

# Northern Cheyenne Tribe Drought Mitigation Plan



Rosebud Valley between Busby and Lame Deer

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# Northern Cheyenne Drought Mitigation Plan

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## **Executive Summary**

The Northern Cheyenne Tribe has prepared this drought mitigation plan to better prepare for drought and its potential direct and indirect impacts.

The drought policy of the Northern Cheyenne Tribe is to monitor drought conditions and using a Drought Advisory Committee (NCDAC), work to ensure:

- all residents have an adequate supply of potable water for drinking, basic health needs, and cultural purposes,
- water is available for agriculture and livestock,
- water is available for fire suppression, and
- water is available to sustain the fish and wildlife resources of the Reservation, and
- that adequate sources of water are identified prior to any new proposed development.

This plan provides background information about the Reservation and previous instances of drought, discusses existing water uses, and identifies potential impacts of drought. The plan also identifies drought verification indices and proposes drought mitigation in the form of goals and mitigation measures or projects. The goals are as follows:

- 1) Establish a tribal Drought Advisory Committee (NCDAC).
- 2) Continue to monitor water quantity and quality on the Reservation.
- 3) Avoid adding demand for water that can not be met.
- 4) Be prepared to provide adequate amounts of domestic and drinking water to communities, rural residents, and medical facilities.
- 5) Increase the resiliency of agriculture and stock production to drought.
- 6) Reduce potential for catastrophic wildland and urban interface fire.
- 7) Reduce negative impacts to fish and wildlife from drought.

The plan is consistent with and builds upon the tribe's Water Code and the draft Northern Cheyenne Pre-Disaster Mitigation Plan.

## **Acronyms Used in This Plan**

BIA	Bureau of Indian Affairs
DNRC	Montana Department of Natural Resources and Conservation
DMP	Drought Mitigation Plan
EPA	Environmental Protection Agency
FWP	Montana Fish, Wildlife and Parks
GWIC	Montana Ground Water Information Center
MBMG	Montana Bureau of Mines and Geology
NCDAC	Northern Cheyenne Drought Advisory Committee
NCR	Northern Cheyenne Reservation
NRCS	USDA Natural Resources Conservation Service
NRIS	Montana Natural Resource Information System
NWS	National Weather Service
PDM	Pre-Disaster Mitigation Plan
PDSI	Palmer Drought Severity Index
SPI	Standard Precipitation Index
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

# **I. Introduction**

## **Project Area Description**

The project area for this plan is the Northern Cheyenne Indian Reservation. The Northern Cheyenne Reservation was created by the Executive Order of the President of the United States in November 1884.

The Northern Cheyenne Reservation is located in southeastern Montana and encompasses 442,193 acres. The Crow Indian Reservation borders the Northern Cheyenne Reservation to the west. The nearest town with additional emergency services beyond Reservation boundaries is Hardin, approximately 55 miles west of Lame Deer (on Interstate 90 to the west, north of Crow Agency). The next closest resource center is Billings, the largest city in Montana (2000 population of 89,847)

The Northern Cheyenne Tribe operates under a constitution consistent with the Indian Reorganization Act. Tribal government consists of a Tribal Council (with representation based on population in the various districts), headed by a President, elected at large for a four year term.

The Northern Cheyenne Reservation is in the open, rolling country of southeastern Montana. Much of the landscape is dry open rangeland, with smaller areas of irrigated farmland along river bottoms. The area also contains some forestland, primarily in the hills. Elevations range from approximately 3,000 to 5,000 feet above sea level.

More than 97% of all of the land within the Reservation remains in tribal hands, most of it held in common by the tribe and in trust with the federal government. The private land holdings not held by tribal members are primarily agricultural land along the Tongue River and within the town of Lame Deer (Northern Cheyenne Reservation Emergency Operations Plan). The predominant land use on the Reservation is agricultural.

The Northern Cheyenne Reservation population is on the rise. Between 1990 and 2000, the number of persons living on the Reservation increased by 14%. There were 4,471 persons living on the Northern Cheyenne Reservation in 2000, according to the U.S. census.

The Northern Cheyenne Reservation private sector economy is based primarily on livestock. Businesses within the boundaries of the Reservation include a laundromat, hardware store, restaurants, bank, gas station, and a grocery store. With a few exceptions, all private commercial businesses are located in Lame Deer.

Government employment accounted for roughly half of all workers on the Northern Cheyenne Reservation according to the 2000 census (U.S. Bureau of the Census, Table DP-3) Major government employers on the Reservation include the Northern Cheyenne Tribe, Bureau of Indian Affairs (BIA), Indian Health Service, and educational institutions.

Per capita income on the Northern Cheyenne Reservation in 1999 was \$8,224, compared to the national per capita income of \$21,587. In 1999, 46% of all persons on the Reservation were at or below poverty level, compared to a national poverty rate of 12%. (U.S. Bureau of the Census)

Future development is anticipated to be similar to what has occurred over the past ten years. Population is expected to continue to increase with resulting increased demand for additional housing. In addition, many existing homes are in severe disrepair and could necessitate complete rebuilding. There is a potential for the tribe to build a gaming casino on the off-Reservation lands near the Tongue River Reservoir. There is also some potential that coal and gas could be developed in the future.

### **Drought Policy**

The Northern Cheyenne Tribe adopted a Water Code in 1999 and subsequently amended the code in 2000 and 2001. The tribe declares its water policy as follows: *“Preserve and protect in perpetuity the quantity and quality of tribal water resources and to exercise the self-determination of the Tribe through the wise use, administration, protection and management of tribal water resources.”* (Northern Cheyenne Water Code)

The drought policy of the Northern Cheyenne Tribe is to monitor drought conditions and using a Drought Advisory Committee (NCDAC), work to ensure:

- all residents have an adequate supply of potable water for drinking, basic health needs, and cultural purposes,
- water is available for agriculture and livestock,
- water is available for fire suppression, and
- water is available to sustain the fish and wildlife resources of the Reservation, and
- that adequate sources of water are identified prior to any new proposed development.

## **Plan Preparation**

The plan was prepared by Beck Consulting with the assistance of many. Allen Clubfoot, Director of Natural Resources for the tribe provided guidance and numerous key contacts within the tribe. Joel Adams, hydro-geologist, of HydroSolutions, Inc. researched and wrote the description of Groundwater resources found in Section II. The Northern Cheyenne Pre-Disaster Mitigation (PDM) Plan was drawn upon heavily for the background and drought history sections. The PDM Plan was prepared by Cossitt Consulting.

Also consulted were employees of the Natural Resources Conservation Service, the Bureau of Indian Affairs, the U.S. Geological Service, the Environmental Protection Agency, the Montana Bureau of Mines and Geology, and Montana Fish, Wildlife and Parks. These individuals are cited in the text and referenced as appropriate. Information was obtained from the National Drought Mitigation Center at the University of Nebraska, Lincoln. Drought management plans prepared by other tribes, specifically the Ft. Peck, Navajo, and Hopi plans were reviewed. Finally, various state and federal data bases, maps, and plans were utilized.

The tribe's drought policy was drafted by the contractor and reviewed by the participants at the meeting held in Lame Deer on December 6, 2006. Goals and mitigation projects were also developed by the group at this meeting, then organized and formatted by the contractor. A 30-day comment period was provided from December 15, 2006 to January 15, 2007. Sixteen copies of the draft plan were mailed directly to various tribal departments, organizations, individuals, and state and federal agencies. The draft plan was posted on the tribe's website. A small number of primarily editorial comments were received and were incorporated into the draft plan.

