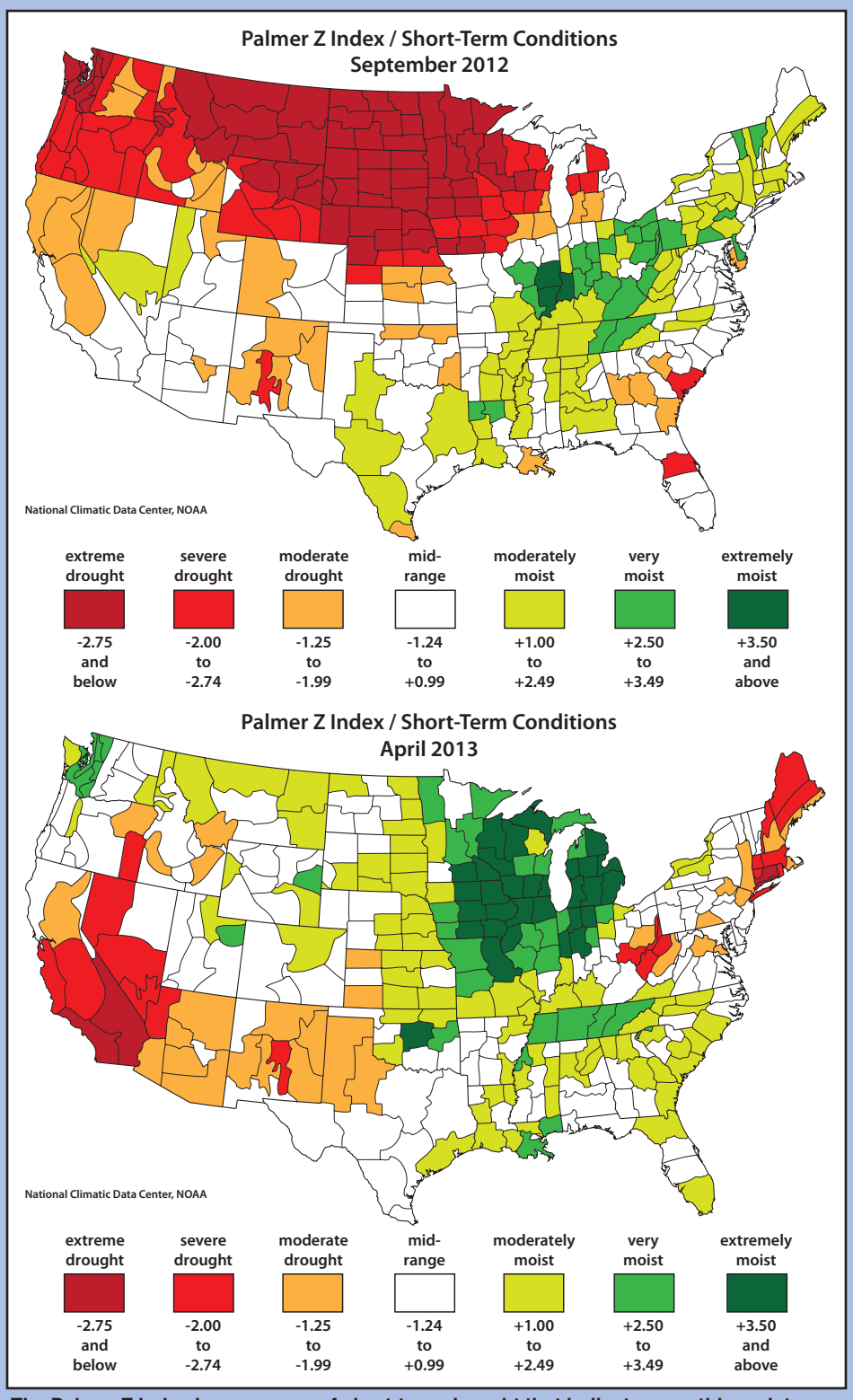
many areas of the state receiving 2-3" of rain. The next few months did not produce significant snowfall, but in the beginning of March, several snow events resulted in increasing moisture accumulations.

