Powder Basin Status Report and Action Plan

November 2013

State of Oregon
Department of Environmental Quality

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Executive Summary

The Powder Basin WA Plan consists of a Status Report and an Action Plan. The Status Report summarizes the DEQ's current knowledge of the water quality conditions for the three subbasins that comprise the Powder Basin, while the Action Plan identifies priority actions and sets the stage for strategic implementation. Together these sections will allow for the adaptive management of water quality in the Powder Basin for the next five years (2014-2018).

The Powder Basin includes the Brownlee (1750201), Burnt (17050202), and Powder (17050203) USGS 4th Field HUC subbasins in eastern Oregon. All streams in these subbasins drain into the Snake River along the border of Oregon and Idaho.

Land use/cover in the Powder Basin consists of areas of irrigated agriculture along the Burnt River, the Baker Valley north of Baker City, the Keating Valley, near Richland and in the Pine Valley near Halfway; grassland/shrub areas in the plains and foothill areas; and forested areas in mountains on the east and northwest portions of the basin. Urban areas are small, with the largest being Baker City, located near the center of the basin. Federal public lands administered by the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) make up close to 50% of the land area in the Powder Basin, ranging between 45% in the Powder River Subbasin and 62% in the Brownlee Reservoir Subbasin. Annual precipitation levels, in the form of rain and snow, range from 10-20 inches in the valleys and foothills to 50-60 inches in areas of the Elkhorn, Wallowa, and Blue Mountains.

Four species of salmonids have been extirpated from the basin, and several other species of fish have been introduced. The anadromous fish (fish that migrate to the ocean, such as salmon and steelhead) were eliminated from a majority of the Powder subbasin by the construction of the Thief Valley Dam in 1932. Anadromous fish were eliminated from the rest of the Powder, Brownlee and Burnt subbasins after the construction of Brownlee, Oxbow, and Hells Canyon Dams on the Snake River in the late 1950s and 1960s. Available water in the Powder Basin is fully appropriated. In low water years, reservoirs are often drawn down to minimum levels and there is not enough water to supply all users.

Ambient Water Quality
Three DEQ ambient water quality sites are currently being monitored in the Powder Basin. Two are located on the Powder River, site 11490 in Baker City, and site 10724 at the lower end of the Keating Valley. The third site (11494) is located near the mouth of the Burnt River in Huntington .

The ambient site 11490 located on the Powder River at Highway 7 in Baker City is rated as Fair using the Oregon Water quality Index (OWQI). No trend for the OWQI was evident during the 2001-2010 time period. The dissolved oxygen sub-index shows an improving trend, while phosphorus and bacteria had decreasing water quality trends. The major drivers of impaired water quality are Biological Oxygen Demand (BOD), total phosphorus, and pH.

The ambient site 10724 located on the Powder River at the Highway 86 crossing below Keating is rated as Very Poor using the OWQI. A positive trend was detected for the 2001-2010 time period. The major drivers of water quality impairment at this site were determined to be total phosphorus and BOD. The temperature and phosphorus sub-indices show a significant improving trend during the period.

The ambient site 11494 located on the Burnt River near its mouth in Huntington is rated as Poor using the OWQI. A positive trend was observed for the 2001-2010 time period. The major drivers of decreased water quality are total phosphorus, BOD, and temperature. Temperature, pH, dissolved oxygen, total solids, and bacteria sub-index scores had significant improving trends during the period.

Bacteria, phosphorus and temperature are key drivers of water quality in the Powder Basin and are discussed in more in the following sections.

Bacteria

Additional sampling conducted by DEQ in 2007/2008 for the Powder Basin was based on the 303(d) listed parameters for bacteria and turbidity. This monitoring was planned and carried out in collaboration with the Wallowa Whitman National Forest to assist in the future development of TMDLs. In this project, Thief Valley Reservoir was chosen as a downstream boundary for the study, and no sampling was conducted below the reservoir. Additional water sample locations were identified during 2010 at 10 locations in the Powder River and Burnt River subbasins with the intent of filling data gaps and supporting water quality modeling for the TMDL. Water samples from all 10 locations were analyzed for field parameters, *E. coli* bacteria, and nutrients. Bacteria samples were collected 5 times in a 30-day period during 5 sampling rounds each year in 2010, 2011 and 2012. The samples in the Burnt River subbasin were also analyzed for chlorophyll in response to listings for dissolved oxygen and chlorophyll in the Burnt River below Unity Reservoir. Continuous datasonde measurements of dissolved oxygen, pH, conductivity, and temperature were also made at two locations in this reach of the Burnt River during each sample round.