## **Plan Organization**

This plan is organized into five sections.

- Section I is the introduction and provides background information about the Reservation.
- Section II describes the water resources of the Reservation, both surface and groundwater.
- Section III lists the existing water uses on the Reservation.
- Section IV provides a history of drought including past occurrences, drought definition, and lists the potential impacts of drought.
- Section V contains the drought monitoring and verification indices that will be used to determine drought severity on the Reservation.
- Section VI is the drought response or steps that can be taken to prepare for and deal with long-term drought.

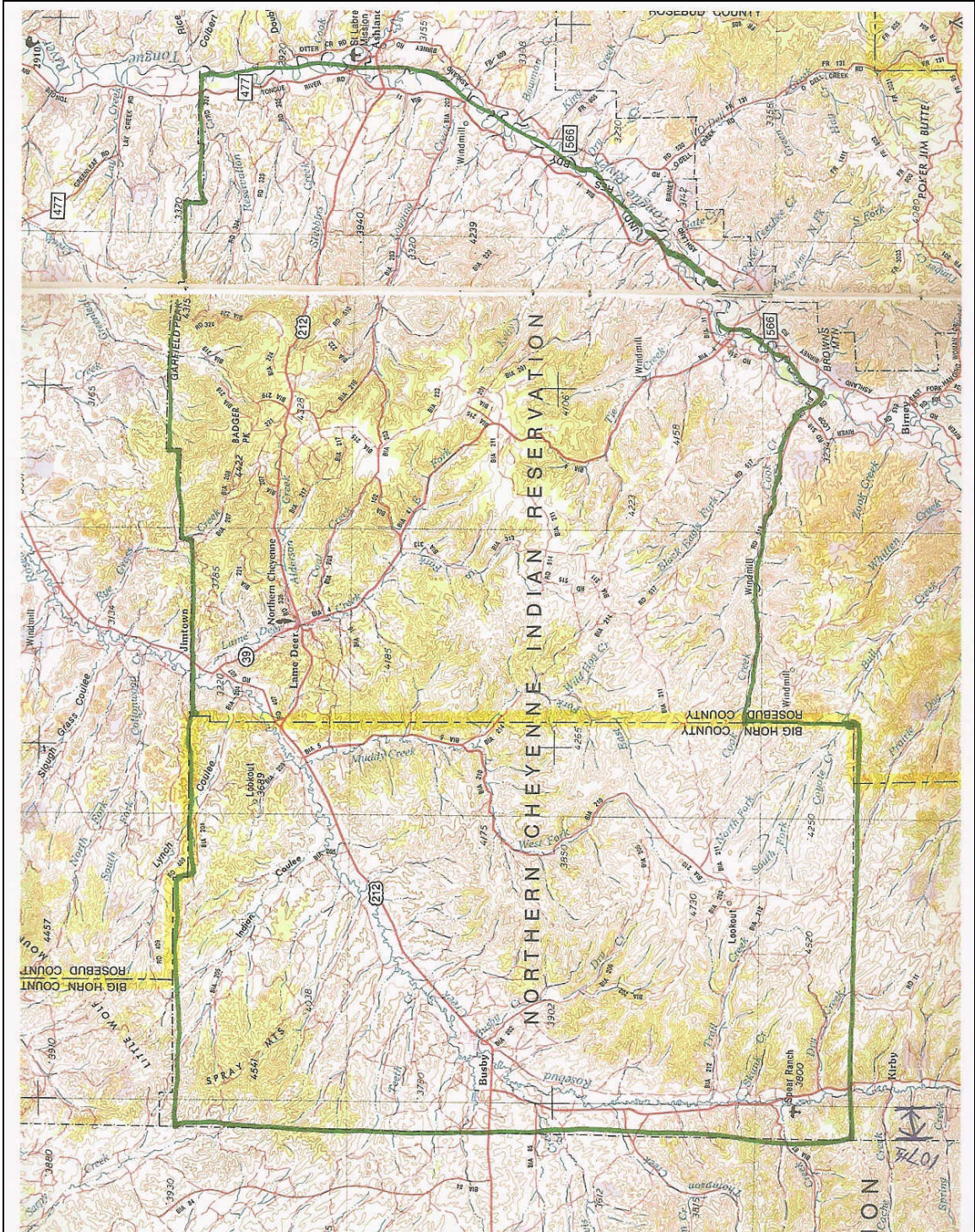


Figure 1. Northern Cheyenne Reservation



## II. Water Resources

*“The management and protection of water is a central attribute of tribal sovereignty and is vital to the health and welfare of Reservation residents and to the vitality of the Reservation economy and environment.”* (Northern Cheyenne Water Code, Finding #1)

Average annual precipitation ranges from approximately 14 to 24 inches, with higher precipitation in the hills. (Montana Natural Resource Information System, Map of Average Annual Precipitation 1961-1990) Average annual snowfall is approximately 46 inches in Lame Deer, 51 inches in Busby, and 30 inches in Birney. (Western Regional Climate Center)

### Surface Water

Major rivers and creeks include the Tongue River, and Rosebud, Muddy, Lame Deer, and Cook Creeks. The Tongue River forms the eastern boundary of the Reservation. Rosebud Creek flows along the western border of the Reservation and then crosses the northwest portion of the Reservation. Both the Tongue River and Rosebud Creek flow northeastward in broad, alluvial valleys. The tribe also has rights to water in the Bighorn River. Flows on the Bighorn River at St. Xavier have ranged from 600 to 1700 cubic feet per second from October 1, 2006 through mid-January 2007. Flows on the Tongue (at Decker) have ranged from 60 to 518 CFS over the same period. (USBR Hydromet data base) Flows on both the Big Horn and Tongue Rivers are affected by upstream dam releases.



