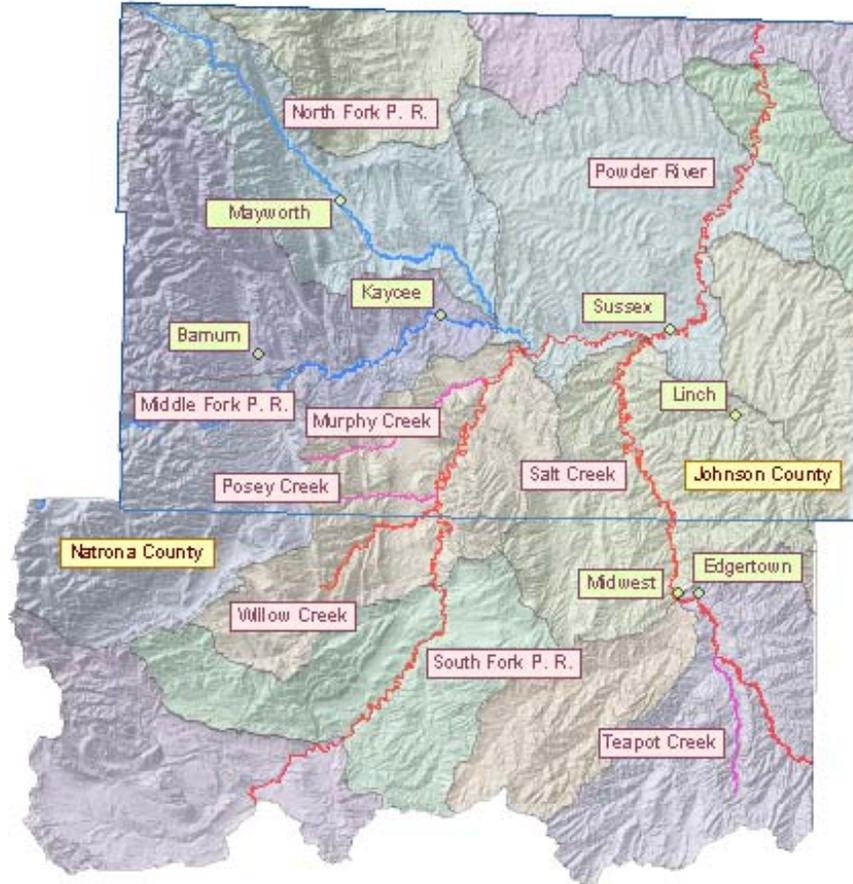


# Powder River Watersheds Water Quality Management Plan



A comprehensive natural resource management plan  
designed to address water quality issues and concerns  
in the Powder River Watersheds

**DEVELOPED BY:**  
**POWDER RIVER CONSERVATION DISTRICT**  
**THE POWDER RIVER WATERSHEDS STEERING COMMITTEE**

**ASSISTANCE PROVIDED BY:**  
**USDA NATURAL RESOURCES CONSERVATION SERVICE, KAYCEE FIELD OFFICE**  
**WYOMING ASSOCIATION OF CONSERVATION DISTRICTS**

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## **EXECUTIVE SUMMARY**

### ***Mission***

**The mission of the Powder River Watersheds Steering Committee is to address human related and natural non point and point source water quality issues within the Powder River Watersheds, with consideration given to cultural, historic and natural background influences. Our overall goal is to improve or maintain water quality where possible; while retaining a locally led, voluntary and incentive based approach to water quality issues to eliminate the need for government regulatory action.**

### ***Purpose***

**The purpose of the Powder River Watersheds Plan is to:**

1. Maintain local stewardship and control of water quality issues in the Powder River Watersheds avoiding potential State and Federal regulatory actions.
2. Provide information and recognition of the Powder River Watersheds and their natural, historic, current, and possible future water quality conditions;
3. Develop proactive conservation while protecting the traditional local economy and culture, while still maintaining opportunities for future growth.
4. Develop a positive working relationship between local landowners, industry, agencies, and other valid stakeholders.
5. Facilitate the implementation of the goals, objectives and Best Management Practices associated with this watershed plan while respecting the rights of landowners.
6. Maintain local, dynamic, long term watershed planning.

### ***Clean Water Act***

The Clean Water Act (CWA) was adopted by Congress for two primary purposes. That is to:

- Restore and maintain the chemical, physical, and biological integrity of the nation's waters; and
- Where attainable, to achieve water quality that promotes protection and propagation of fish, shellfish, and wildlife, and provide for recreation in and on the water. This goal is commonly expressed by the phrase "fishable/swimable".

### ***Wyoming Department of Environmental Quality***

In order to ensure compliance with the CWA, the State of Wyoming is required to adopt water quality standards (laws or regulations) to enhance water quality and protect public health and welfare. Under Section 305(b) of the CWA, the State of Wyoming

must also report on the condition of their water(s) to the U.S. Environmental Protection Agency (EPA) once every two years. This report, prepared by the Wyoming Department of Environmental Quality (WDEQ), is known as the 305(b) report. Under section 303(d) of the CWA, States must identify those waters within its boundaries that are not meeting the water quality standards (“impaired waters”) applicable to that waterbody based on its designated use(s). A designated use is that use that a waterbody is capable of attaining although it may or may not be currently attained by that specific segment or body of water. States are required to address impaired waterbodies by establishing water quality standards and pollution control activities designed to achieve and maintain the designated uses.

### ***Conservation District’s Role***

Following the enactment of the Clean Water Act (CWA), the U.S. EPA has delegated water quality assessment and regulatory responsibilities to the Wyoming Department of Environmental Quality (WDEQ) which is the regulatory agency responsible for enforcement of the CWA as it applies to Wyoming waters. Local Conservation Districts, by statutory authority, have assumed the responsibility of leading information and education programs and providing technical and financial assistance to their constituents to conserve Wyoming’s natural resources, and to protect the quality of life of all Wyoming citizens. Conservation Districts serve as a liaison between WDEQ and local land managers within the Powder River Watershed to address water quality concerns and to investigate historical, custom, cultural, and background conditions as they apply to environmental compliance with regard to water quality standards. The Powder River and Natrona Conservation Districts have also endorsed the formation of the Powder River Watershed Plan Steering Committee to develop a locally-led, comprehensive watershed management plan to improve water quality while preserving the economic sustainability of activities and maintaining multiple uses within the Powder River Watershed.

### ***WDEQ 303(d) list of Impaired Waterbodies***

There are currently six streams within the Powder River Conservation District listed on the Wyoming 2008 305(b) List, Table A: 303(d) list of impaired waters. This table contains waters with water quality impairments that require Total Maximum Daily Loads (TMDLs). These streams include:

#### **1998 Listing**

- **Powder River** from Salt Creek downstream to the confluence with Clear Creek. This stream was listed due to exceedence of the chloride standard. The impairment sources are listed as point and natural. This stream is classified as a 2ABWW stream, which means it is a warm water fishery that will support the following uses: drinking water, game fish, non-game fish, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry, and scenic value of these uses the following are listed as impaired on this stream: warm water fish and aquatic life. A Use Attainability Analysis (UAA) was written on this stream. It has been approved by WDEQ and EPA, however this stream still exceeds the new site specific criteria and will remain listed on the 303(d) list.

### 2000 Listing

- **Powder River** from the South Fork of Powder River downstream to the confluence with Crazy Women Creek. The impairment sources are listed as point, natural, and undetermined. This stream is classified as a 2ABWW stream, which means it is a warm water fishery that will support the following uses: drinking water, game fish, non-game fish, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry, and scenic value of these uses the following are listed as impaired on this stream: warm water fish, wildlife and aquatic life. This stream was listed due to exceedence in selenium standard.

### 2002 Listing

- **Salt Creek** from the Powder River to an undetermined distance upstream. The impairment sources are listed as point and natural. This stream is classified as a 2C stream, which means it is a cold water fishery that will support the following uses: non-game fish, fish consumption, other aquatic life, recreation, wildlife, industry, and scenic value of these uses the following are impaired: non-game fish and aquatic life. This stream was listed due to exceedence in the Chloride standard. A Use Attainability Analysis (UAA) was written on this stream and it has been approved by the EPA and this stream has been delisted.

### 2006 Listings

- **South Fork of the Powder River** from the confluence with Middle Fork upstream an undetermined distance above Willow Creek. The impairment sources are listed as natural, non-point, and undetermined. This stream is classified as a 2C stream, which means it is a cold water fishery that will support the following uses: non-game fish, fish consumption, other aquatic life, recreation, wildlife, industry, and scenic value of these uses the following are impaired: non-game fish, aquatic life, and wildlife. This stream was listed due to exceedence of the Selenium standard with its sources being natural, non-point, and undetermined.
- **Willow Creek** from the confluence with South Fork of the Powder River to an undetermined distance upstream. The impairment sources are listed as natural, non-point, and undetermined. This stream is classified as a 3B stream, which means it is a cold water fishery that will support the following uses: other aquatic life, recreation, wildlife, agriculture, industry, and scenic value of these uses the following are impaired: aquatic life and wildlife. This stream was listed due to exceedence of the Selenium standard.

### 2008 Listings

- **Posey Creek** is a tributary to the South Fork of the Powder River. The impairment sources are listed as natural, irrigated crop production, and unknown. This stream is classified as a 3B stream, which means it is a cold water fishery that will support the following uses: other aquatic life, recreation, wildlife, agriculture, industry, and scenic value of these uses the following are impaired: aquatic life and wildlife. This stream was listed due to exceedence of the Selenium standard. It is interesting to note that the original name of the water body was “Shit Creek”, the name being later changed to Posey Creek so as to not offend “the ladies” when addressing the water.
- **Murphy Creek** is a tributary to the South Fork of Powder River. The impairment sources are listed as natural, irrigated crop production, and unknown. This stream

is classified as a 3B stream, which means it is a cold water fishery that will support the following uses: other aquatic life, recreation, wildlife, agriculture, industry, and scenic value of these uses the following are impaired: aquatic life and wildlife. This stream was listed due to an exceedance of the Selenium standard.

- **Salt Creek** from the Powder River upstream to Castle Creek. The impairment sources are listed as petroleum production. This stream is classified as a 2C stream, which means it is a cold water fishery that will support the following uses: non-game fish, fish consumption, other aquatic life, recreation, wildlife, industry, and scenic value of these uses the following are impaired: non-game fish, aquatic life, and wildlife. This stream was listed due to an exceedance in the Selenium standard.

It is important to note that the theoretical sources of the impairments are based primarily on the observations and opinion of the WDEQ, and that limited amounts of data and information exist on some of these potential sources. In general consultants and others have noted that within the watershed there is a high likelihood that any waters flowing on or through areas that have Cody Shale geology will show exceedance of standards related to salinity and selenium. To emphasize this point, Western Water Consultants Engineering said “WDEQ should include ‘natural sources’ as an additional source of selenium because the majority of the selenium exceedances in Salt Creek are likely due to the presence of seleniferous parent materials.”