As discussed in **Section 4.3.1** of this report, data from these sites located throughout the Powder Basin indicate that exceedences of bacteria criteria are much more widespread than suggested by these two stream segments listed as water quality limited for bacteria. Exceedances of the log mean criterion of 126 organisms/100 ml, as well as the single sample maximum criterion of 406 organisms/100 ml, occur year round in many areas. Irrigation season bacteria levels are generally higher than non-irrigation season levels, with the exception of the two North Powder River sites where non-irrigation season levels are higher. The TMDL that is currently being developed will address bacteria pollution in the entire basin throughout the year and will use data collected during 30 day periods.

Phosphorus

The Powder River was allocated a phosphorus load of 33 kg/day of total phosphorus to the Snake River in the Snake River-Hells Canyon TMDL in 2004. This allocation was based on a 0.07 mg/l total phosphorus concentration limit. The Burnt River was also allocated a phosphorus load of 21 kg/day based on a total phosphorus concentration limit of 0.07 mg/l. These load allocations were established to reduce the growth of algae, and protect fish and aquatic life beneficial uses.

Total phosphorus data from the DEQ ambient water quality sites on the Powder River and Burnt River are presented in **Figure ES-1**. The dark line in each box represents the median value (box plots are described in more detail in **Figure 4-6**). Phoshorus data are discussed in more detail in **Section 4.3.7**.

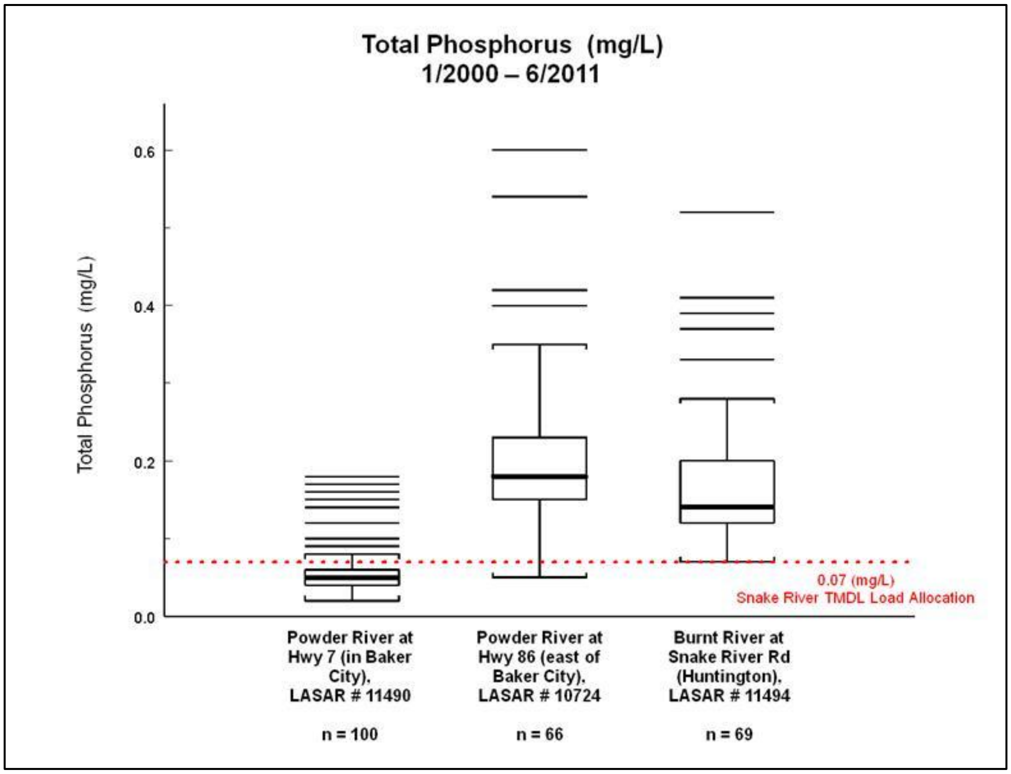


Figure ES-1. Box and whisker plot of total phosphorus concentrations at the Powder River and Burnt River DEQ ambient water quality sites, 2000-2011.

The total phosphorus data from the DEQ ambient water quality site in Baker City indicate relatively low levels of total phosphorus in the range of the 0.07 concentration limit most of the year, with spring/summer peaks ranging from approximately 0.1 mg/l to approximately 0.18 mg/l. The trend in total phosphorus concentrations at this site is decreasing.