Rosebud Creek between Busby and Lame Deer

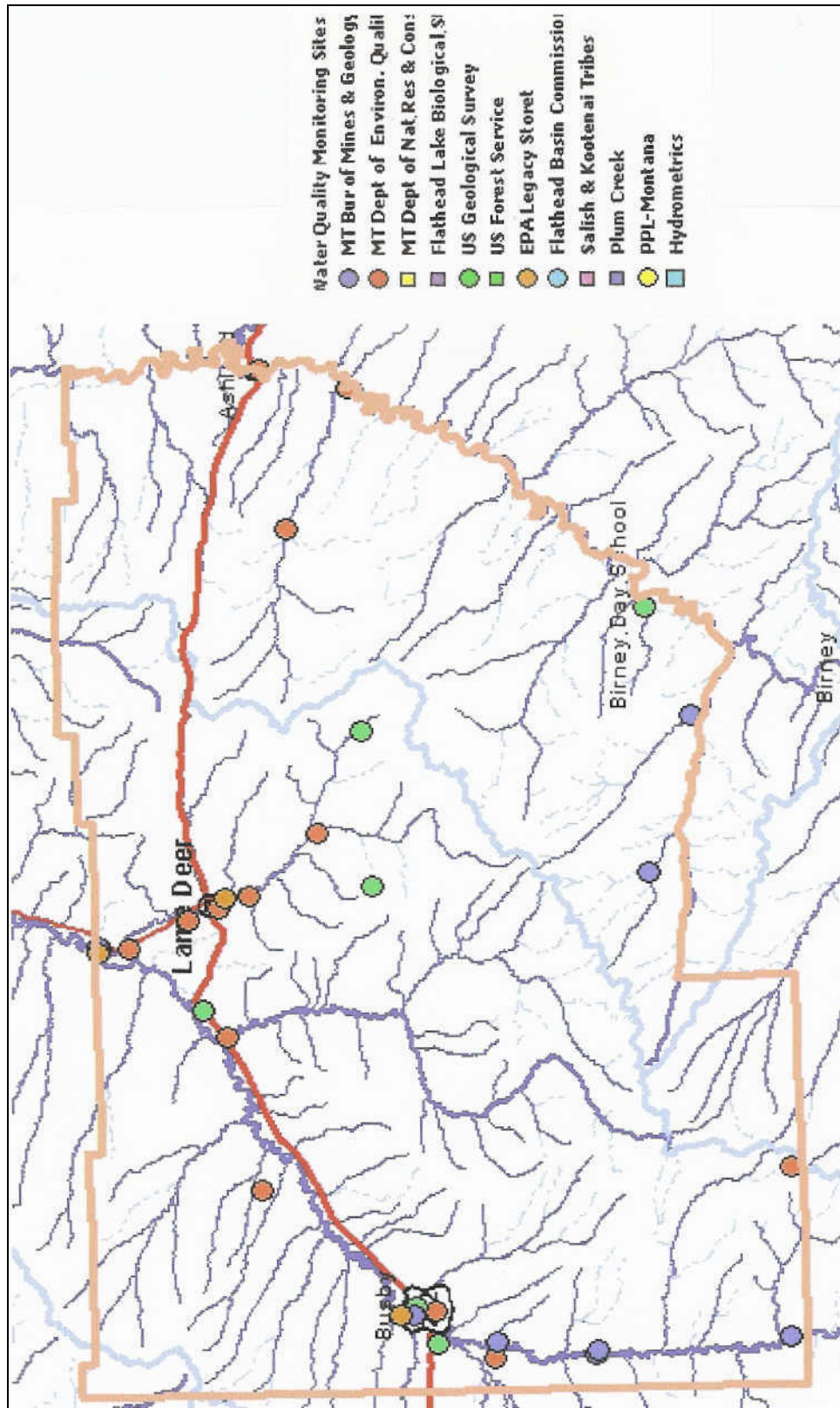


Figure 2: Water Quality Monitoring Sites  
 Source: Montana NRIS

## **Ground Water**

Groundwater produced from wells and springs is an important source of domestic, municipal and livestock water on the Northern Cheyenne Reservation (NCR). A search of the Groundwater Information Center (GWIC) data base indicates that over 200 wells are present within the boundaries of the Reservation (Figure 2). It is not mandatory to submit logs for wells drilled on the NCR to the Montana Bureau of Mines and Geology, therefore, the GWIC data base is not a comprehensive source of water use data for the Reservation. It is likely that the actual number of wells is significantly greater than is reported.

Although no recently-published information was located regarding the use of springs, it is reported that many residents rely on springs such as Crazy Head Springs located on the Lame Deer - Ashland divide, for drinking water (Mike Cannon, USGS, personal communication). The use of groundwater for industrial and agricultural uses on the NCR appears to be very limited.

Groundwater flow in the area occurs in two general flow systems (Slagle, 1982):

- Water in shallow aquifers at depths of less than 200 feet tends to have flow patterns that reflect the local topography, and flow distances are shorter. These flow systems often discharge to springs and upland drainages. They are the most likely to reflect noticeable impacts of drought, primarily in the form of decreased spring discharge.
- Water in deeper aquifers (depths greater than 200 feet) has more regional flow patterns and longer flow distances. Drought is unlikely to have noticeable effects on deeper aquifers.

A detailed study of the hydrogeology of the Northern Cheyenne Reservation was published by Woessner, et al (1980), in which six aquifers were identified as being significant (or potential) sources of water (Table 1):

1. Shallow alluvial aquifers associated with surface water bodies (sand, silt and gravel)
2. The Anderson unit of the Tongue River Member of the Fort Union Formation (coals and sandstone)
3. The Knobloch unit of the the Tongue River Member of the Fort Union Formation (coals and sandstone)
4. The Lower Tongue River Member unit
5. Tullock/Hell Creek Aquifer (sandstone)
6. Madison Aquifer (limestone and dolomite).

The shallow alluvial aquifers consist of sand, silt and gravel beds that were deposited by rivers and creeks, and are limited in extent. The largest occurrences of these aquifers are along the Tongue River and Rosebud Creek

drainages. The alluvial aquifers are recharged primarily by run-off of surface water, and regional discharge from deeper groundwater aquifers.

Coals, clinkers and sandstones within the Tongue River Member of the Fort Union formation represent the most common bedrock sources of water on the NCR. High quality groundwater in significant quantities can flow from springs that originate in clinker deposits. Some springs, such as Crazy Head Springs, have large flows that fluctuate with the seasons, indicating substantial local recharge. The clinker deposits are baked sediments that overlays coal beds which burned. Numerous wells are completed in bedrock coal aquifers, which are primarily the Anderson and Knobloch coal seams.

A search of the GWIC database indicates that over 120 additional wells have been drilled within the NCR since 1979, with depths ranging from 25 to 700 feet, and averaging 137 feet in depth. As mentioned above, the number of wells in the GWIC data base likely underestimates the actual number of wells that exist. Numerous monitoring wells have been developed on the NCR for various projects over the past 30 years. These wells may not be included in the well totals.

Drought-related effects are most likely to be seen in local groundwater flow systems that are recharged by direct precipitation and local surface water. These include coal and clinker deposits that are perched above the elevations of major drainages, and shallow alluvial aquifers that are associated with perennial drainages such as the Tongue River and Rosebud Creek, illustrated in Figure 3.

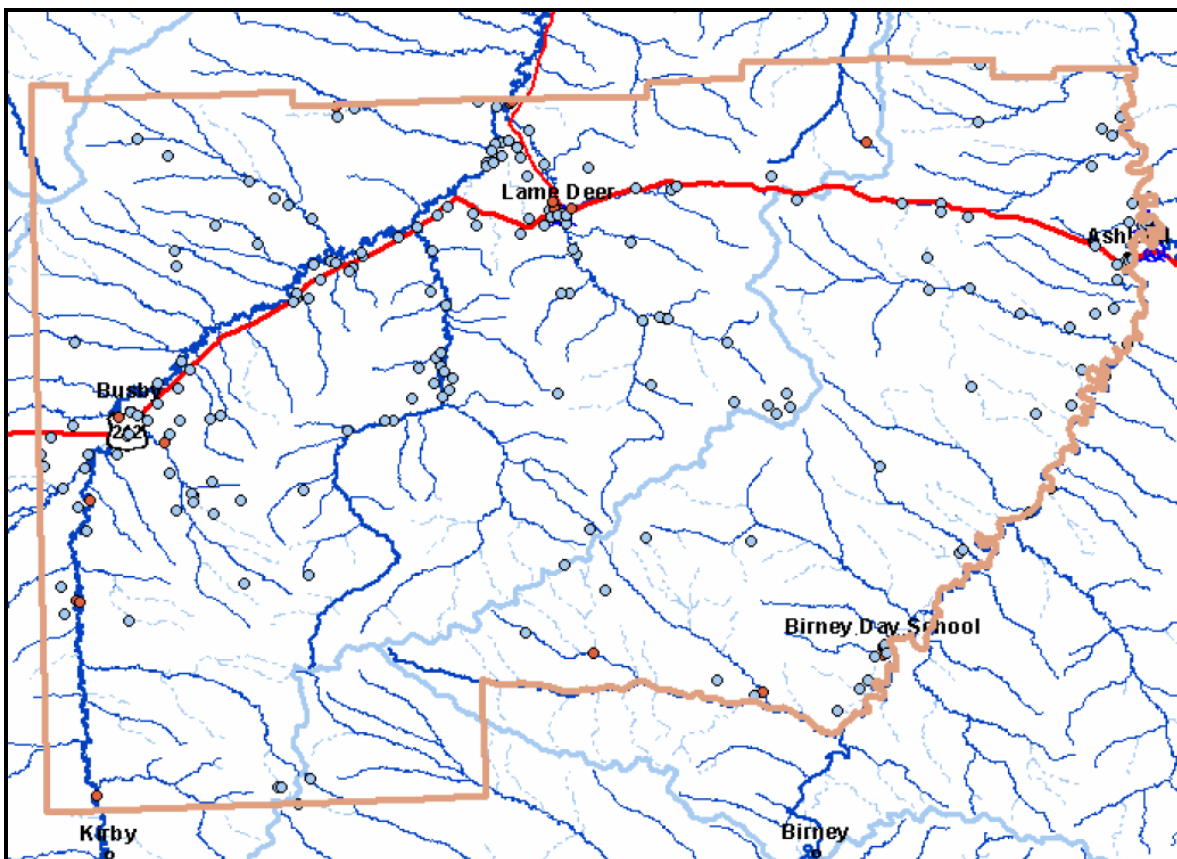
Springs fed by perched local groundwater systems are the most likely to be impacted by drought. The discharge rates of springs originating from clinker deposits tend to fluctuate with the seasons, which indicate that they are recharged locally, and are more susceptible to drought effects. Deeper, confined aquifers tend to be part of larger groundwater flow systems, and are not likely to react as sharply or as quickly to declines in precipitation or the quantity of surface-water available for recharge.