Streams listed for impairments of selenium have either a non-point, natural, or undetermined source, with the exception of Salt Creek, the source of which is listed as petroleum production. Non-Point Source water quality impairments require a Total Maximum Daily Load (TMDL), given there is credible data to indicate that the water body does not support all of its designated uses. These “designated uses” are those possible uses identified by the WDEQ with the recommendation of the Wyoming Game and Fish Department and others. This classification may or may not be based on “credible” data.

Along with the six streams on the 303(d) list there is one additional stream that has the potential to be listed. Teapot Creek was identified during the 2006 monitoring season as having an exceedance of Selenium. As with any other exceedance, there are a number of possible reasons that waters may not meet the states identified criteria which may or may not be related to any human influences. The PRCO has realized that there is a definitive link between selenium levels within the Powder River Basin and the locally prominent Cody Shale Geologic formation. A study is being undertaken on waters with selenium impairments and the possible need for an area wide site specific criteria to account for naturally high levels of selenium in the Cody Shale derived soils.

### ***Public Awareness***

Prior to the Powder River Conservation District becoming involved in water quality issues, as early as the late 1960’s local landowners worked with the area’s oil industry to maintain the quality of water that they discharged. This was and still remains a major concern for the landowners and the Powder River Conservation District, because without the industry’s discharged water, there would be very limited or no water

available for livestock or wildlife in the Salt Creek area. These discharges are vital and keep many of these streams flowing during times of drought.

The Powder River Conservation District became seriously involved in water quality in 1998 when Powder River was listed for exceedence in the Chloride standard. In 2001 the PRCO contracted with Rick Gay of Lost Iguana Consulting to compile a document called Historical Data Review and Analysis for the Salt Creek Watershed including a Section of the Upper Powder River, this document was completed in 2002. After the WDEQ listed Powder River for an exceedence in the Selenium standard in 2000 and Salt Creek for an impairment in Chloride in 2002, the PRCO began having Public Water Quality Meetings to discuss water quality issues in Southern Johnson County. Three meetings were held in 2002. In 2003 three public water quality meetings were held and the PRCO commissioned Environmental Design Engineering Consultants (EDE) to begin water quality monitoring. This was phase I of the Salt Creek/South Fork 319 Watershed Assessment. Phase I was completed in 2004 and this monitoring determined that permitted water discharged into Salt Creek by the oil industry was seen as beneficial to both the Salt Creek and Powder River. More testing was needed to determine if the source of Selenium was a point source or natural source. Following the completion of Phase I, Phase II began in the fall of 2004. The PRCO held three public water quality meetings in 2004 to discuss the findings in Phase I of the watershed assessment and to determine if they should continue with water quality monitoring. Finally in 2004 Anadarko submitted a Use Attainability Analysis to WDEQ on November 10, 2004. This UAA covers chloride only and includes Salt Creek and a section of Powder River.

In 2005 Phase II of the Salt Creek/South Fork 319 Watershed Assessment was completed and Phase III began. Phase II found that the source of selenium was inconclusive and more testing was required on the South Fork. There were also three public water quality meetings held in 2005 to discuss the findings of the Phase II analysis and the steps to take to continue on to Phase III of the assessment.

In 2006 the South Fork of Powder River and Willow Creek were listed for exceedence of the Selenium standard. Phase III was completed and the determination of the source of selenium were inconclusive; drought played a major factor in this. Lack of water in general made it impossible to test. Two public water quality meetings were held to discuss this issue. EDE recommended additional water testing, establishing a permanent monitoring site upstream of the outcrops of Cody Shale, among other possibilities.

In 2007 the PRCO commissioned WWC Engineering to do a Data Review Summary of all of the data collected by EDE. On April 25, 2007 the UAA Anadarko submitted in 2004 was approved by WDEQ and submitted to EPA for final approval. In June the PRCO held a public meeting to discuss the options available to the District in regards to watershed planning and TMDL development. It was determined at that meeting that the PRCO would set up a steering committee and watershed planning would begin.

### ***Monitoring Activities***

In 1998 the Powder River, from Salt Creek downstream to the confluence with Clear Creek, was listed as impaired by chloride by the Department of Environmental Quality (DEQ). The listing was due to water monitoring performed by the DEQ. DEQ

also monitored and listed the Powder River as impaired for selenium from its South Fork tributary to an undetermined distance downstream below Sussex in 2000.

The Powder River Conservation District (PRCD) contracted with a private water resource engineering firm, EDE, between the years 2003 and 2006 to monitor and analyze water quality data on the Powder River, Salt Creek and the South Fork of the Powder River. Ten sites were monitored in 2003, 12 routine monitoring sites were in place during 2004.

Due to monitoring activities performed in 2003, a chloride impairment on Salt Creek was identified. The report indicated that there was a possible relation between water produced by the oil and gas industry and natural geology. All produced waters in the watershed are permitted by the WDEQ to discharge and were in compliance with their permits. It was determined that the most likely source of elevated chlorides was soil interaction with the creek itself, and not any individual discharge. The natural sources of chloride in the Salt Creek drainage are significant (p. 54, Salt Creek / South Fork 319 Watershed Assessment, Final Project Report for 2003 Monitoring, EDE Consultants, March 1, 2004). It was determined at that time that the chloride impairment issue in Salt Creek could be best addressed through a Use Attainability Analysis (UAA). This UAA was developed under the premise that the natural levels of chloride in the water were sufficiently high to warrant the development of site specific criteria. These criteria would set a higher allowable chloride level due to the large natural presence of chloride in the stream.

The PRCD then shifted focus of monitoring from the Salt Creek drainage to monitoring on the South Fork of Powder River drainage during the years 2004 through 2006 so as to determine the possible level of selenium impairments. Twelve routine monitoring sites were in place during the years 2004 through 2006. Of these sites ten were placed on the South Fork drainage and the other two on the Salt Creek drainage.

A second private engineering firm, Western Water Consultants Engineering (WWC Engineering), was contracted in early 2007 to perform a Data Review Summary on the monitoring data collected in the South Fork drainage and make a determination as to whether a Use Attainability Analysis (UAA) would be a feasible solution in that situation. The Data Review Summary was delivered on March 22, 2007. Although the UAA was considered a possibility, it was not possible to determine the exact nature of non-point source related levels of selenium. Inconsistent stream flow related to severe drought played a significant factor in the inability to collect sufficient data for a determination. Key points of the Data Review Summary emphasized the need for a watershed level plan to be developed for the South Fork of Powder River drainage to address the selenium impairment.

## **Powder River Watershed Description**

### ***History***

The early recorded history of the area started with efforts of the trappers and fur traders to establish a relationship with the indigenous Native Americans. In time this led to the development of the Bozeman trail. In the 1860's the Bozeman Trail passed through the area surrounding Midwest, Edgerton, and Kaycee.

The Bozeman Trail began as a gold-rush trail, a shortcut from the main trail on the North Platte River to the gold fields of Montana. About 3,500 immigrants utilized this trail in 1864-1866. To protect the influx of settlers, the U.S. Government sent the Army, who then established Fort Connor, (the name was later changed to Fort Reno) on Powder River in 1885. Major settlement in the Kaycee area generally took place after the battle of Dull Knife in 1876. The Town of Kaycee was established near the year 1887, getting its name from the old “KC” Ranch.

The cattle industry replaced the historic plains animals and thrived in the basin. The area became the headquarters for many large cattle ranches. During the late 1800’s and early 1900’s, federal law allowed unrestricted grazing by livestock. All the unpatented land (public domain) was open to grazing regardless of whether or not the owner of the livestock owned land in the immediate area. The unrestricted right to graze was enforced by U.S. Marshals. The settling of the land by homesteaders led to some notable and historic confrontations with those using the open range. These confrontations were known as “cattle wars”. One of these was the famous “Johnson County” cattle war of 1892.

During the late 1800’s and early 1900’s the basin was abnormally wet, allowing many to homestead in the area. Some of the early water rights in Powder River related to this homesteading date back to the late 1800s. The drought of the 1930’s brought the return of the more average precipitation. This resulted in the failure of most dry-land crops. This failure made it difficult to sustain many viable farm/ranch operations. Most homesteads were eventually consolidated. This allowed the development of larger livestock based operations. Agriculture in Powder River Watershed has grown in importance and is still centered around livestock. Both cattle and sheep operations are common to the area.

There are many pertinent historical sites in the watershed which include but are not limited to:

- The site of the Portuguese Houses / Fort Antonio (Montero) (established 1828) on Middle Fork of Powder River, 11 miles east of Kaycee.
- The Bozeman Trail (named in 1863).
- Cook’s Seventeen-Mile Stage Station on the Bozeman Trail.
- Fort Reno, initially named Fort Connor, established on Powder River north of the Sussex Community to guard Bozeman Trail (1865 - 1868).
- Cantonment Reno on Powder River north of the Sussex Community (1876 to 1878)
- The Hole-In-the-Wall and Outlaw Cave in the Red Wall country south of Barnum
- Site of the Dull Knife Battle (1876) located on the Red Fork of Powder River.
- Johnson County Cattle War begins in Kaycee, Nate Champion and Nick Ray murdered (1892).
- Site of the killing of Deputy United States Marshal George A. Wellman on Nine Mile Creek of Powder River (1893).
- The Lost Cabin Mine Territory

## Historical Observations of the Area

There has been a significant effort to keep historical data on this watershed. Portions here are taken from Historical Data and Analysis for the Salt Creek Watershed including a Section of the Upper Powder River by Lost Iguana Consulting, 2001.

Upon researching historical archives at both the Midwest Museum and at the UW American Heritage Center, many written references to the Salt Creek area were found. Without exception, recurrent depiction was one of dry and desolate landscape.

“The road is over the same sands and desolate country . . . There has been little rain or snow this spring and the whole country is torrid. There is nothing for game to subsist on. (I) passed today through a heavy patch of sand about 2 miles long.” – Diary entry June 14, 1868 by US Cavalry Paymaster Robert Dunlap Clark, approaching Fort Reno from Fort Fetterman. (American Heritage Center Digital Collection)

“The Townsend wagon train first came through the area in the 1850’s. Salt Creek was referred to as Dry Creek in the diary of one of the early pioneers on that wagon train as no useable water could be found. Fort Reno existed in the late 1860’s. The area surrounding the fort was described as barren prairie – a land forsaken by stockmen.” (1870 diary, Author unknown, The Midwest Review, June 1921)

“Natural seeps occurred frequently in the area although they were usually covered in oil. After rains, patches of oil were found on the ground and in many water drainage areas. Indians used oil seeps in war paint and medicinally. Trappers used the oil on friction burns and pioneers used the oil as lubricant on axels and water proofed their boots . . . Jackass Springs had water that was highly alkaline and contained so much oil it could be skimmed in buckets.” (News Article Ghost voices cry over old Salt Creek field – Velma Matrix, date undetermined, Midwest Museum Collection.)