Total phosphorus concentrations increase downstream at the Keating site (east of Baker City), generally ranging from approximately 0.1 mg/l to a high of approximately 0.6 mg/l. Peaks in concentration typically occur in summer. The trend in total phosphorus concentrations at this site is decreasing.

Total phosphorus concentrations in the lower Burnt River at Huntington are also elevated well above the 0.07 mg/l target concentration. Total phosphorus concentrations generally range from a low of approximately 0.10 mg/l to over 0.50 mg/l with the highest peaks occurring in April through October. The trend in total phosphorus concentration is flat.

Temperature

Numerous stream reaches in all three subbasins, including most of the Powder River, North Fork Powder River, Burnt River, and Pine Creek, are 303(d) listed as water quality limited due to high water temperatures. The listings are based on temperature data collected by the BLM, USFS, DEQ, BOR, and Baker Valley Soil and Water District (SWCD). Some of the listings are based on comparison to the salmonid rearing criterion of 17.8°C (64°F). This criterion no longer applies in the Powder Basin due to a re-evaluation of the standard in 2004, which included a review of redband trout temperature needs. Most streams in the basin are currently designated Redband Trout habitat with a temperature criterion of 20°C (68°F). The Bull Trout Spawning and Rearing criterion has also been changed from 10°C (50°F) to 12°C (53.6°F) due to a re-evaluation of Bull trout temperature needs. Some headwater areas in the Powder Basin are designated Bull trout Habitat with a temperature criterion of 12° C (53.6° F). Compliance with current temperature criteria will be examined during TMDL development. Temperature data are discussed further in **Section 4.3.8**.

Priority Water Quality-Related Actions

Many water quality-related actions have been identified in this report, priority DEQ actions are listed below:

- TMDL outreach and Load Allocation Development
- Basin Status Report and Action Plan outreach
- Water Quality Monitoring (TMDL, ambient, biomonitoring, HABs, volunteer monitoring)
- ODA Area Plan development and implementation coordination
- Federal Agency Coordination (USFS, BLM, NRCS, BOR)

1. Introduction

Local groups as well as federal and state agencies have been working to address water quality issues in the Powder Basin for many years. The Oregon Department of Environmental Quality (DEQ) has placed many portions of rivers and streams within the Powder Basin on the Clean Water Act 303(d) list of water quality limited water bodies due to pollutants such as bacteria, chlorophyll, low dissolved oxygen, sediment, turbidity, and high water temperatures. The federal Clean Water Act requires the development of Total Maximum Daily Loads (TMDLs) for pollutants entering 303(d) listed water bodies in order to meet water quality standards and protect beneficial uses of water.

The watershed approach includes the development of a Basin Status Report and Action Plan. The Status Report summarizes the DEQ's current knowledge of the water quality conditions for the three subbasins that comprise the Powder Basin, while the Action Plan identifies priority actions and sets the stage for strategic implementation. Together these sections will allow for the adaptive management of water quality in the Powder Basin. It is hoped that this holistic approach will allow for more stakeholder input that will guide TMDL development, TMDL implementation, and a wide range of other watershed restoration actions. In addition the WA will provide greater opportunities for internal DEQ sub-program alignment, stakeholder involvement, and interagency collaboration.

This plan is an initial version, and should not be viewed as a static document. It builds on previous studies and assessments and attempts to summarize available information in a way that is useful for planning and identifying future actions.

2. Basin Description

2.1 Geographic Area

The Powder Basin includes the Brownlee (1750201), Burnt (17050202), and Powder (17050203) USGS 4th Field HUC watersheds **(Figure 2-1)**. All streams in these watersheds drain into the Snake River along the border of Oregon and Idaho.