**Table 1: Summary of Aquifers, Wells, and Springs**

Aquifer	Description	Wells <sup>1</sup>	Springs	Yield [gpm]
Alluvial	Unconsolidated silts, sand and gravel deposits, primarily along the Tongue River and Rosebud Creek drainages	80		10 - 700
Anderson Unit	Coal seams and clinker	2	35	1 - 92
Knobloch Unit	Coal seams, sandstone and clinker	52	28	0.2 - 27
Lower Tongue River Member Unit	Coal seams, sandstone and clinker	57	5	1 - 20
Total		191	68	

<sup>1</sup> Domestic and municipal water supplies only (does not include monitoring wells)

Source: Woessner et al (1980)



**Figure 3: Distribution of Wells within the Northern Cheyenne Reservation Boundaries based on a search of NRIS and GWIC databases as of Nov. 2006.**

### III. Water Uses

*“The water resource has cultural, spiritual, social, environmental and economic values that require protection and must guide the appropriate use and management of all resources in the watershed and drainage basins of the Reservation.” (Northern Cheyenne Water Code, Finding #2)*

#### **Agriculture/stock-raising**

Kathy Knobloch of the Natural Resources Conservation Service estimated that there are currently a total of 430 acres under active irrigation on the Reservation. Of this number, 150 acres are flood irrigated with water from Tongue River, 200 acres have pivot irrigation systems from alluvial wells along Rosebud Creek, and 180 acres in the Rosebud and Davis Creek drainages have water spreading. There are no functioning major water projects. Crops produced on the Reservation include; wheat, barley, and alfalfa grass hay.

Grazing is low intensity and the range units are not well watered. Many stock operators rely on springs to water stock and there are some high yielding springs on the Reservation. Most grazing is season long without pasture management. The number of AUM’s (Animal Unit Months) on Reservation allotments are determined by the Bureau of Indian Affairs based on range productivity.



Livestock operation east of Busby

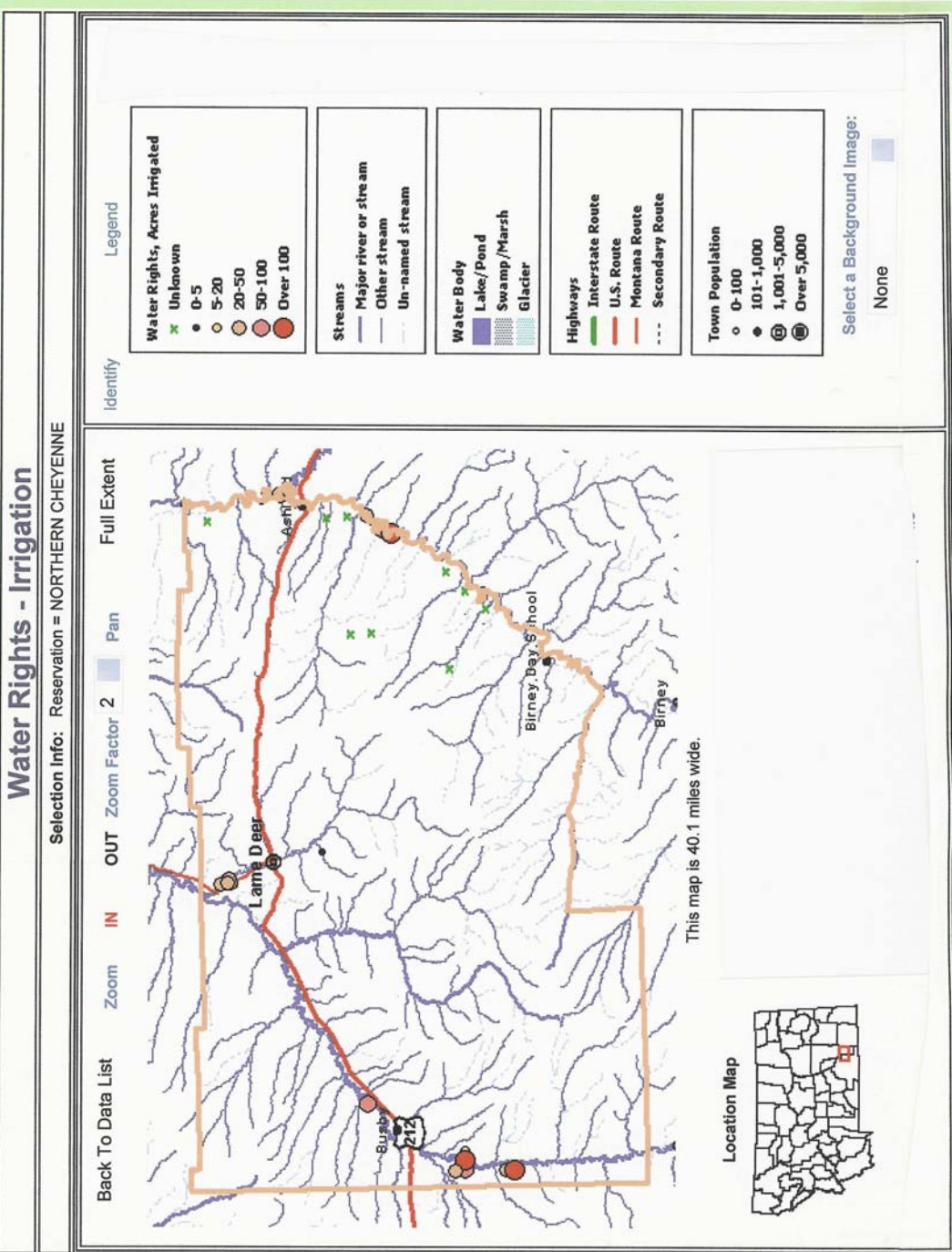


Figure 4: Irrigation on the Northern Cheyenne Reservation

## Domestic and Drinking Water

There are a number of water supply systems on the Northern Cheyenne Reservation. In addition to the systems managed by the tribe, there are also the systems operated by the BIA for the detention facility in Busby and by the St. Labre School for the school campus.