“Salt Creek field investigated but on account of extreme barrenness, oil seeps, no potable water nearer than Horse Ranch 25 miles distant, George Aggers of the 179<sup>th</sup> Ohio Infantry moved on.” (1884 Diary Entry, Origin Unknown, Midwest Museum Collection.)

Additional Surface Oil observations were taken from ‘The Salt Creek Oilfield’ by L.W. Trumbull, State Geologist, 1914. Trumbull is quoting others in a large part of his text.

“Samuel Aughey in the territorial geologist report for 1886 says on page 81:

‘The largest oil flow is on the southwest quarter of Section 13, Township 40, north Range 79 west. The oil comes up vertically from beneath the edge, and some of it from the bottom of Salt Creek, at a point where a bank twenty-five feet high on the north side constitutes the shore line. When I last visited this spring in May, 1884, not less than twenty barrels of oil had accumulated in the creek bed. The rise of the creek from a rainfall one night washed it away, but it commenced again to accumulate, and in less than a week the original quantity was stored. At that time the amount of flow was estimated at one barrel per day. Some distance from the west side of the creek, and in a northerly direction from the above spring, on the west half of Section 12, two other escapes close together occur. All these oil flows come from Fort Benton shales, the petroleum coming up directly from below.’

Observations by a Mr. Wegemann are as follows:

'In the Salt Creek fields indications of lower oil-bearing sand than the one reached by Shannon wells are given by numerous oil seeps occurring within the encircling outcrop of the Shannon sandstone.

In another seep in the bed of Salt Creek, bubbles of gas may be seen rising at intervals through the water and spreading an oily film on the surface.

On Castle Creek, a little above its junction with Salt Creek, sand and gravel along the stream bed is saturated with oil which may rise from above. It is not a definite oil bearing stratum.

Trumbull himself continues:

"Now that the district is so thoroughly drilled and so much waste oil has been allowed to flow over the surface and into the creeks, it is impossible to find any of the original seeps. As these seeps were inside the Shannon scarps and came up through the shales, it is evident that the oil came up through some sandstone reservoir lower than the Shannon." (pg 102 & 121, *The Salt Creek Oil Field*, Bulletin Number 8, Series B, L.W. Trumbull, Wyoming State Geologist, S.A. Bristol Co., Cheyenne, Wyo., 1914)

## **Wildlife and Recreational Natural Resources**

Of the 1,331,402.00 acres in the Powder River Conservation District nearly 70% is privately owned land. It should also be mentioned that the bottom lands on the streams and rivers are almost entirely private land. The relationship between the private landowner and the watershed wildlife resources is extremely close, without the contributions of habitat and forage by landowners there would be little large game in the watershed.

Wildlife resources that exist within the Powder River Watershed include mammals such as Mule Deer, White Tail Deer, Elk, Pronghorn Antelope, Prairie Dogs, Bear, Mountain Lion, Coyotes, Wolves, Rabbits, Beaver, Muskrats, etc.

Birds are present in varied numbers and varieties and are both resident and migratory. They include Sage Grouse, Blue Grouse, Pheasant, Turkey, Ducks, Bald Eagles, Golden Eagles, Canadian Geese, Doves, Ducks, Cranes, Vultures, Bluebirds, Meadowlarks, and many others.

Aquatic species of interest include various species of trout such as Brook Trout, Rainbow Trout, and Brown Trout, as well as other species including but not limited to Pallid Sturgeon (found only in the Powder River Watershed), Channel Catfish, Black Bullhead, and others.

The Wyoming Game and Fish Department has noted the following Endangered/Threaten Species (both Plant & Animal) and has noted that they may be present within the area covered by this plan: Bald Eagles, Black Footed-Ferrets, Canada Lynx, Ute Ladies-Tresses, Eskimo Curlew, Interior Least Tern, Pallid Sturgeon, Piping Plover, Western Prairie Fringed Orchid, and the Whooping Crane. The presence of Endangered Species is a concern to many people who deal with land use and management. The ESA has been viewed by some as a somewhat flawed legislation in that it may not adequately protect the rights of private landowners and can become a disincentive to actual protection of a species. Landowners who are primarily responsible for the protection of these species are often put in the

uncomfortable situation of weighing the benefits of reporting a species presence with the fear losing control of their private property. In many cases, private landowners who have these species feel that a species is more likely to benefit from the overall good management of private land than it might in situations where agencies take control of that habitat.

There are many recreational activities within the watersheds that benefit from or rely on the presence of wildlife. They include but are by no means limited to hunting, fishing, sight seeing, and photography, as well as recreational activities such as fossil hunting, camping, and hiking. Specific Recreational Resources (Sites) are often similar to the historical sites in the area and include Outlaw Cave, Hole-In-The-Wall, Mayoworth Slip Road, Rome Hill / Dryfarm Road, Dullknife Reservoir, Ed Taylor Wildlife Refuge, Fort Reno, Portuguese Cabins, Bozeman Trail, Site of Champion and Ray Murder, Fishable streams (Middle Fork, North Fork, etc) as well as others.

### **Agricultural Resources**

There are approximately 1,331,402 acres within the boundaries of the PRCO. Of the total area of the PRCO, approximately 910,510.20 acres are privately owned; approximately 312,422 acres are administered by the Bureau of Land Management; approximately 104,468.10 acres are owned by the State of Wyoming; approximately 3,454.80 are owned by the U.S. Forest Service and approximately 546.90 acres are owned by Johnson County. The exact makeup of the land management/ownership in the watersheds themselves is similar to the general distribution of the land ownership within the Conservation District.

### **Extractive Industry**

#### **Oil & Gas:**

P.M. Shannon of Pennsylvania drilled the first producing oil well in 1889, less than a mile North of what was later know as the Salt Creek Field.

The Salt Creek Oilfield well No. 1 completed in October 1908 marked the start of a new dramatic chapter in the history of the field and the industry. By 1911 there were two large oil companies vying for dominance, the newly formed Midwest Oil Company and the foreign-owned Franco-Wyoming Company. These companies merged in February 1914 to form the Midwest Refining Company.

The Midwest Refining Company discovered gas in 1917 and the first gas plant was built in 1918. By 1925 there were 10 gas plants in the Salt Creek Field. By 1973 they were all out of operation. Today Anadarko Petroleum Corporation owns and operates this field.

There is interesting history surrounding many of the early oilfields, and this is especially true for the boom years of the Salt Creek Field. The Teapot Dome Oilfield was known as Irish Park in the earlier years and was claimed by various companies before 1910. In 1915, President Woodrow Wilson designated the Teapot Dome Field as the third oil reserve source for the U.S. Navy. This set the stage for the Teapot Dome scandal of President Warren G. Harding's administration. Prior to Watergate, the Teapot Dome oil-lease scandal was the most notorious incident of corruption in the nation's History.

Three naval oil fields, Elk Hills and Buena Vista Hills in California and Teapot Dome in Wyoming, were tracts of public land that were reserved by previous presidents to be emergency underground supplies to be used by the Navy only when the regular oil supplies diminished. Many political and private oil interests had opposed the restrictions placed on the oil fields claiming that the reserves were unnecessary and that the American oil companies could provide for the U.S. Navy.

One of the politicians who opposed the conservation was Senator Albert B. Fall who became President Harding's Secretary of the Interior in 1921. Fall, upon becoming the Secretary of the Interior, convinced the Secretary of the Navy to turn control of the oil fields over to him. Fall then moved to lease Teapot Dome Reserve to Harry Sinclair's Mammoth Oil Company and the Elk Hills reserve to the Pan American Petroleum Company. In return for leasing these oil fields to the respective oil magnates Fall received "gifts" from the oilmen totaling about \$404,000 (equivalent to \$4 million in the year 2000). The "gift" was illegal though the lease itself was not. The scandal was first revealed to the public in 1924 after findings by a committee of the U.S. Senate. Albert Fall had made legitimate leases of the oil fields to the private companies but the taking of money was his undoing.

In 1927 the Supreme Court ruled that the oil leases had been corruptly obtained and invalidated these leases. The Navy regained control of the reserves as a result of the court decision. The concentrated attention on the scandal made it the first true symbol of government corruption in America. The scandal did reveal the problem of natural resource scarcity and the need to protect for the future against the depletion of resources in a time of emergency.

Today, the Teapot Dome Field is operated by the U.S. Department of Energy with 730 oil and gas wells in production earning approximately \$5 million per yr. in revenues. Of the three naval reserves set up by the U.S. Government, Teapot Dome Naval Petroleum Reserve #3 is the only one still owned and operated by the U.S. Government.

The Sussex Field came into production in 1948. Within two years, additional gas production was derived from the nearby Meadow Creek Field. In 1952, the West Sussex Field came into production. During this time period the watershed population was significantly higher than it is today. Several municipalities that existed at the time have since been abandoned. It is interesting to note that these towns imported water from Tisdale Mountain, and later Casper.

### **Uranium:**

A rush of uranium prospecting occurred on public lands in southeast Johnson County during the 1950's. Much of the Uranium activity in the PRCD is in the Dry Fork of Powder River proximate to Pumpkin Buttes. Significant levels of Uranium in the area remain untapped. Renewed interest is largely due to a French National Corporation.

### **Bentonite:**

Bentonite was utilized as early as pioneer days for uses such as roofing and wall building in early homes and as a reservoir liner due to its water sealing capacity. In 1951 Bud Perry and his company Mayoworth Royal Earth began mining Bentonite from the Mayoworth area. In 1962 Black Hills Bentonite purchased this company and began to mine clays in the watershed. They have since expanded to other areas in the watershed

and continue to extract Bentonite from the area today. This resource is utilized today for sealing reservoirs, cosmetics, cat litter, drilling mud, and many other applications. This industry is economically significant to the population of the watershed.

**Coal:**

There are literally dozens of little coal mines dispersed throughout the area, though most mines have been located in the Pine Ridge up-thrust belt. Geologically coal bearing formations outcrop in the surface geology today. There are significant coal deposits underneath the area covered by this plan today, though the amount of overburden covering that resource has made it less economically attractive when compared to other coal resources to the north and east in the Powder River Basin.