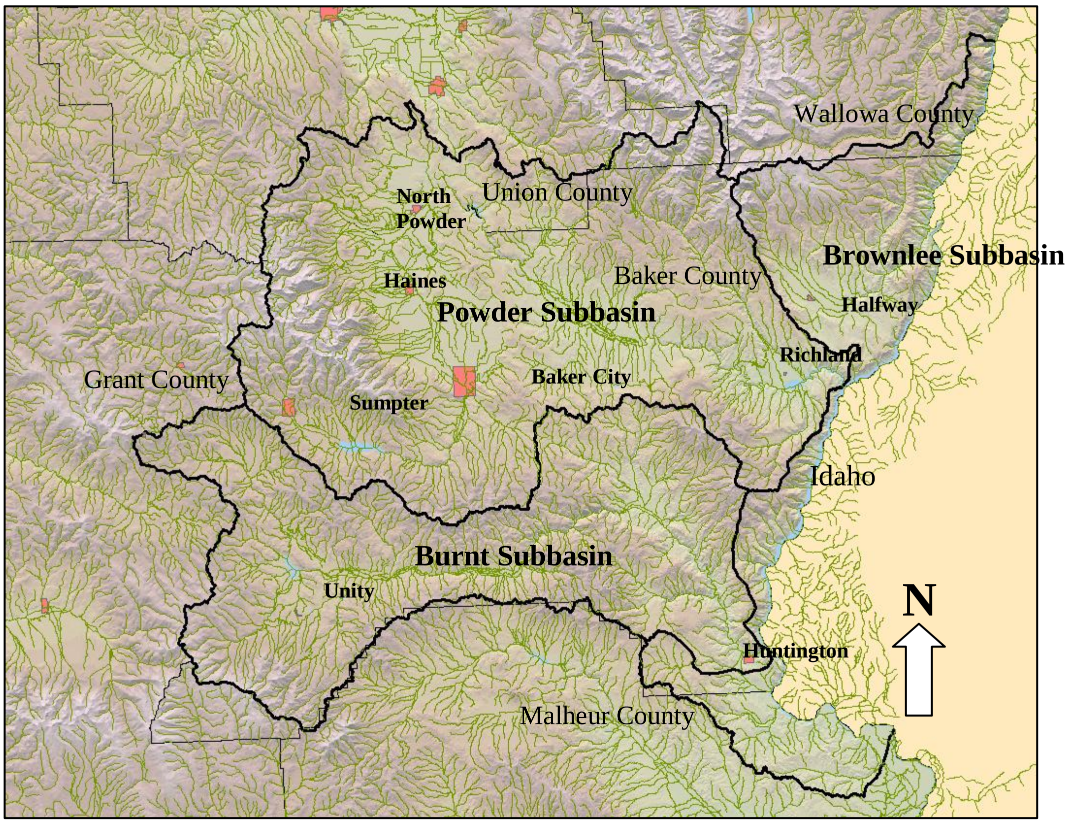


Figure 2-1: Subbasins and Communities of the Powder Basin.

The Powder Basin is almost entirely located in Baker County Oregon, with smaller portions of the northern part of the basin in Union and Wallowa Counties, the southeast corner of the basin in Malheur County **(Figure 2-1)**.

2.2 Climate

The climate of the Powder Basin is influenced by the Cascade Mountains located approximately 200 miles to the west. This mountain range forms a barrier against the modifying effects of warm, moist fronts from the Pacific Ocean. As a result, the overall climate is classified as Temperate Continental – cool summer phase. Light precipitation, low relative humidity, rapid evaporation, abundant sunshine and wide temperature and precipitation fluctuations are characteristics of this climate. The mean annual temperature is 45.5°F, and temperature extremes of -28° F (Feb.) and 104° F (Aug.) have been recorded at the Baker City Airport. The majority of annual precipitation, which averages 10.87 inches at Baker City, falls as snow during winter. Portions of the basin commonly experience rain-on snow events, which reduce the snow pack and may cause brief, localized flooding. Late summer and early autumn provide the area with convectional storms resulting from masses of cool air crossing the Cascades and passing over the mountains at high elevation **(NWPCC, 2004a)**.

Average annual precipitation for the Powder Basin is shown in **Figure 2-2**. Annual precipitation levels range from 10-20 inches in the valleys and foothills to 50-60 inches in areas of the Elkhorn, Wallowa, and Blue Mountains.