Water storage tank for Busby

Approximately 3,100 people are served with the Northern Cheyenne Tribal public water and waste water systems. Total estimated population on the Northern Cheyenne Reservation was approximately 4,500 persons in census year 2000. Those who are not on public systems generally rely on individual wells and septic systems. (Northern Cheyenne Tribe Pre-Disaster Mitigation Plan, 2006)



**Table 2: Tribally-Managed Public Water Systems**

Location	Population and Connections	Water Supply Wells	Water Storage Capacity
Lame Deer	Population: 2,018 Connections: 537 residential; 54 commercial	5 wells, 3 currently active; depth 80-100 feet	3 tanks, only one on-line at present with 326,000 gal. capacity; est. at 1-2 days
Muddy Creek	Population: 195 Connections: 64 residential	3 wells, one currently on line (other have inadequate flow); depth: 95 feet	2 tanks each with 30,000 gallon capacity; est. at 2 days
Busby	Population: 615 Connections: 116	2 wells, only one on-line; depth 260-265 feet	5 storage tanks each with 20,000 gallon capacity, est. at 2-3 day
Birney	Population: 113 est., Connections: 25 est.	1 well, 51 feet deep	2 tanks each 20,000 gallon capacity; 5-7 day supply
Ashland Meadows (Rabbit Town)	Population: 152 est. Connections: 38 est.	1 well, 104 feet deep	2 storage tanks one with 35,000 gal capacity; one with 15,000; est. 5 day supply

Sources: U.S. EPA Sanitary Surveys for Lame Deer (2004), Muddy Cluster (2002), Busby (2002), Birney (2002), and Ashland (2002), McManus, Cleve. Northern Cheyenne Utilities

### **Commercial/Industrial**

There are currently no commercial/industrial uses of water on the Reservation. In November 2006, tribal members voted to proceed with the development of coal resources on the Reservation. Surface and groundwater resources could be affected by this decision.

### **Fish and Wildlife**

The fishery on the Reservation is a warm-water fishery. It is considered a recreational and not a commercial fishery. The following species may be found in surface waters on the Reservation; carp, catfish, black bullhead, killifish, green sunfish, fathead minnows, mountain suckers, white suckers, short-head rednose suckers, sauger, sandshiner, pumpkin seed, and long-nose suckers. Recent surveys conducted by Montana Fish, Wildlife and Parks have shown a decrease in both distribution and speciation. (Montana Natural Resource Information System (NRIS), Brad Schmitz, Montana Fish, Wildlife and Parks)

### **Power Generation**

There are no hydropower generation facilities located on the Northern Cheyenne Reservation.

## IV. Drought

### Drought Definition

Many definitions of drought exist and there is no one universally accepted definition for drought. Droughts vary in extent, duration, and severity and are caused by lack of precipitation. Drought can be difficult to define because unlike flooding, drought is not a distinct event, is the result of many complex factors, and its inception and end are difficult to determine. Two definitions are provided.

“Drought is an extended period of below normal precipitation which causes damage to crops and other ground cover; diminishes natural stream flow; depletes soil and subsoil moisture; and because of these effects causes social, environmental, and economic impacts to Montana.” (Montana Drought Response Plan, 1995)

“A deficiency of precipitation from expected or “normal” that, when extended over a season or longer period of time, is insufficient to meet demands. This may result in economic, social, and environmental impacts. It should be considered a normal, recurrent feature of climate. Drought is a relative, rather than absolute, condition that should be defined for each region. Each drought differs in intensity, duration, and spatial extent.” (*How to Reduce Drought Risk*, Western Drought Coordination Council, Preparedness and Mitigation Working Group, 1998)

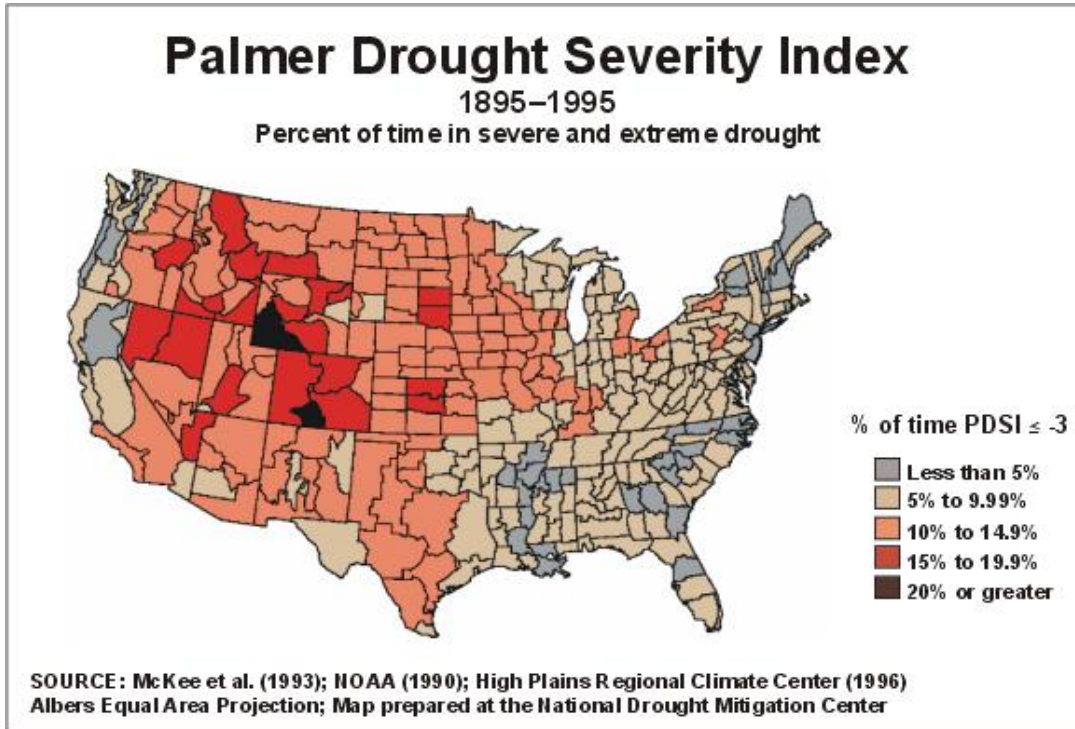
Drought typically progresses in the following manner:

- 1) Meteorological drought: conditions at this stage include any precipitation shortfall of 75% of normal for three months or longer.
- 2) Agricultural drought: soil moisture is deficient to the point where plants are stressed and biomass (yield) is reduced. Deficiency of water for livestock can also characterize this stage of drought.
- 3) Hydrological drought: reduced stream flow (inflow) to reservoirs and lakes is the most obvious sign that a serious drought is in progress.
- 4) Socioeconomic drought: this final stage refers to the situation that occurs when physical water shortage directly affects people.

## Drought History

Figure 5 shows drought severity in the 100 years between 1895 and 1995, and is based on the Palmer Drought Severity Index (PDSI), which quantifies drought in terms of moisture demand and moisture supply. The Northern Cheyenne Indian Reservation has been in severe or extreme drought approximately 10-15% of the time between 1895 and 1995.