Snowpack In Spring of 2013

Although the beginning of the winter of 2012-2013 seemed to indicate a mild spring, the significant amounts of snowfall received in the late spring, caused many professionals in the water and emergency management fields a great deal of concern. In March and April, snowfall amounts greatly surpassed "normal" amounts for that time of year. Almost overnight, it seemed, several watersheds in the state appeared to be facing significant spring flooding, based upon the moisture content in the snow. The Red River, Devils Lake, and Mouse River basins all contained snow-moisture amounts equal to or greater than what had been measured during their floods of record. Throughout the state and region, various cities, states, and agencies began preparing for potential record-breaking flooding; increasing their on-the-ground monitoring, enacting preventative measures such as staging sandbags, and ensuring adequate coordination amongst the many and varied local, state, and federal entities who all have a stake in flood planning and protection.

The record flooding, and corresponding damages in 2009 and 2011 gave flood forecasters, resource professionals, and local units of government good reason to be concerned when facing a year when the moisture in the snowpack was as bad or worse than what had already been experienced.

With snowpack moisture at record levels and a record late spring melt looking likely, one important variable became the low soil moisture going into the winter season. The unique combination of high snow moisture content, a late spring, and dry soil in the preceding fall had not been experienced at



The Palmer Z Index is a measure of short-term drought that indicates monthly moisture condition differences from normal. In September of 2012, North Dakota was in a severe drought, but by April of 2013, the winter moisture received in the form of snowfall had reversed that trend. Source: NOAA

Snow Moisture Content

Upper Red River Basin	Devils Lake Basin	Mouse River Basin
2009 (March 14) 2.8 million acre-feet **(Record Flood)**	2009 (March 14) 0.78 million acre-feet	2009 (March 14) 2.9 million acre-feet
2011 (March 26) 2.9 million acre-feet	2011 (March 26) 0.83 million acre-feet **(Record Lake Elevation)**	2011 (April 4) 3.3 million acre-feet **(Record Flood)**
2013 (April 22) 3.6 million acre-feet	2013 (April 22) 1.2 million acre-feet	2013 (April 14) 3.7 million acre-feet

A comparison of snow moisture content, as measured by the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) (http://www.cocorahs. org/) which collects snowpack moisture information.

these levels during the period of record. Another important variable became the rains that North Dakota typically receives in April and early May and their potential for worsening flooding conditions.

As was described earlier, flood forecasting is, to oversimplify, taking records of conditions from various years, on-ground physical information, and then applying complex math and experience in order to come up with a range of possible outcomes, from likely to unlikely. When you get a year that lies significantly outside what has been experienced previously, it grows increasing complicated to make predictions about what is going to occur.

Those responsible for public safety tend to be very conservative and cautious, and for good reason. Taking risks with property, and especially human lives is not something anyone wants to do. In the absence of a good model for predicting how the spring flood would evolve, caution dictated erring on the side of public safety, which is what those responsible did. If the worst-case scenario that was predicted by the models had occurred, devastation on par with what happened to Minot in 2011, but on a greater scale, was a real possibility.

The Flood That Wasn't

As we know now, the 2013 spring flood ended up far lower than what the models predicted. So, what happened?

Red River at Fargo
Predicted Crest (50% Chance) made on April 17, 2013: **40.3'**
Actual Crest on May 1, 2013: **33.3'**

A lot of the behind the scenes groundwork is ongoing, but it appears that a really dry year preceding a wet winter and a late spring, provided sufficient storage in the soil to absorb a significant portion of the snows' moisture. At this time, the speed at which the soil absorbed the snow moisture is still an unknown. What is known is that significant spring rains were fortunately delayed until the latter half of May, allowing for the existing water systems to handle the volume of snowmelt passing through them. In the future, flood forecasting will take into account the winter of 2012-2013 and the models that predict the next potential flood will be better, having incorporated another unprecedented year during their period of record.

It is important to note that although this spring did not result in significant spring flooding, 2013 has seen some instances of serious post-spring flooding. Periodic heavy rains that have fallen after the spring runoff, in addition to soils that are again saturated, have caused flooding in the Lower Red River and Mouse River basins, with dams being threatened and urban and rural flooding.

The public's perception of flood forecasting is often that it is an exact science. However, it is important to remember that North Dakota's detailed weather recording history dates back a little more than a century. There are longer-term indicators of climate between the end of the last ice age, approximately 13,000 years ago, and when detailed records began, that show evidence of serious droughts like the "Dirty Thirties" and the wet cycle like we are currently experiencing, but lasting for decades, and of a far greater severity than has been experienced. In the face of such extremes, the professionals doing their best to protect the people and property of this region are justifiably wary.

It has been said, that everything appears to have been inevitable, in recollection. It is fortunate that the people of North Dakota have so many professionals working on their behalf to ensure the worst-case scenario is not so inevitable.

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