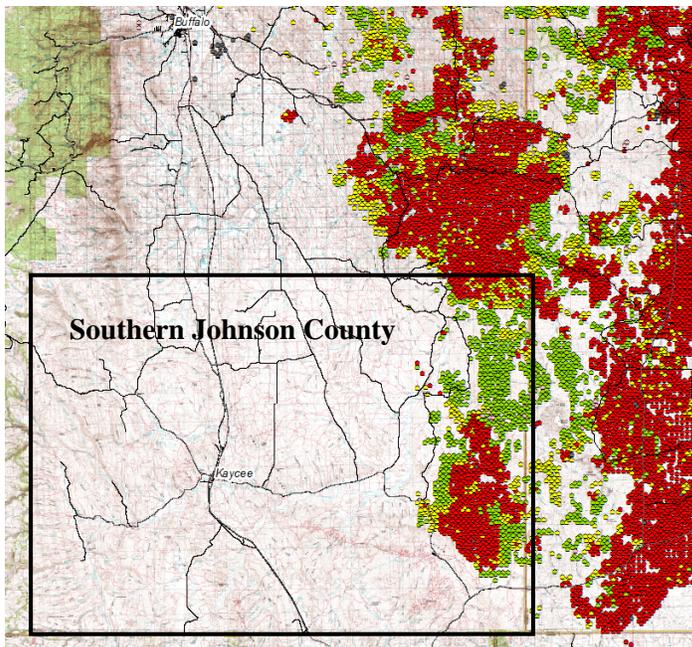
**Methane:**

Coal Bed Methane (CBM) development in SE Johnson County started in 2002 by the Williams Production Co. They targeted the Big George coal bed near the southern outcrop. This was quite a gamble, since conventional “wisdom” stated that there was little gas so near the outcrop. The wells were drilled from 700 to 1700 feet and intercepted the southern edge of the Big George where it is 60 feet thick. The main part of the field was in and around the Bullwhacker Creek and Little Bullwhacker Creek drainages.

The Big George field has proven to be extremely productive and, contrary to all expectations, has produced some of the highest gas concentrations in the Powder River basin. This field, located just east of Sussex, is an extension of the larger Big George field to the north. The main body of the Big George lies almost wholly within eastern Johnson County and ranges in thickness from 200 to 250 feet. The amount of gas within this massive coal reservoir is still undefined, but early speculation appears to have been conservative. There are 61 wells that have produced over 1,000,000 Mcf (million cubic feet) each, the bulk of which are less than 3 years old. The highest CBM producing well

in the state is in this field; having produced 2,333,168 Mcf gas since December, 2004.

There are now 6150 wells completed in the Big George, of which approximately 1200 are producing gas. The remainder must generally pump water from 6 months to 2 years before gas is produced. This field has produced 460,000,000 Mcf of gas as of October 3, 2007; that is 460 Tcf of gas in approximately 4 years. There have also been 795,000,000 barrels of water produced, which equals 33,390,000,000



*Figure 1: Coalbed Methane wells in Southern Johnson County. Red and yellow are completed wells; green wells are yet to be drilled as of 2007.*

gallons or approximately 102,500 acre feet of water.

The value of the gas has changed Johnson County's annual natural gas valuation from \$4,717,000 in 2001 to approximately \$677,400,000 in 2006. To say that the development has had an impact on the economy of Johnson County would be an understatement. By 2008, the valuation should be in the neighborhood of \$1,200,000,000. This is a significant change in 7 years and can be generally attributed to the Big George Coal bed.

**Industry Contributions to Agriculture:**

Industry has been active in assisting agriculture through various means over time. The most important and notable activity has been the introduction of water to Salt Creek, Meadow Creek, and to some extent the South Fork of Powder River. This resource has helped ranching exist in areas where livestock production was limited in the past. During seasons of the year when water was previously available, rangeland was always utilized, but lack of water during some time periods rendered some areas unusable.

Industry has contributed to the development of roads, electrical power, reservoirs, fire suppression, fences and other infrastructure within the watershed. These resources have contributed to the productivity of the land and economic viability of ranching operations. Wildlife has also benefited greatly from these resource improvements.

Industry has contributed to the economy of the area in several ways that are related to natural resource stewardship. The viability of some ranching operations is supplemented by second incomes related to the mineral industry. In many cases families have members who work off the ranches in these industries. Other notable economic contributions include increased tax base provided by industries as well as significant donations by industry to community activities and endeavors.

**Climate**

**Period of Record Monthly Climate Summary**

Period of Record: 08/01/1948 to 12/31/2005

Month	Average Max. Temperature (F)	Average Min. Temperature (F)	Average Total Precipitation (in)	Average Total Snowfall (in)
January	37.6	6.9	0.4	6.7
February	41.6	12.6	0.36	6.4
March	48.9	19.8	0.7	7.4
April	57.9	28.5	1.5	6.6
May	67.8	38.2	2.25	1.3
June	78.7	46.5	2.05	0.1
July	88	52.6	1.15	0
August	86.7	50.2	0.83	0
September	75.6	40.1	1.07	0.4
October	63.1	29.5	1.03	2.4
November	47.6	17.6	0.52	5.6
December	39.7	9.7	0.37	6.5
Annual	61	29.4	12.24	43.3

*Table 1 - Source: Western Regional Climate Center*

The average Growing Season extends to about 136 days each year. The average relative humidity is 60 percent. Wind speed averages about 8 miles per hour (mph), and ranges from 10 mph during the spring to 7 mph during late summer. Daytime winds are generally stronger than nighttime. Occasional strong storms may bring brief periods of high winds with gust of more than 75 mph. All of this information is for the town of Kaycee and may be somewhat misleading in nature. Much of the wind and other weather in the watershed can be quite extreme in nature.

### ***Drought effects***

Data both quantitative and anecdotal indicate that it has been a great deal dryer in the west in general over the past decade, though other data also indicates that even more dramatic conditions may have existed in the past. This is certainly the case in this watershed area. Two major studies are referenced in the appendix of this plan and were provided by Wyoming State Climatologist Dr. Stephen T. Gray.

Both studies were of tree rings in the western US. The first study was in the Bighorn Basin and the second on a much larger regional scale from Canada to Mexico. Both studies indicated that drought is a common occurrence in the western US including Wyoming and that drought periods tend to be cyclical in nature, typically 10 years or greater. Studies also indicated that extended periods of drought are highly likely in the western US when climate change increases the average global temperature.

Dr. Gray was asked if severe drought has been the norm for our region. In his correspondence Dr. Gray stated the following:

“Defining ‘normal’ in the context of climate is a very tricky business, but in these cases it means that (1) drought is not an unusual event in this region and (2) we should always be expecting and planning for the next big dry event. Both of these studies also indicate that droughts of much greater severity or duration than anything we saw in the 20th century have occurred in the past, and there's no reason to expect that such massive dry events couldn't happen again. Finally, my take on these studies is that Wyoming tends to be either very dry or very wet for many years (even decades) on end, but we rarely spend much time in what you might think of as ‘average’ or ‘middle of the road’ conditions. Historically speaking, it's either feast or famine.” (Fig. 2)

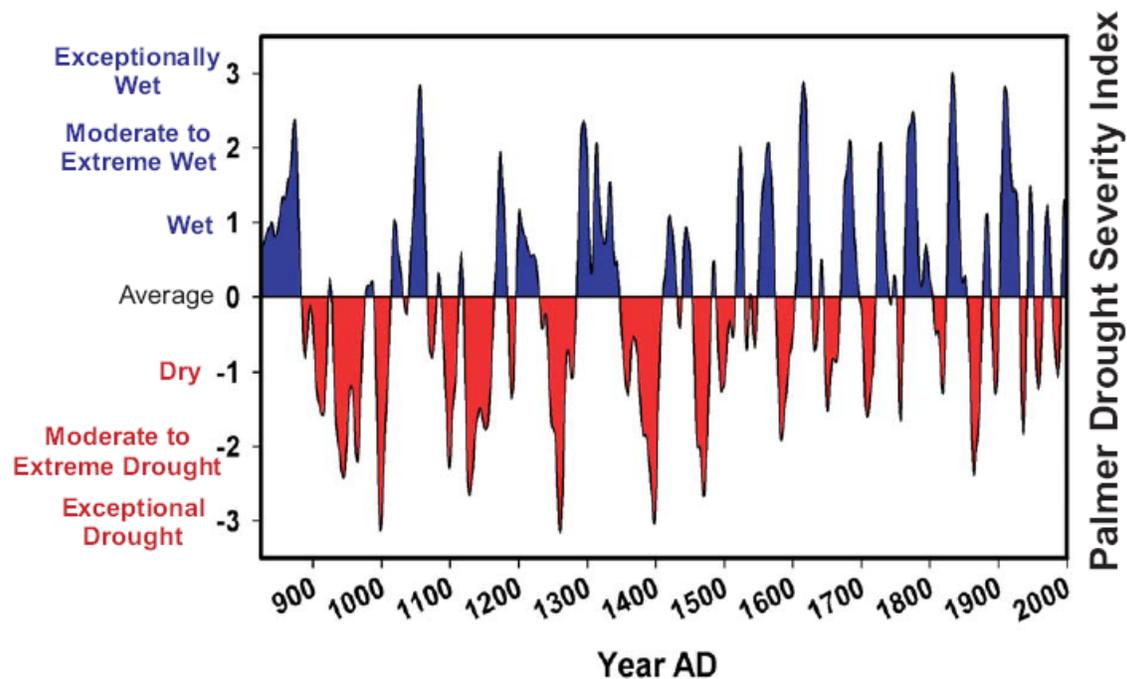


Fig.2 Historical Average Drought Index for the Powder River from 900 AD to 2000 AD.

Current climate trends have not gone unnoticed in developing watershed based activities. One effect of the current drought is the noted impact on recent Water Quality Testing in the Powder River Watershed.

“Analysis and interpretation are complicated by incomplete data due to drought, a limited monitoring period, the use of groundwater for irrigation in at least one South Fork tributary catchment, complex dynamics of soil-water interactions, and complex chemical behavior of selenium.”(pg. 1, par. 4, Salt Creek / South Fork Water-Quality Monitoring Project, Project Report 2004-2005 Monitoring (Phase III), EDE Consultants, January 5, 2007)

“During the period of this study (2003- 06), the Midwest and Powder River stations were consistently below the period of record averages, indicative of drier than normal conditions. Similarly, South Fork stream flow data during the study were well below the historical mean for all monitored months. Water-quality data collected for this study are therefore likely not representative of long-term periods.”(pg. 12, par. 5, Salt Creek / South Fork Water-Quality Monitoring Project, Project Report 2004-2005 Monitoring (Phase III), EDE Consultants, January 5, 2007)

### ***Soils & Geology***

The geologic history of the Powder River Basin has been the subject of a great deal of study due to the mineral resources of the area. Most of the Powder River Basin is covered by sedimentary rocks that were deposited in conditions ranging from shallow coastal to low lying river deltas and swamps. The wet environment lent itself to the deposition of plant material that ultimately became coal and other resources. The

watersheds around the Kaycee area are somewhat different in that they are dominated by the Cody Shale geology. This was a near shore marine shale. Being in a marine depositional environment, the Cody Shale had large levels of salts and other elements associated with its deposition. The Cody Shale, as well as the other geology of the basin, is prone to erosion by water. The bedrock of these formations is soft in nature and can typically be excavated with a shovel.