**Figure 5: Palmer Drought Severity Index**



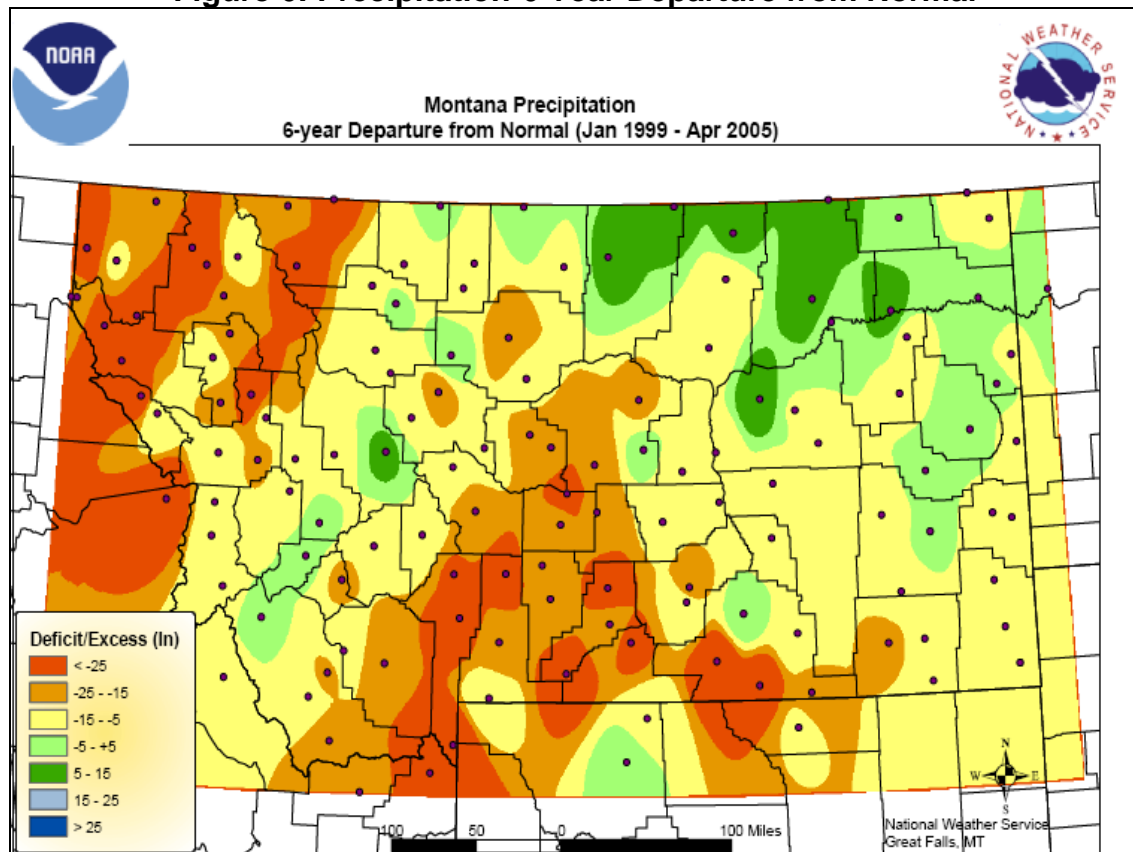
Average annual precipitation ranges from approximately 14 to 24 inches, with higher precipitation in the hills. (Montana Natural Resource Information System, Map of Average Annual Precipitation 1961-1990)

Figure 6 shows the six-year departure from normal precipitation between January 1999 and April 2005. The cumulative decrease over the six years from January 1999 to April 2005 was estimated at between 5 inches and 15 inches for the area of the Northern Cheyenne Indian Reservation.

In addition, extreme heat with or without prolonged drought can stress humans, crops, and animals, causing heat-related illness and in some cases, death. Temperatures of 109 degrees have been recorded in Busby (July 14, 2002) and Lame Deer (August 6, 1949). (Western Regional Climate Center)

Based on past history, there is continued probability that drought will occur in the future on the Northern Cheyenne Indian Reservation. Although there may be periods of higher than average precipitation, the Palmer Drought Severity Index long-term trend data indicate that the Reservation is in severe or extreme drought up to nearly 15 percent of the time. (Northern Cheyenne Pre-Disaster Mitigation Plan, 2006)

**Figure 6: Precipitation-6 Year Departure from Normal**



Source: NOAA. [http://www.wrh.noaa.gov/tfx/pdfs/hydro/mt\\_1999.pdf](http://www.wrh.noaa.gov/tfx/pdfs/hydro/mt_1999.pdf)

**Table 3: Drought Disaster Declarations**

Date	Type	Area Affected	Designation
1997	Drought	Big Horn and Rosebud Counties among many in state	USDA
1998	Drought	Big Horn County one of many in state	USDA
1999	Drought and excessive heat	All Montana Counties receive designation	USDA
1999	Drought, early frosts and fire conditions	Rosebud County one of 10 counties receiving this designation	USDA
2000	Grasshoppers	Powder River, Big Horn, Carter, Custer, and Rosebud Counties	USDA
2000	Hail and Grasshoppers	Rosebud, Big Horn, Custer, Garfield, Musselshell, Petroleum, Powder River, Treasure, Yellowstone	USDA
2001	Drought	All Montana Counties	USDA
2002	Drought	All Montana Counties	USDA
2003	Drought	Big Horn and Rosebud Counties among many in state	USDA
2004	Drought	Big Horn County, Carbon, Carter, Powder River Counties and counties in Wyoming	USDA

Northern Cheyenne Pre-Disaster Mitigation Plan, 2006

**Potential Impacts**

As the stages of drought evolve over time, the impacts to the economy, people, and environment converge into an emergency situation.

Without water to farm, food supplies are in jeopardy. Without spring rains for the prairie grasslands, open range grazing is compromised. Without groundwater for communities, the hardships result in increases in mental and physical stress as well as conflicts over the use of whatever limited water is available. Without water, wetlands and riparian areas disappear. The quality of any remaining water decreases due to its higher salinity concentration. There is also an increased risk of fires, and air quality degrades as a result of increased soil erosion in strong winds (blowing dust).

Drought produces a complex web of impacts that spans many sectors of the economy. Direct effects of drought include:

- reduced water levels and potential for reduced drinking water supply
- reduced crop, livestock, and rangeland productivity
- increased fire hazard
- damage to wildlife and fish habitat.

Indirect effects include those impacts that ripple out from the direct effect. Indirect effects include reduced business and income for retailers, increased credit risk for financial institutions, capital shortfalls, loss of tax revenues and reduction in government services, unemployment, and out-migration. (Northern Cheyenne Tribe Pre-Disaster Mitigation Plan, 2006)

Anecdotal evidence from PDM steering committee members and other persons interviewed for information for the PDM and Drought Management Plan indicated that multiple years of drought may have affected surface and ground water supplies. Some persons indicated springs and wells have dried up; others stated that there has been no effect. Lame Deer Creek used to flow year round, but over the past couple of decades has become an intermittent stream. Participants indicated that water pressure can be extremely low in the public systems from time-to-time, but it was unclear if that was a result of drought or the storage and distribution systems. (Northern Cheyenne Pre-Disaster Mitigation Plan, 2006)

## **Agriculture**

There is no standardized method for tracking economic losses related to drought in Montana. Historical data for direct economic effects of drought taken from the tribe's Pre-Disaster Mitigation Plan developed in 2006 include the following:

- 42 out of 44 livestock producers on the Northern Cheyenne Indian Reservation participated in the American Indian Livestock Feed program in drought years when such assistance was available (Denny).
- Due to drought and lack of water for livestock, pipelines have been established over the past decade that carry water from four wells and a spring to stock watering locations (participants at Steering Committee meeting, McManus, Knobloch).
- In 2001, the Montana Department of Livestock estimated a decrease in Montana cattle herds of approximately 450,000 head of cattle, or 18%, due to drought. The loss estimate consisted primarily of cattle moved out of state for change of pasture (and includes those that were sold). (Drought Relief Activities of the Montana Department of Livestock and Montana Agricultural Statistics Service)

- In May 2005, the USDA Farm Services Agency approved Emergency Conservation Program (ECP) funding to assist producers with cost-share assistance to provide emergency water in pastures where the previously adequate water source had failed.
- Damage Assessment Reports filed by the Farm Service Agency in Big Horn County in 2004 and 2005 indicated that 84% of all producers were experiencing production losses of 40% or more.