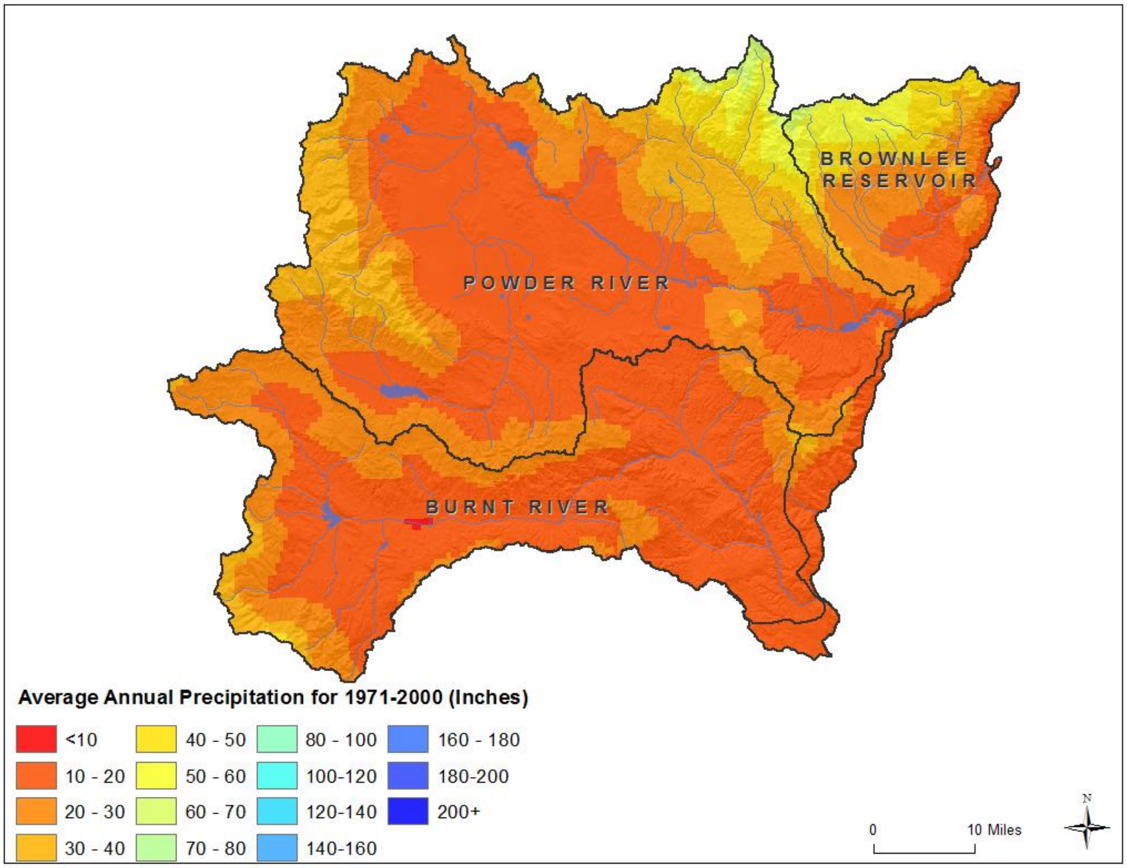


Figure 2-2. Average Annual Precipitation (inches) in the Powder Basin (OSU, 2011).

2.3 Current Land Uses/Cover and Land Ownership

Land use in the Powder Basin is shown in **Figure 2-3**. Areas of irrigated agriculture are found in the along the Burnt River, the Baker Valley north of Baker City, the Keating Valley, near Richland and in the Pine Valley near Halfway. Grassland/shrub areas are located in the plains and foothill areas, and forested areas are concentrated in the mountains. Urban areas are small, with the largest being Baker City (population approx. 9,700), located near the center of the basin. Agricultural and forestry land uses and their potential impacts to water quality are described in more detail in **Section 3.2**.