The soils in the watershed are typically arid. They usually exhibit little in the way of diagnostic soil formation. Young soils (Orthents, Entisols, and Inceptisols) are common. Highly arid soils (Aridisols) dominate the remaining portions of the landscape. Particle sizes usually range from silts to clays, with intermittent areas of sandy soils sometimes located close to large drainages. Clay loams and clays are the most common soil textures in the watershed. The most common soils in the area typically exhibit heavy textures, low levels of organic matter, and high levels of sodium, calcium, and other salts. This is especially true in areas dominated by the Cody Shale geology. The soils derived from this geology are naturally high in soluble salts. Water that comes in contact with these soils quickly increases its total dissolved solids (TDS) load. Water that is low in TDS typically picks up more salts and erodes soils at a higher level than water with some salt content.

### ***Previous Studies and Work Pertinent to the Powder River Watershed Plan***

Since 2000 the Powder River Conservation District has utilized \$152,073.92 in the effort to address water quality issues. This effort to address water impairments has resulted in five scientific studies:

1. Historical Data Review and Analysis for the Salt Creek Watershed including a Section of the Upper Powder River, Lost Iguana Consulting, January 1, 2001
2. Salt Creek / South Fork 319 Watershed Assessment, Final Project Report for 2003 Monitoring (*Phase I*), EDE Consultants, March 1, 2004
3. Salt Creek / South Fork 319 Watershed Assessment, Project Report for 2003-2004 Monitoring (*Phase II*), EDE Consultants, November 2, 2005
4. Salt Creek / South Fork Water-Quality Monitoring Project, Project Report 2004-2005 Monitoring (*Phase III*), EDE Consultants, January 5, 2007
5. Analysis and Interpretation of Water Quality/Quantity Data from the South Fork Powder River, Posey Creek, Murphy Creek, Willow Creek and Middle Fork Powder River, WWC Engineering, March 22, 2007

In addition to these conservation district activities Anadarko Petroleum Corporation developed a Use Attainability Analysis (UAA) that was previously mentioned in this document.

The impairment issue seen in 1998 led to the discovery and listing of selenium as an impairment in the Powder River at its confluence with the South Fork to Crazy Woman Creek in 2000. Further water sampling and analysis led to the listing of Salt Creek as impaired by Chloride in 2002. Additional testing resulted in the listing of both the South Fork of the Powder River, and Willow Creek as impaired for Selenium in 2006.

As water monitoring and analysis grew so did the number of impaired waters. In 2003 the data and analysis obtained regarding the chloride impairment on Salt Creek led

to the decision by Anadarko Corporation to create the UAA. What has proved most elusive is the nature of the impairment for selenium on the South Fork of Powder River. The Data Review Summary of South Fork monitoring data was completed in March of 2007 and has resulted in the efforts of the PRCD to proceed with a Watershed Plan and a Use Attainability Study.

Due to the nature of the Powder River watershed a certain amount of water monitoring is performed in Natrona County. The Natrona County Conservation District is aware of and has approved the water monitoring conducted in the watershed within their district by PRCD.

The scope of the PRCD impairment concerns were originally confined to chloride below Salt Creek on the Powder River, but over time has expanded to include selenium in the South Fork sub-watershed. The effort and resources directed to understand and improve the water quality in the area has been large. The Use Attainability Analysis regarding Salt Creek and Powder River was submitted in 2004 and was approved by the Wyoming Environmental Quality Council in April of 2007; much depends on final approval of this UAA by the EPA.

### ***Conservation District Authority for Watershed Planning Process***

Under Wyoming Statute, 11-16-103 Legislative Declarations and Policy, the Powder River Conservation District has the authority to “provide for the conservation of the soil and water resources of this state, and for the control and prevention of soil erosion and for flood prevention or the conservation, development, utilization, and disposal of water, and thereby to stabilize ranching and farming operations, to preserve natural resources, protect the tax base, control floods, prevent impairment of dams and reservoirs, preserve wildlife, protect public lands, and protect and promote the health, safety and general welfare of the people of this state.”

Wyoming Statute 11-16-122 (b) authorizes the Conservation Districts to “conduct surveys, investigations and research and disseminate information relating to . . . the conservation, development, utilization and disposal of water. . . in cooperation with the government of this state or its agencies . . . (v),” to “develop comprehensive plans for . . . conservation of soil and water resources . . . [that] specify in detail the acts, procedures, performances, and avoidances necessary or desirable to carry out the plans (xvi),” and to “make public the plans and information and bring them to the attention of owners and occupiers of land within the district (xvii).”

In 1996 Wyoming Conservation Districts, the Natural Resources Conservation Service and the Wyoming Department of Agriculture saw an increasing need for Conservation Districts to represent local interests and take the lead in watershed planning efforts. As a result they developed the Watershed Strategic Plan to guide watershed planning efforts across the state. This document insists that “any Watershed effort led by a conservation District should be landowner driven. . . [and] any participation on behalf of any landowner is strictly voluntary.” By taking an active role in the planning process, the Powder River Watershed landowners and the Powder River Conservation District have adhered to this principle. The landowners have followed the steps for watershed planning as outlined in the Watershed Strategic Plan. They have identified and prioritized concerns, set goals

and objectives, and developed a watershed management plan. Included in the Powder River Watershed Plan are elements to solicit funds, implement the plan, and evaluate the plan.

## **ISSUES AND CONCERNS**

### **Industry**

Industry plays an important role in the Powder River Watershed. Although WDEQ requires industrial developments to hold discharge permits, road development, and pipeline construction may contribute additional surface runoff and, therefore, pollutants such as selenium and chloride to surface waters. Industry is closely monitored and must abide by all requirements prior to activity.

***Oil and Gas Developments*** – Discharges of water from production operations and from the disturbance of vegetation increasing surface runoff are a concern.

***Bentonite Mining Operations*** – Runoff from mine lands and discharged water may impact water quality but are point source in nature and are allowed under WYPDES Permits.

***Road Construction*** – Road construction operations are also required to hold stormwater management plans, but the plans are enforced only sporadically. Road construction for coalbed methane development and mineral exploration are extensive.

***Pipeline Installations*** – Pipe laying operations disturb vegetation and increase erosion thereby impacting water quality.

***Shale and Gravel Pits*** – Large scale land disturbances will increase erosion.

***Discharge Permits*** – The South Fork of the Powder River, Salt Creek and Meadow Creek are examples of stream systems that derive a significant portion of their flow from industrial discharges. This water provides an important asset for agriculture, wildlife and other uses. There may be a need to pursue effluent dominated water quality classification in instances like these.

***Reclamation of Disturbed Industrial Sites*** – Revegetation of disturbed areas remains an issue.

### **Designated Use and Classification**

There are many streams within the District that do not support primary contact recreation. The District may need to pursue submitting UAAs for these streams for secondary contact recreation. There is also a need to reclassify some of the streams in the District to accurately reflect designated uses other than for contact recreation. The priority for reclassification will be highest for currently listed stream segments.

### **Site Specific Criteria**

Data shows pervasive selenium every place that has been sampled and regardless of land use (with and without irrigation) and industrial discharges. This may indicate that selenium is attributable to natural background conditions and are not man-induced. Chloride levels are not likely being influenced by activities of man and this may also indicate a need to pursue additional site specific criteria for chloride.

## **Agriculture**

The agricultural community has been an economic and cultural mainstay of the Powder River Watershed for generations. Specific agricultural based issues and concerns include:

***Grazing Management*** - Opportunities exist for enhanced grazing management practices to address potential pollutant loads as well as using grazing as a tool to enhance stream bank stability and riparian area conditions. Increase awareness and educate the community on options, including cost-share opportunities, to increase grazing efficiency and distribution to improve water quality. To this point in time, during the summer grazing season, the vast majority of livestock operators trail cattle and sheep to the mountains beginning in May and do not return until October. Livestock numbers are low in the basin regions of the watershed.

***Corrals*** – Corrals and feeding pens with either direct access to streams or man-made water conveyance structures with flow through confinement areas and both have potential to impact water quality and should be in compliance with WDEQ rules and regulations.

***Economic Impacts of Remediation*** – Remediation should not place an undue economic burden on those who participate in BMP programs. Economic viability of the agricultural operation should be a priority as BMP alternatives are considered. There is a variety of conditions within the watershed that make economic impacts hard to quantify. Agricultural producers in these watersheds must carefully evaluate if any BMP implementation is feasible.

***Information and Education*** – Increase awareness and educate the community on options, including cost-share opportunities, for improving water quality through improved livestock and wildlife waste management, grazing management and irrigation management.

***Irrigation Management*** – In recent years, there have been changes within the watershed to increase irrigation efficiencies. For crops such as irrigated grass hay, grass/alfalfa hay and even alfalfa, switching from flood irrigation to center pivot irrigation is not always economically feasible. There are alternatives such as field borders, grassed waterways, buffer strips and border dikes to reduce overland flow contributions to the waterbodies.

## **Natural Background and Climatic Conditions**

The Powder River Watershed experiences short-duration, high-intensity storm events that coupled with naturally low vegetative cover can cause severe water erosion and contribute significant sediment to the channel. The underlying geology (Cody Shale) and soils are naturally high in salts and are influencing concentrations in the water. Natural disasters such as wildfires may also contribute abnormally high levels of sediment and therefore, salts, to the Powder River. Efforts should be taken to account for events such as these when collecting water quality samples. Documentation of natural disasters or land management practices that influence water quality will be important to ensure that samples are representative of actual conditions.

## **Weed Management**

There is an existing program to eradicate Salt Cedar in Johnson County. This effort is currently being supported by the Johnson County Weed and Pest. There is an initiative to use a mil levy to sustain the salt cedar program. Salt Cedar can influence quantity and quality (especially salt) of water in systems where the plant is established and dominant. Knapweed is also a problematic species within the watershed. Vigilance in weed control is always a consideration and the Johnson County Weed and Pest has been effective in controlling weeds.

## **Education and Awareness of Watershed Plan**

Recognition of water quality issues by landowners and the public at large is the initial challenge and in order to encourage participation in voluntary BMP activities, the PRCD will have to lead effective information dissemination programs. This watershed plan must be in the public's eye in order to be effective. PRCD will play a key role in keeping the public updated on cost-share opportunities for BMP implementation, new technology for addressing water quality related resource concerns and progress achieved through the implementation of this watershed plan. Recognition of this watershed plan will also be important in securing the needed funding for implementation.

## **Natural Resource Information/Education**

The Powder River Conservation District has programs currently in effect to increase the level of understanding of resource management. These programs have been effective in educating the community on many different resource topics and will continue to be important.

## **Water Quality Monitoring**

Continuing water quality monitoring is important to gain insight into data trends in response to changing climatic conditions and management decisions. The committee believes that some water quality data needs to be collected to document any drastic changes in data. Some of the current water quality sites are not rendering additional insight into the cause for the pervasive and consistent concentrations of salt in the surface waters of the watershed. As this watershed plan is implemented, sampling sites and dates may change in response to management activities or trends noticed in the data. For these reasons, the steering committee believes that local expertise in water quality issues is also important. Therefore, water quality training for PRCD employees is a priority.