Because agricultural production on the Northern Cheyenne Indian Reservation is predominately livestock and associated hay production, the biggest impacts of drought are on livestock and hay.

Livestock ranchers and agricultural producers can experience any number of economic impacts from drought that include:

- Reduced productivity of rangeland
- Forced reduction of foundation stock
- Reductions of irrigation water from the Tongue River Reservoir
- Cost of supplemental feed, cost of moving to other locations with pasture
- High cost to haul or unavailability of water for livestock
- Cost of new or supplemental water resource development (wells, etc.)
- Increased feed transportation costs
- Disruption of reproduction cycles
- Decreased stocking rates
- Range fires
- Reduced groundwater well yields

(Source: Northern Cheyenne Pre-Disaster Mitigation Plan, 2006)



Hay production along Rosebud Creek

### **Domestic and Drinking Water**

Springs can dry up or experience reduced flow during drought. Static water levels in wells can drop and/or wells can go dry. Residents of the Reservation depend on both springs and wells for domestic uses. Loss of domestic water can cause a myriad of public health issues and becomes quickly life-threatening. Water must either be hauled in and stored on site or property abandoned if the domestic water supply is lost.

### **Fish and Wildlife**

Fish and wildlife can be affected in several ways by drought. Drought creates lower flows in streams and rivers which can be exacerbated by draw-down from irrigation demands. Lower flows have the effect of reducing available habitat and precluding the use of some side and main channels. Fish distribution changes and more fish are concentrated into remaining pools. This leads to crowding and increased predation by larger fish and non-fish predators such as raccoons and hawks. Water temperatures rise resulting in less oxygen available to the fish. Riparian vegetation important for shade can be affected as well. This vegetation also produces insects on which fish feed.





Woody riparian vegetation along streams is important for fish habitat

Wildlife are affected by loss of forage and hiding cover. Distribution patterns change as wildlife search for food. Allen Clubfoot reported that during the recent years of drought more wildlife (deer, bear, etc.) have been observed in the town of Lame Deer in search of food. Lack of good nutrition can affect reproduction and young survival rates.

### **Timber**

Timber (primarily Ponderosa Pine) on the Reservation has commercial value. The value varies depending on a number of factors. These factors can include the amount of timber on the market at any given time, the size of the timber, the costs to log the timber, the percentage of defect, and whether the timber is fire-killed or salvage as opposed to green. Fire-killed trees lose 20% of their value off the top and must be harvested within six months due to the appearance of blue stain in the wood. For example, a loss of 850,000 board feet (500 acres of Ponderosa Pine at a density of 1.7 thousand board feet (mbf) per acre selling for \$72/mbf) to wildfire on the Northern Cheyenne Reservation could represent an economic loss of over \$60,000. (Anderson, 11/17/06)



Pine stand east of Lame Deer

## **Wildland Fire**

Bureau of Indian Affairs Fire Dispatcher for the Northern Cheyenne Reservation, Ron Burns reported that there were 140 fires on the Reservation in 2006, an extremely dry year. The ten-year average for fires on the Reservation is 100 fires per year. By contrast, in 2005, the Reservation received significantly more precipitation and had only 38 fires.

Drought can have severe effects on wildland fire. Drought affects fire in the following ways.

- Extending the fire season. For example the first fire in 2006 on the Reservation was in January and the last major fire was in September.
- Fire starts caused by lightning spread faster.
- Lightning strikes that would extinguish naturally turn into fires.
- Fire behavior becomes extreme. Fires spread faster, burn hotter, have longer flame lengths, and spot farther.
- Extreme fire behavior makes fighting the fires more dangerous for crews and makes equipment loss more likely.
- More fires started by individuals to burn off grass escape and turn into uncontrolled fire.

More and larger fires are costlier because they require more fire fighting resources, both crews and equipment. Crews must be available longer seasons and more hours. Bulldozers and aviation support in the form of air tankers and helicopters are called in more frequently—escalating fire suppression costs. Larger fires consume more timber and range resources—translating into economic losses for individuals and the tribe.

## V. Drought Monitoring and Verification

A number of drought indices are available for use in determining drought conditions. The most accurate view of a situation can often be obtained by looking at several indices, each of which has strengths and weaknesses. For purposes of this plan, the following indices will be used. Information from these indices is easily available and is consistent with drought monitoring in the state plan.

### Percent of Normal

Percent of normal is a simple calculation of rainfall for a location, effective for comparing a single region or season. This index is calculated by dividing the actual precipitation by normal precipitation (30-year mean) and then multiplying by 100%. (Hayes, National Drought Mitigation Center)

### Standardized Precipitation Index (SPI)

The SPI is an index based on the probability of precipitation for any time scale. The SPI can be computed for different time scales, is less complex than the Palmer Drought Severity Index and can provide early warning of drought. The SPI is based on the long-term precipitation record for a location.

<b>Table 4: SPI Values</b>	
2.0+	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-.99 to .99	Near normal
-1.0 to -1.49	Moderately dry
-1.5 to -1.99	Severely dry
-2 or less	Extremely dry

Monthly SPI maps can be found at the following website.

- <http://drought.unl.edu/monitor/spi.htm>

## Palmer Drought Severity Index (PSDI)

The PSDI is a meteorological drought index that responds to weather conditions that have been abnormally wet or dry. This measure is used by the federal government to trigger drought response programs.

Weekly PSDI maps are found at the following site.

- [http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/regional\\_monitoring/palmer.gif](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif)

## VI. Drought Response

The current long-term drought is not the first drought experienced by the Reservation. Measures that have been taken to reduce drought effects on the Northern Cheyenne Indian Reservation in the past have included:

- Piped in water to cattle “Tongue River Dam Project”—stored in 20,000 gallon tanks—this project is now completed—it was done in 2-3 areas along the Tongue River divide. Purpose was to offset drought by improving grazing management and range condition.
- Water conservation education.
- Guidelines for water use (for public water in Lame Deer/Busby)—restrictions on lawn watering, for example.
- Water monitoring stations along the river and creeks.
- Lawn watering restrictions in Reservation communities.
- Fire prevention education.

The Northern Cheyenne Water Code provides the following guidance for drought:

*“In drought conditions, every effort will be made to find supplemental water through water development or exchange as a first measure to meet water demands. Thereafter, water will be allocated on a priority use basis in accordance with the following priorities from first to last: individual personal use; essential health and safety function; other domestic and municipal use; stock water; instream flows for, among other things, fish and wildlife; agriculture; and industrial uses. The Board may also require water conservation measures as necessary within various uses.”*

*In drought conditions, the Board may order permit holders to reduce or cease water use. Prior to any such order, the Board shall give notice of its intent to require reductions through publication in a Reservation newspaper of general circulation and posting in at least four places on the Reservation. A public hearing shall be held at which public comment may be given. Decisions to require water use reductions may be appealed in accordance with Chapter IV.”*

## **Mitigation Goals**

Mitigation goals and measures have been identified that will help the tribe to realized its Drought Policy. These measures are consistent with the Northern Cheyenne Water Code.