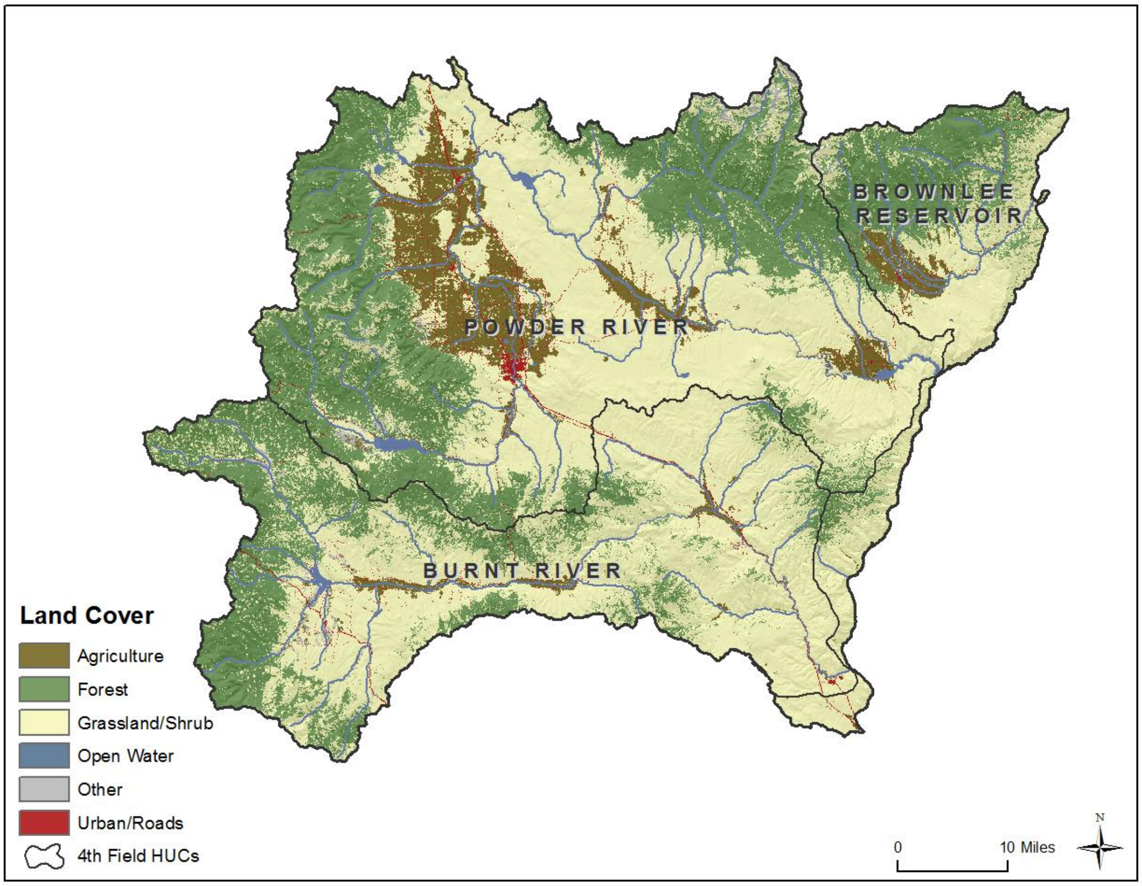


Figure 2-3. Land Use/Cover in the Powder Basin (National Land Cover Database, 2006).

Land ownership in the Powder Basin is shown in **Figure 2-4**. Federal public lands administered by the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) make up close to 50% of the land area in the Powder Basin, ranging from 45% in the Powder River Subbasin to 62% in the Brownlee Reservoir Subbasin. **Table 2-1** provides a more detailed description of both land use and land ownership divided by subbasin that was developed by the Natural Resource Conservation Service **(NRCS, 2006)**.