## **Coordination with WDEQ and Other Entities**

To insure successful implementation of this watershed plan, WDEQ and other agencies involved with water quality regulation, funding and assessment will have to be aware of the status of this planning effort. PRCD will use this watershed plan as a business plan in applying for funding for implementation, so broad awareness of activities within the watersheds will be beneficial.

## **Water Usage and Development**

The Powder River Steering Committee recognizes that water quality concerns have no impact on Wyoming Water Law. Diversions of water do alter hydrology of the watersheds, which can be beneficial or in some cases may be detrimental, and should be considered in watershed planning. Water development projects, including water storage, may also function in improving water quality within the watersheds.

## **Documentation of Watershed Plan Progress and Implementation Efforts**

In order to effectively track the progress of implementing this plan, a system for recording all of the water quality efforts of the district, federal, state and local agencies, landowners, industry and other parties will need to be developed.

## **OBJECTIVES TO ADDRESS WATERSHED CONCERNS**

**Industry** – Although most industrial activities are monitored and regulated by WDEQ, the Powder River Steering Committee recognizes that there are projects that can be implemented to help industry understand the water quality issues in the Powder River Watershed. Specific issues related to industry include:

*Oil and Gas Developments* – Discharges of water from production operations and from the disturbance of vegetation increasing surface runoff are a concern.

### **OBJECTIVES**

Increase the level of understanding of the requirements and strategies for effective Stormwater Pollution Prevention Plans.

### **ACTION ITEMS**

Provide an educational opportunity for construction contractors and industry representatives.

*Bentonite Mining Operations* - Runoff from mine lands and discharged water may impact water quality but are point source in nature and are allowed under WYPDES Permits.

### **OBJECTIVES**

Increase the level of understanding of the requirements and strategies for effective Stormwater Pollution Prevention Plans.

### **ACTION ITEMS**

Provide an educational opportunity for construction contractors and industry representatives.

*Road Construction* – Road construction operations are also required to hold stormwater management plans, but the plans are enforced only sporadically. Road construction for coalbed methane development and mineral exploration are extensive.

### **OBJECTIVES**

Increase the level of understanding of the requirements and strategies for effective Stormwater Pollution Prevention Plans.

Reduce the impact of dust on grazing resources and water quality.

### **ACTION ITEMS**

Provide an educational opportunity for construction contractors and industry representatives.

Coordinate with other Conservation Districts to provide technical assistance for dust mitigation strategies.

*Pipeline Installations* – Pipe laying operations disturb vegetation and increase erosion thereby impacting water quality.

### **OBJECTIVES**

Increase the level of understanding of the requirements and strategies for effective Stormwater Pollution Prevention Plans.

**ACTION ITEMS**

Provide an educational opportunity for construction contractors and industry representatives.

*Shale and Gravel Pits* – Large scale land disturbances will increase erosion.

**OBJECTIVES**

Increase the level of understanding of the requirements and strategies for effective Stormwater Pollution Prevention Plans.

**ACTION ITEMS**

Provide an educational opportunity for construction contractors and industry representatives.

*Discharge Permits* – The South Fork of the Powder River, Salt Creek and Meadow Creek are examples of stream systems that derive a significant portion of their flow from industrial discharges. This water provides an important asset for agriculture, wildlife and other uses. There may be a need to pursue effluent dominated water quality classification in instances like these.

**OBJECTIVES**

Ensure that discharged water is still be available for beneficial uses if desired by the landowners.

**ACTION ITEMS**

Assist in preparing UAAs for classification changes if needed.

*Reclamation of Disturbed Industrial Sites* – Revegetation of disturbed areas remains an issue.

**OBJECTIVES**

Provide training opportunities for industry representatives regarding reclamation and restoration activities.

**ACTION ITEMS**

Invite a reclamation expert to the PRCD Speaker Series to provide advice and strategies for improving plant establishment on disturbed land.

**Designated Use and Classification** – There are many streams within the District that do not support primary contact recreation.

**OBJECTIVES**

Ensure that waterbodies within the District are classified as accurately as possible.

**ACTION ITEMS**

Prepare UAAs for recreational use designations starting with those currently listed on the 303(d) list and then proceeding with work on other streams (largest first) within the District.

**Site Specific Criteria** – Data shows pervasive selenium every place that has been sampled and regardless of land use (with and without irrigation) and industrial discharges. This may indicate that selenium is attributable to natural background conditions and are not man-induced. Chloride levels are not likely being influenced by

activities of man and this may also indicate a need to pursue additional site specific criteria for chloride.

**OBJECTIVES**

Accurately portray the influence of background conditions such as surrounding geology, topography and climate on water quality parameters.

**ACTION ITEMS**

Prepare a UAA to provide for realistic and achievable water quality standards for water influenced by the Cody Shale within the District.

**Agriculture** - The agricultural community has been an economic and cultural mainstay of the Powder River Watershed for generations. Specific agricultural based issues and concerns include:

*Grazing Management* - Opportunities exist for enhanced grazing management practices to address potential pollutant loads as well as using grazing as a tool to enhance stream bank stability and riparian area conditions. Increase awareness and educate the community on options, including cost-share opportunities, to increase grazing efficiency and distribution to improve water quality.

**OBJECTIVES**

Work with the Conservation District and others to identify and provide educational opportunities on the implementation of Best Management Practices (BMPs) that improve grazing conditions, such as but not limited to: off site water, range monitoring, and rotational grazing.

**ACTION ITEMS**

Provide at least one educational workshop or tour per year for the first five years of the watershed plan detailing advancements and opportunities in range management.

*Corrals* – Corrals and feeding pens with either direct access to streams or man-made water conveyance structures with flow through confinement areas have the potential to impact water quality and should be in compliance with WDEQ rules and regulations.

**OBJECTIVES**

Maintain compliance with relevant state and federal guidelines regarding Animal Feeding Operations (AFOs) and Confined Animal Feeding Operations (CAFOs).

**ACTION ITEMS**

Work with landowners and NRCS to identify opportunities and resources to implement one or more AFO/CAFO projects over the first five years of the watershed plan.

*Economic Impacts of Remediation* – Remediation should not place an undue economic burden on those who participate in BMP programs. Economic viability of the agricultural operation should be a priority as BMP alternatives are considered.

**OBJECTIVES**

Provide cost effective BMP implementation.

### **ACTION ITEMS**

Work with the NRCS to identify BMP opportunities and alternatives, as well as working with the NRCS, Conservation District, Industry and others to identify opportunities for financial assistance in implementing voluntary efforts.

*Information and Education* – Increase awareness and educate the community on options, including cost-share opportunities, for improving water quality through improved livestock and wildlife waste management, grazing management and irrigation management.

### **OBJECTIVES**

Increased knowledge on water quality and waste management issues.

### **ACTION ITEMS**

Participate in and encourage community involvement in any relevant workshops dealing with water quality issues and write a quarterly article in the Conservation District newsletter or the local newspaper on a water quality or watershed subject during the first five years of the watershed plan.

*Irrigation Management* – In recent years, there have been changes within the watershed to increase irrigation efficiencies. Alternatives such as field borders, grassed waterways, buffer strips and border dikes to reduce overland flow contributions to the waterbodies should also be explored.

### **OBJECTIVES**

Increase irrigation efficiency where appropriate and effective.

### **ACTION ITEMS**

Work with landowners and NRCS where appropriate to implement one irrigation efficiency project per year over the first five years of the watershed plan.

**Natural Background and Climatic Conditions** – The Powder River Watershed experiences short-duration, high-intensity storm events that coupled with naturally low vegetative cover can cause severe water erosion and contribute significant sediment to the channel. The underlying geology (Cody Shale) and soils are naturally high in salts and are influencing concentrations in the water. Natural disasters such as wildfires may also contribute abnormally high levels of sediment and therefore, salts, to the Powder River. Efforts should be taken to account for events such as these when collecting water quality samples. Documentation of natural disasters or land management practices that influence water quality will be important to ensure that samples are representative of actual conditions.

### **OBJECTIVES**

Track natural conditions and possible affects on water quality through water monitoring, and note possible environmental factors that could affect water quality.

### **ACTION ITEMS**

Encourage the district to note any significant environmental factors during monitoring.

**Weed Management** – There is an existing program to eradicate Salt Cedar in Johnson County. This effort is currently being supported by the County Weed and Pest.

There is an initiative to use a mil levy to sustain the salt cedar program. Salt Cedar can influence quantity and quality (especially salt) of water in systems where the plant is established and dominant. Knapweed is also a problematic species within the watershed. Vigilance in weed control is always a consideration and the Johnson County Weed and Pest has been effective in controlling weeds.

**OBJECTIVES**

Educate and encourage land owners to work with the Weed and Pest to control invasive species within the watershed.

**ACTION ITEMS**

Support an annual workshop that addresses invasive species during at least the first five years of this watershed plan.

**Education and Awareness of Watershed Plan** - Recognition of water quality issues by landowners and the public at large is the initial challenge and in order to encourage participation in voluntary BMP activities, PRCD will have to lead effective information dissemination programs.

**OBJECTIVES**

Educate the general public on watershed level issues such as those in this watershed plan.

**ACTION ITEMS**

Have a yearly update on watershed plan implementation and opportunities, utilizing either a public meeting or newsletter, during at least the first five years of this watershed plan.

**Natural Resource Information/Education** – The Powder River Conservation District has programs currently in effect to increase the level of understanding of resource management. These programs have been effective in educating the community on many different resource topics and will continue to be important.

**OBJECTIVES**

Continue education on resource management issues within the watershed and conservation district in general.

**ACTION ITEMS**

Support a quarterly newsletter by the conservation district detailing items of interest within the watershed.

**Water Quality Monitoring** - Continuing water quality monitoring is important to gain insight into data trends in response to changing climatic conditions and management decisions.

**OBJECTIVES**

Maintain consistency and quality in water monitoring within the district and the watershed.

**ACTION ITEMS**

Support yearly training activities for the Conservation District or other relevant entities in water quality monitoring and support efforts to maintain funding for a water quality monitoring program within the district. Training should be sought on an as needed basis and funding sought biannually as it is appropriated by the state.

**Coordination with WDEQ and Other Entities** - To ensure successful implementation of this watershed plan, WDEQ and other agencies involved with water quality regulation, funding and assessment will have to be aware of the status of this planning effort.

**OBJECTIVES**

Use this watershed plan as a business plan in applying for funding for implementation, so broad awareness of activities within the watersheds can be beneficial.

**ACTION ITEMS**

Maintain communication with the WDEQ and other relevant entities at least yearly during the first five years of this watershed plan to share accomplishments and remain abreast of any significant changes in actions or policy.