### **1) Establish a tribal Drought Advisory Committee (NCDAC).**

A) Appoint a Northern Cheyenne Drought Advisory Committee (NCDAC.)

The NCDAC will meet at a minimum every spring (March) and fall (October) or more frequently as necessary to review indices (Percent of Normal, SPI, and PSDI) and anecdotal information, determine drought severity, and address drought issues.

NCDAC membership recommended by participants in the June 5, 2007 tribal departments meeting: Director, Natural Resources Department (Chair), tribal public health, tribal forestry, tribal housing, tribal utilities, tribal council, Environmental Protection Agency, NRCS, Natural Resources Conservation Service, BIA Range Management and BIA Forestry/Fire, Indian Health Service (environmental engineer.)

The tribe may want to consider the following additional resources; National Weather Service, Tongue River Water Users, Montana Department of Natural Resources and Conservation, U.S. Geological Survey, and the Montana Bureau of Mines and Geology.

### **2) Continue to monitor water quantity and quality on the Reservation.**

- A) Work with the U.S. Geological Survey to map and monitor major springs.
- B) Continue to monitor static water levels in monitoring wells in coordination with the U.S. Geological Survey and the Montana Bureau of Mines and Geology.
- C) Continue to monitor water quality in cooperation with the U.S. Environmental Protection Agency and the U.S. Geological Survey.
- D) Monitor water quality and static water levels in existing individual wells.
- E) Work with the U.S. Geological Survey to install monitoring wells along the Tongue River.
- F) Encourage documentation of all new wells in the Montana Ground Water Information Center data base (GWIC) through education
- G) Inventory and prioritize abandoned wells that need to be sealed. Apply for funding and seal highest priority wells.

### **3) Avoid adding demand for water that can not be met.**

- A) Require all developers (commercial, industrial, mining, and residential) to provide projections of water needs and identify water sources to meet the projected need
- B) Evaluate all development proposals for potential impacts to surface and groundwater as directed in the Northern Cheyenne Water Code.
- C) Continue to issue permits as required by Northern Cheyenne Water Code.
- D) Study aquifer yield potential in the Rosebud drainage. Use results of study for decisions on permitting new uses.

### **4) Be prepared to provide adequate amounts of domestic and drinking water to communities, rural residents, and medical facilities.**

- A) Identify emergency/back-up water supply for each public drinking water system and the IHS clinic.
- B) Develop and maintain a list of individuals/companies able to haul water.
- C) Develop additional storage capacity for public water supplies
- D) Establish a fund for assisting individuals in replacing wells that go dry
- E) Develop wellhead protection plans for public water supplies.
- F) Work with tribal extension to encourage the practice of water conservation through education.
- G) Develop program in conjunction with tribal housing to identify and repair easily-fixed plumbing leaks.
- H) Develop public drinking water source west of Busby.

### **5) Increase the resiliency of agriculture and stock production to drought.**

- A) Educate producers, implement, and enforce the tribal grazing ordinance.
- B) Assist individual operators in grazing management practices in cooperation with the BIA and NRCS.
- C) Inventory stock water sources and monitor yields.
- D) Encourage water conservation practices.
- E) Work with the NRCS and Tribal Extension Office to complete the noxious weed control plan for the Reservation.
- F) Develop a grasshopper control program.
- G) Working with elected officials, consider water projects that would utilize water from the Tongue and/or Big Horn Rivers for agricultural and other purposes.

## **6) Reduce potential for catastrophic wildland and wildland-urban interface fire.**

- A) Develop a list of fire hydrants across the Reservation that need to be replaced. Make a bulk purchase and install new hydrants.
- B) Work with IHS facility and new Lame Deer school to install adequate hydrants.
- c) Identify best locations and develop additional water storage in Lame Deer for fire fighting.
- D) Identify best locations and develop water sources for wildland fire fighting in remote areas.
- E) Investigate the feasibility of obtaining the unused water tank at the sawmill in Ashland and relocating it for structural and wildland fire fighting water storage.
- F) Continue to utilize burning permits to reduce the number of escaped fires.
- G) Continue fire prevention education.
- H) Continue with fuel reduction and prescribed burning

## **7) Reduce negative impacts to fish and wildlife from drought.**

- A) Establish enforcement of existing fish and game regulations.
- B) Review and adjust regulations during drought to reduce pressure on stressed species.
- C) Evaluate proposed irrigation uses of Rosebud Creek to determine impacts to fishery.
- D) Work with U.S. Fish and Wildlife Service to remove diversion dam on the Tongue River north of Ashland to accommodate fish passage.
- E) Develop springs for wildlife use.

**Table 5: Project Priority Rankings and Estimated Costs**

Goal/Project	Priority	Cost
1.A. Appoint a tribal drought advisory committee	H	L
2.A. Map and monitor major springs	M	M
2.B. Continue to monitor static water levels	Ongoing	L
2.C. Continue water quality monitoring	Ongoing	L
2.D. Monitor existing wells	M	M
2.E. Install monitoring wells along Tongue River	M	M
2.F. Encourage use of GWIC for new wells	M	L
2.G. Inventory and prioritize abandoned wells	L	M
3.A. Developers provide projections of need	H	L
3.B. Evaluate developments as per Water Code	H	L
3.C. Issue permits	Ongoing	L
3.D. Study Rosebud aquifer potential	M	M
4.A. Emergency drinking water supplies	H	H
4.B. Water hauler list	H	L
4.C. Develop additional storage capacity	M	H
4.D. Fund for dry wells	H	M
4.E. Wellhead protection plans	M	H
4.F. Education for water conservation	H	L
4.G. Detect and repair residential plumbing leaks	M	M
4.H. Develop public drinking water west of Busby	L	H
5.A. Adopt tribal grazing policy	M	M
5.B. Individual grazing management plans	M	L
5.C. Inventory stock water sources, monitor yields	H	M
5.D. Encourage water conservation practices	M	L
5.E. Develop noxious weed plan	M	M
5.F. Develop grasshopper control program	M	M
5.G. Water projects	L	H
6.A. Fire hydrant bulk purchase and replacement.	H	H
6.B. Fire hydrant for HIS and Lame Deer school.	H	L
6.C. Water storage for fire fighting in Lame Deer.	M	M
6.D. Water sources for rural fire fighting.	L	M
6.E. Relocate and utilize tank at sawmill.	M	H
6.F. Issue burn permits	Ongoing	L
6.G. Fire prevention education	Ongoing	H
6.H. Fuel reduction and prescribed burning	M	M
7.A. Enforcement of fish and game regulations	M	H
7.B. Adjust regulations in response to drought	M	L
7.C. Evaluate irrigation effects on Rosebud fishery	L	M
7.D. Remove Tongue River diversion dam	M	L
7.E. Develop springs for wildlife use	L	M



Priority Rankings correspond to the following scale.

High (H): complete in 1-2 years

Medium (M): complete in 3-5 years

Low (L): complete in 6 or more years

Cost estimates correspond to the following scale.

High (H): Over \$ 25,000

Medium (M): \$ 5001 to \$25,000

Low (L): \$5000 or less

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