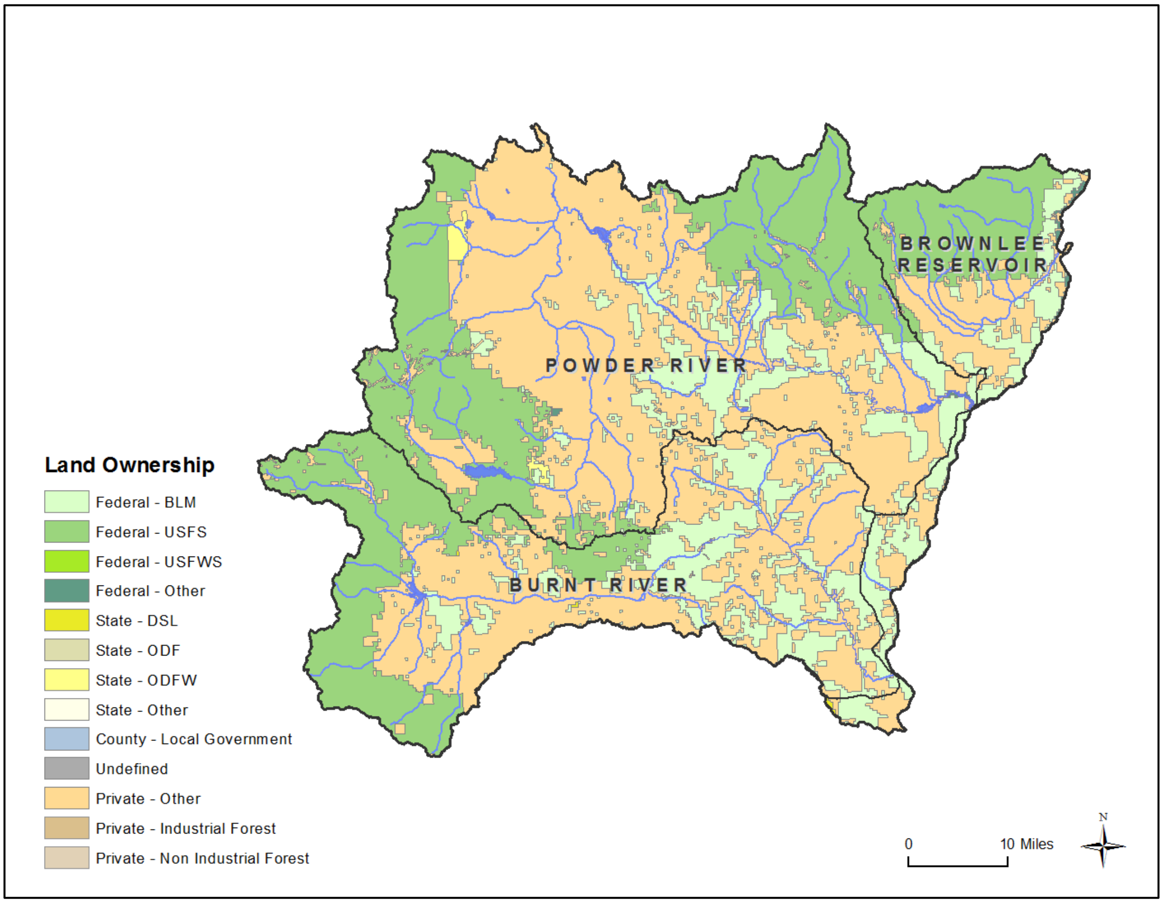


Figure 2-4. Land Ownership in the Powder Basin (Oregon Geospatial Data Clearinghouse, 2011).

Table 2-1: Land Cover/Use in the Powder, Burnt and Brownlee Reservoir Subbasins (NRCS, 2006)

Land Cover/Use Powder Subbasin	Public		Private		Totals	%
	acres	%	acres	%		
Forest	294,000	27%	94,900	9%	389,000	35%
Grain Crops	*	*	16,900	2%	17,000	2%
Conservation Reserve	*	*	*	*	*	*
Grass/Pasture/Hay	41,200	4%	159,000	14%	200,200	18%
Orchards/Vineyards	0	0	0	0	0	0
Row Crops	*	*	*	*	*	*
Shrub/Rangelands	148,100	14%	314,600	29%	462,700	42%
Water/Wetlands/ Developed/Barren	*	*	*	*	26,400	2%
Subbasin Totals	**496,000**	**45%**	**600,900**	**55%**	**1,096,900**	**100%**

Land Cover/Use Burnt Subbasin	Public		Private		Totals	%
	acres	%	acres	%		
Forest	177,000	25%	54,500	8%	231,500	33%
Grain Crops	*	*	*	*	*	*
Conservation Reserve	*	*	*	*	*	*
Grass/Pasture/Hay	33,800	5%	65,800	9%	99,600	14%
Orchards/Vineyards	0	0	0	0	0	0
Row Crops	0	0	*	*	*	*
Shrub/Rangelands	141,200	20%	227,200	32%	368,400	52%
Water/Wetlands/ Developed/Barren	*	*	*	*	*	*
Subbasin Totals	**353,100**	**50%**	**352,600**	**50%**	**705,700**	**100%**

Land Cover/Use Brownlee Subbasin	Public		Private		Totals	%
	acres	%	acres	%		
Forest	109,800	27%	10,100	2%	119,900	29%
Grain Crops	*	*	*	*	*	*
Conservation Reserve	*	*	*	*	*	*
Grass/Pasture/Hay	31,200	8%	35,700	9%	67,200	16%
Orchards/Vineyards	0	0	0	0	0	0
Row Crops	*	*	*	*	*	*
Shrub/Rangelands	112,800	27%	95,200	23%	208,300	50%
Water/Wetlands/ Developed/Barren	*	*	*	*	13,800	3%
Subbasin Totals	**258,500**	**62%**	**149,500**	**36%**	**413,600**	**100%**

2.4 Fisheries

2.4.1 Fish Species Status

Table 2-2 is a list of native fish currently known to occur in the Powder Basin. Fishery resources have changed dramatically in the Powder Basin in the last 50-100 years. Four species of salmonids have been extirpated from the basin and several other species of fish have been introduced **(Table 2-3 and 2-4)**. The anadromous fish (fish that migrate to the ocean, such as salmon and steelhead) listed in Table 2-3 were eliminated from a majority of the Powder subbasin by the construction of the Thief Valley Dam in 1932. Anadromous fish were eliminated from the rest of the Powder, Brownlee and Burnt subbasins after the construction of Brownlee, Oxbow, and Hells Canyon Dams on the Snake River in the late 1950s and 1960s.