**Water Usage and Development** - Water quality concerns have no impact on Wyoming Water Law. Diversions of water do alter hydrology of the watersheds, which can be beneficial or in some cases may be detrimental, and should be considered in watershed planning. Water development projects, including water storage, may also function in improving water quality within the watersheds.

**OBJECTIVES**

Research opportunities to develop water resources.

**ACTION ITEMS**

Maintain a dialogue at watershed meeting about opportunities for water development at least once a year for the first five years of the watershed plan.

**Documentation of Watershed Plan Progress and Implementation Effort**

In order to effectively track the progress of implementing this plan, a system for recording all of the water quality efforts of the district, federal, state and local agencies, landowners, industry and other parties will need to be developed.

**OBJECTIVES**

Maintain a record of actions related to this watershed plan.

**ACTION ITEMS**

Develop a binder and record keeping system to be maintained by the district and updated at watershed meetings. Watershed meetings will initially occur quarterly and may be scaled back to a minimum of at least once a year for the first five years of the watershed plan.

## **POWDER RIVER WATERSHED STEERING COMMITTEE**

Don Sell-Bill Barrett Corporation  
Mike Wolcott  
Clayton McGuire  
John Garrett  
Pete Meike  
Marcia Campbell  
Robin Taylor  
Anita Bartlett-PRCD  
Emma Lee Koch  
Dale Firnekas  
Perri Wheeler  
Allison McKenzie-NRCS  
John Farrell-Anadarko Petroleum Corp.  
Jerri Bennett  
Steve Shire-Department of Energy-NPR-3  
Mike Curuchet

Brad Neville  
John McNary  
Cindy McGuire  
George Renkert  
Jo Harlan  
Ken Campbell  
Sunny Taylor  
Kenneth Koch  
Larry Smith  
Boone Firnekas  
Shannon Wheeler  
Lee Lohse  
Wayne Graves  
Bonnie Smith  
Gene Vieh  
Don Meike

## **Appendix 1 – Drought Effects**

Data both quantitative and anecdotal indicate that it has been a great deal dryer in the west in general over the past decade, though other data also indicates that even more dramatic conditions may have existed in the past. This is certainly the case in this watershed area. The following information demonstrates this point. This information was provided to the PRCD by Wyoming State Climatologist Dr. Stephen T. Gray. Dr. Gray was asked if severe drought has been the norm for our region. In his correspondence Dr. Gray stated the following:

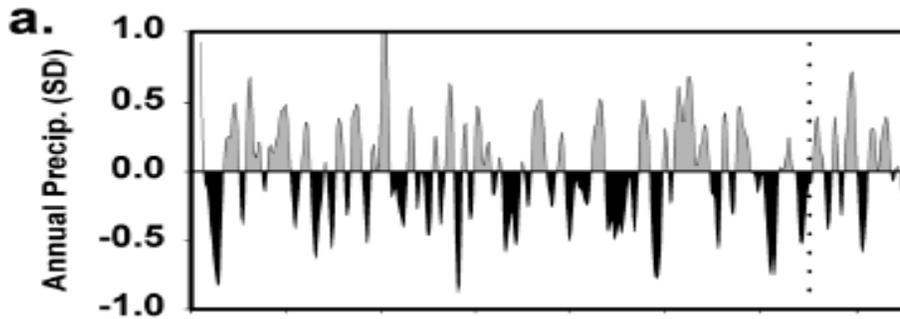
“Defining ‘normal’ in the context of climate is a very tricky business, but in these cases it means that (1) drought is not an unusual event in this region and (2) we should always be expecting and planning for the next big dry event. Both of these studies also indicate that droughts of much greater severity or duration than anything we saw in the 20th century have occurred in the past, and there’s no reason to expect that such massive dry events couldn’t happen again. Finally, my take on these studies is that Wyoming tends to be either very dry or very wet for many years (even decades) on end, but we rarely spend much time in what you might think of as ‘average’ or ‘middle of the road’ conditions. Historically speaking, it’s either feast or famine.”

The following articles help articulate this issue. The information is taken from ‘Tree-Ring-Based Reconstruction of Precipitation in the Bighorn Basin, Wyoming since 1260 A.D.’, Stephen T. Gray Et Al, 2004. While the study addressed the effects of drought in the Bighorn Basin the ramifications of drought described in the study would also apply to the Powder River Basin.

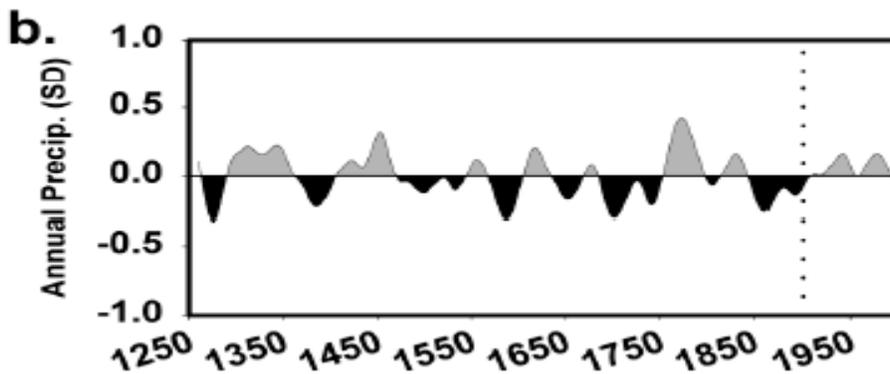
“In the Bighorn Basin region of north-central Wyoming and south-central Montana, drought risks are exacerbated by increasing demands for water coupled with changing economic needs and development patterns. Outdoor recreational activities such as hunting, fishing, skiing, snowmobiling, and boating are gradually replacing ranching and logging as the primary sources of income in the Bighorn Basin. Demands for recreational water, as well as water for fisheries and wildlife management, are often in conflict with demands for municipal and agricultural needs. While human populations in the Bighorn Basin were once concentrated in a few small, urban centers (9000 inhabitants), a recent trend toward rural-residential or ‘ranchette’ style development has led to increased construction in areas prone to wildfires and extended demands on groundwater resources.

In western North America as a whole, most of the precipitation variability at interannual to decadal and longer time scales is thought to originate in the Pacific basin as a result of interactions between the El Niño– Southern Oscillation (ENSO) and lower-frequency modes in the North Pacific (McCabe and Dettinger 1999). Recent studies, however, have pointed to the weakness of Pacific teleconnections in portions of the interior west, and the potential for complex

interactions involving both the Pacific and Atlantic basins in the development of widespread, persistent droughts.”



*Fig.1- Reconstructed Bighorn Basin precipitation (previous Jun–current Jun) smoothed with a 14-yr cubic spline to highlight the dominant mode of decadal variability shown in Fig. 3b. The black horizontal line at 26.1 cm depicts the long-term mean. Periods of above average precipitation are shown in gray while periods of below average precipitation are shown in black. The vertical dotted line crosses at 1900 AD.*



*Fig. 2- As in Fig.1 but smoothed with a 50-yr cubic spline to highlight the dominant modes of multidecadal variability. (‘Tree-Ring-Based Reconstruction of Precipitation in the Bighorn Basin, Wyoming since 1260 A.D.’, Stephen T. Gray Et Al, 2004)*

A second Study gave the following information in ‘Long-Term Aridity Changes in the Western United States’, Cook Et Al, 2004. This study does not specifically apply to the Powder River Basin but covers the west as a whole.

‘The western United States is experiencing a severe multiyear drought that is unprecedented in some hydroclimatic records. Using gridded drought reconstructions that cover most of the western US over the past 1,200 years, we show that this drought pales in comparison to an earlier period of elevated aridity and epic drought in AD 900-1300, an interval broadly consistent with the

“Medieval Warm Period”. If elevated aridity in the western US is a natural response to climate warming, then any trend toward warmer temperatures in the future could lead to a serious long-term increase in aridity over western North America.’

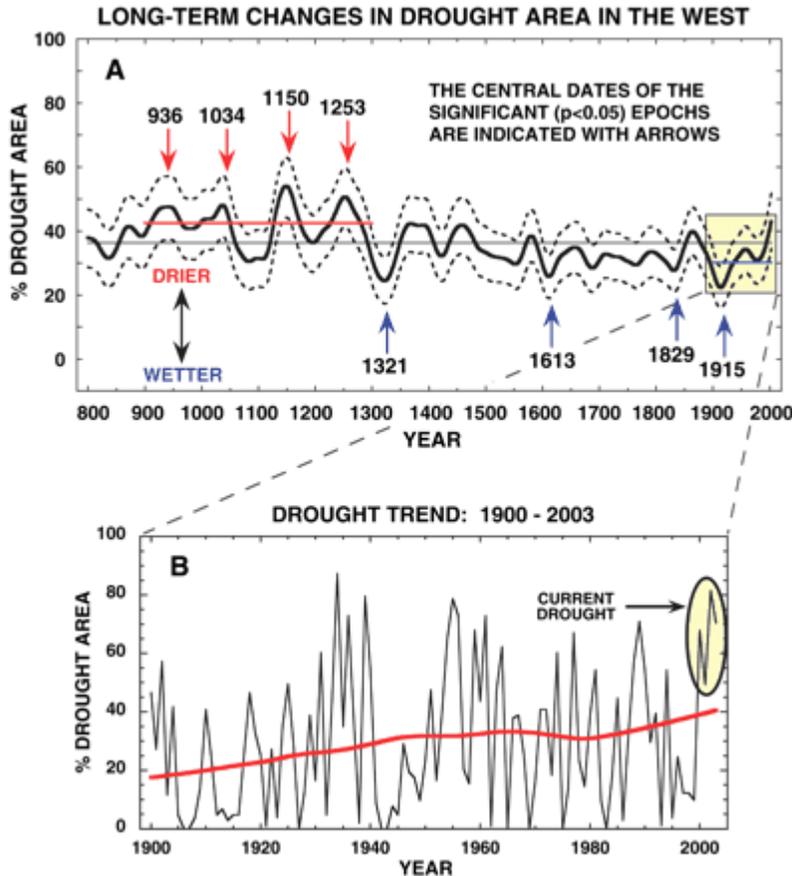
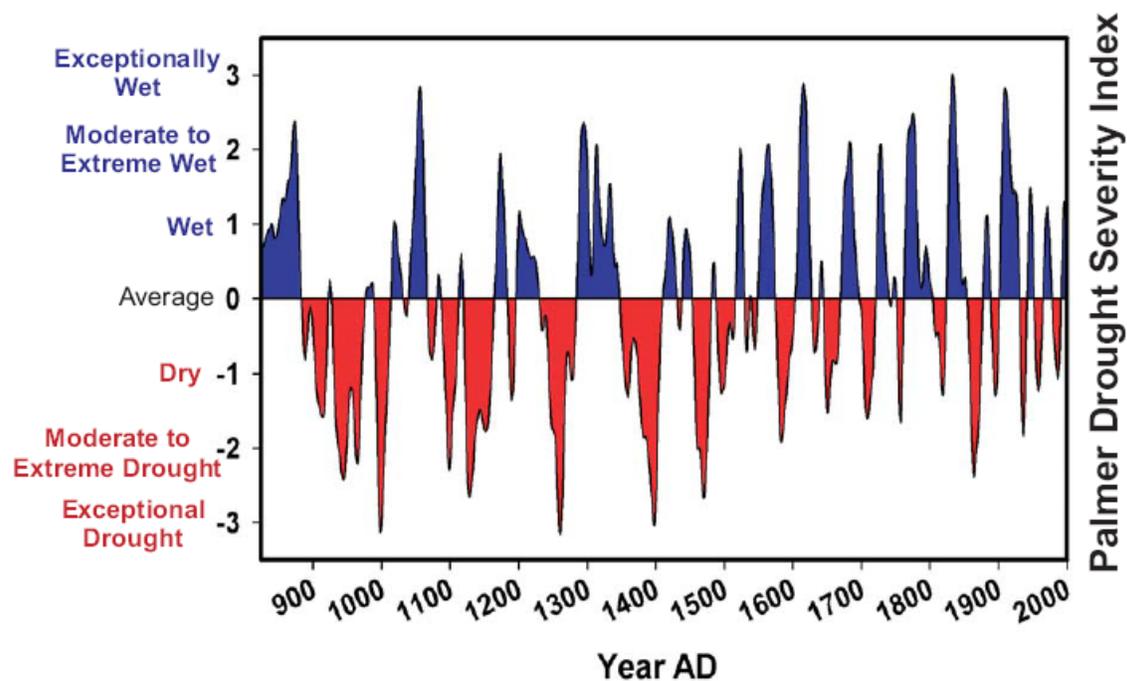


Fig. 3 - Smoothed DAI (Drought Area Index) reconstruction (solid black curve) for the West, showing two-tailed 95% bootstrap confidence intervals (dashed black curves) and the long-term mean (thin horizontal black line).

“Sixty-year smoothing was applied to highlight the multidecadal to centennial changes in aridity. The four driest epochs ( $P < 0.05$ , those with confidence limits above the long-term mean in Fig. 2A) are before AD 1300, whereas the four wettest ( $P < 0.05$ ) epochs occur after that date. The difference between the means of the AD 900 to 1300 period (redline, 42.4%) and AD 1900 to 2003 period (blue line, 30%) are also apparent. The 12.4% difference between the two periods translates into an average drought area (PDSI  $< -1$ ) increase of 41.3% in the West during the earlier period. This difference is statistically significant ( $P < 0.001$ ) given an equality-of-means t test with degrees of freedom corrected for first-order autocorrelation. Even so, some of the AD 900 to 1300 period PDSI estimates are extrapolations, because they fall outside the range of the instrumental PDSI data in the AD 1928 to 1978 calibration period (7). As regression-based estimates, these extrapolations have greater uncertainty compared to those that fall within the range of the calibration period. However, they are still based on the actual

growth histories of highly drought-sensitive trees. Therefore, we argue that our DAI reconstruction is indicative of what really happened in the West, even during the AD 900 to 1300 period of elevated aridity (7). (B) The annually resolved AD 1900 to 2003 portion, which more clearly reveals the severity of the current drought relative to others in the 20th century and an irregular trend (red smoothed curve) toward increasing aridity since 1900.

The following graph was provided by Dr. Stephen Grey and was created by Dr. Edward R. Cook. This is a Historical Average Drought Index for the Powder River from 900 AD to 2000 AD.



*Fig.4 Historical Average Drought Index for the Powder River from 900 AD to 2000 AD.*

Current climate trends have not gone unnoticed in developing watershed based activities. One effect of the current drought is the noted affect on recent Water Quality Testing in the Powder River Watershed.

“Analysis and interpretation are complicated by incomplete data due to drought, a limited monitoring period, the use of groundwater for irrigation in at least one South Fork tributary catchment, complex dynamics of soil-water interactions, and complex chemical behavior of selenium.”(pg. 1, par. 4, Salt Creek / South Fork Water-Quality Monitoring Project, Project Report 2004-2005 Monitoring (Phase III), EDE Consultants, January 5, 2007)

“During the period of this study (2003- 06), the Midwest and Powder River stations were consistently below the period of record averages, indicative of drier than normal conditions. Similarly, South Fork stream flow data during the study were well below the historical mean for all monitored months. Water-quality data

collected for this study are therefore likely not representative of long-term periods.”(pg. 12, par. 5, Salt Creek / South Fork Water-Quality Monitoring Project, Project Report 2004-2005 Monitoring (Phase III), EDE Consultants, January 5, 2007)

## **Appendix 2 – Public Comments**

## Appendix 3 – Glossary

**AFO** – Animal Feeding Operation  
**BLM** – Bureau of Land Management  
**BMP** – Best Management Practices  
**CAFO** – Confined Animal Feeding Operation  
**CWA** – Clean Water Act  
**EPA** – United States Environmental Protection Agency  
**GIS** – Geographic Information System  
**HSCD** – Hot Springs Conservation District  
**NPDES** – National Pollution Discharge Elimination System  
**NPS** – Non-Point Source  
**NRCS** – Natural Resource Conservation Service  
**SAP** – Sampling and Analysis Plan  
**TMDL** – Total Maximum Daily Loads  
**USGS** – United States Geological Survey  
**WDA** – Wyoming Department of Agriculture  
**WACD** – Wyoming Association of Conservation Districts  
**WDEQ** – Wyoming Department of Environmental Quality  
**WGFD** – Wyoming Game and Fish Department  
**WRIR** – Wind River Indian Reservation

### GLOSSARY

**Alluvium** – sediment deposited from flowing water.

**Best Management Practices** – or BMP'S are described as “Guidelines for managing the use or a resource in a manner that protects the resource and promotes ecological and economic sustainability.

**Escherichia coli** – (E.coli) is a type of bacteria found in the intestinal tract of humans and other warm blooded animals. It is used as an indicator of bacterial pollution of water.

**Fecal Coliforms** – are another group of bacteria that are used as an indicator of pollution. They are found in the excremental waste of warm blooded animals and are defined as rod shaped bacteria that ferment lactose to form gas within 48 hours of being placed (Incubated) in lactose broth at 35C.

**Intermittent Stream** – are streams that flow only during high water tables (If ground water fed) or in direct response to precipitation from runoff or snowmelt.

**Non-Point Source Pollution** – is a source of pollution of undetermined origin. An example would be runoff from urban areas, agricultural lands and erosion of soil.

**Perennial Stream** – is a stream that flows throughout the year and is usually fed by ground water.

**Point Source Pollution** – is defined as a known source of pollution such as a pipe from a factory or a waste water treatment facility and is discharged into a nearby water body.

**Quality Assurance** – is an intergrated system of management procedures and activities used to verify that the quality control system is operating within acceptable limits and to evaluate the quality of data.

**Quality Control** – a system of technical procedures and activities developed and implemented to produce measurements of requisite quality.

**Total Maximum Daily Loads** – is the amount of a pollutant that a water body can receive and still meet water quality standards.

**Section 319 Grant**- enables States, Territories and Tribes to address the problems caused by Non-Point Source pollution. The grant also provides funding from the U.S. Environmental Protection Agency for monitoring, mitigation and education.

**Section 303(d) List** – identifies waters not meeting State water quality standards.  
**Section 305(b) Report** – is an assessment of the States water quality and states the degree to which each water body supports the designated uses of a States Water Quality Standards.

## **Appendix 4 – Literature Cited**

Wyoming Water Atlas, University of Wyoming.

Salt Creek / South Fork Water-Quality Monitoring Project, Project Report 2004-2005 Monitoring (Phase III), EDE Consultants, January 5, 2007

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Wyoming Department of Environmental Quality's 2006 305(b) List, Table A: 303(d) list of impaired waters

Diary entry June 14, 1868 by US Calvary Paymaster Robert Dunlap Clark, approaching Fort Reno from Fort Fetterman. (American Heritage Center Digital Collection)

1870 diary, Author unknown, The Midwest Review, June 1921

News Article Ghost voices cry over old Salt Creek field – Velma Matrix, date undetermined, Midwest Museum Collection

1884 Diary Entry, Origin Unknown, Midwest Museum Collection

'The Salt Creek Oilfield' by L.W. Trumbull, State Geologist, 1914

*The Salt Creek Oil Field*, Bulletin Number 8, Series B, L.W. Trumbull, Wyoming State Geologist, S.A. Bristol Co., Cheyenne, Wyo., 1914

'Tree-Ring-Based Reconstruction of Precipitation in the Bighorn Basin, Wyoming since 1260 A.D.', Stephen T. Gray Et Al, 2004

'Long-Term Aridity Changes in the Western United States', Cook Et Al, 2004.

Western Regional Climate center; <http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wy5055>

## **Appendix 5 – Milestone Table**



Site Specific Criteria – Develop UAA for selenium.																				
Completed																				
Funds Available																				
Expended to Date																				
Agriculture – Annual workshop or tour on range management.				X				X				X				X				X
Completed																				
Funds Available																				
Expended to Date																				
Agriculture – Implement AFO/CAFO projects (5 in 5 years)				X				X				X				X				X
Completed																				
Funds Available																				
Expended to Date																				
Agriculture – Cooperation with NRCS to identify BMP opportunities and alternatives	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Completed																				
Funds Available																				
Expended to Date																				
Agriculture – Quarterly education and information in the district newsletter.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Completed																				
Funds Available																				
Expended to Date																				

Agriculture – Implement Irrigation Efficiency project (5 in 5 years)					X				X				X				X				X
Completed																					
Funds Available	Expended to Date																				
Natural Background and Climatic Conditions – Record significant climatic conditions during sampling			X	X	X		X	X	X		X	X	X		X	X	X		X	X	X
Completed																					
Funds Available	Expended to Date																				
Weed Management – Support annual workshop on invasive species.					X				X				X				X				X
Completed																					
Funds Available	Expended to Date																				
Watershed Plan Educational Awareness – Annual watershed informational meeting or newsletter					X				X				X				X				X
Completed																					
Funds Available	Expended to Date																				
Natural Resource Information Education – Quarterly Newsletter		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Completed																					
Funds Available	Expended to Date																				

Water Quality Monitoring – Yearly assessment on water quality training and funding.				X				X				X				X				X
Completed																				
Funds Available	Expended to Date																			
WDEQ Coordination – Maintain annual communication with WDEQ or other pertinent entities				X				X				X				X				X
Completed																				
Funds Available	Expended to Date																			
Water Use and Development – Annual discussion of water development opportunities.				X				X				X				X				X
Completed																				
Funds Available	Expended to Date																			
Watershed Plan Documentation – Quarterly to annual watershed planning meeting to update record of activities.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Completed																				
Funds Available	Expended to Date																			