Table 2-2. Native Fish Currently Known to Occur in the Powder Basin

Common Name	Scientific Name
Redband Trout	*Oncorhynchus mykiss gibbsi*
Rainbow Trout	*Oncorhynchus mykiss*
White Sturgeon	*Acipenser transmontanus*
Mountain Whitefish	*Prosopium williamsoni*
Bull Trout	*Salvelinus confluentus*
Mottled Sculpin	*Cottus bairdi*
Slimy Sculpin	*Cottus cognatus*
Torrent Sculpin	*Cottus rhotheus*
Shorthead Sculpin	*Cottus confuses*
Paiute sculpin	*Cottus beldingi*
Northern Pikeminnow	*Ptychocheilus oregonensis*
Chiselmouth	*Arocheilus alutaceus*
Peamouth	*Mylocheilus caurinus*
Longnose dace	*Rhinichthys cataractae dulcis*
Speckled Dace	*Rhinichthys osculus*
Ridside shiner	*Richardsonius balteatus*
Largescale Sucker	*Catostomus macrocheilus*
Mountain Sucker	*Catostomus platyrhynchus*
Bridgelip Sucker	*Catostomus columbianus*

(NWPCC, 2004a, NWPCC, 2004b)

Table 2-3. Fish Species Extirpated from the Powder Basin

Common Name	Scientific Name
Coho salmon	*Oncorhynchus kusutch*
Sockeye salmon	*Oncorhynchus nerka*
Chinook Salmon	*Orcorhynchus tshawytscha*
Steelhead	*Oncorhynchus mykiss*

(NWPCC, 2004a, NWPCC, 2004b)

Table 2-4: Fish Species Introduced to the Powder Basin

Common Name	*Scientific Name*	Common Name	*Scientific Name*
Brook Trout	*Savelinus fontinalis*	Bluegill	*Lepomis macrochirus*
Lake Trout	*Savelinus nanaycush*	Pumkinseed	*Lepomis gibbosus*
West Slope Cutthroat Trout	*Oncorhynchus clarki lewisi*	Warmouth	*Lepomis gulosis*
Carp	*Cyprinus carpio*	Yellow Perch	*Perca flavescens*
Black Crappie	*Poxomis nigromaculatus*	Channel Catfish	*Ictalurus punctatus*
White Crappie	*Poxomis annularis*	Flathead Catfish	*Pylodictis olivaris*
Largemouth Bass	*Micropterus salmoides*	Brown Bullhead	*A,eiurus nebulosus*
Smallmouth Bass	*Micropterus dolomieui*	Golden Trout	*Oncorhynchus aguabonita*
Walleye	*Stizostedion vitreum*		

(NWPCC, 2004a, NWPCC, 2004b)

Redband Trout and Bull trout were identified as important aquatic species in the Powder Subbasin and Burnt River Subbasin reports **(NWPCC, 2004a, 2004b)**. They are also are some the most sensitive aquatic species in the Powder Basin and therefore their habitat is one of the most sensitive beneficial water uses. The distribution and status of these two species is discussed in following sections of this report.

2.4.2 Redband Trout

Redband Trout are present throughout the Powder Basin, however no specific information is available regarding population numbers. Population densities vary throughout the basin in response to habitat quality and connectivity. Redband Trout that migrate to the ocean are known as Steelhead. This life history was extirpated from the Powder River above Thief Valley Dam in 1932, and completely eliminated from the basin by the construction of the Hells Canyon complex of dams on the Snake River. In areas where there are no barriers to migration within the basin, there are population segments which exhibit fluvial (resident to rivers) and adfluvial (migrating between lakes and rivers) life histories **(NWPCC, 2004a)**.

The Powder River has four distinct populations of Redband Trout: Powder River from mouth to Thief Valley Dam, Eagle Creek, Powder River from Thief Valley Dam to Mason Dam, and Powder River above Mason Dam **(NWPCC, 2004a)**. The Burnt River subbasin has three populations of Redband Trout: Burnt River below Unity Dam, the North Fork Burnt River, and South Fork Burnt River above Unity Dam **(NWPCC, 2004b)**. Pine Creek (Brownlee Subbasin) and its tributaries also contain Redband Trout.

The limited available data indicate that Redband Trout are widely distributed in the Powder Basin. Management and land use activities have affected the seasonal use of habitat within stream reaches **(NWPCC, 2004a)**.

2.4.3 Bull Trout

Bull Trout in the Powder Basin are part of the Hells Canyon Species Management Unit (SMU) designated by Oregon Department of Fish and Wildlife (ODF&W). This unit includes 14 populations in the Pine Creek and Powder River watersheds. Bull Trout have not been recently documented in the Burnt River Subbasin and there is no known historic documentation of Bull Trout presence **(NWPCC, 2004b).**

Bull Trout are listed as Threatened under the federal Endangered Species Act throughout their range in the Pacific Northwest. Most of the Bull Trout Populations in the Hells Canyon SMU are characterized by extremely low abundances and restricted distributions. Productivity of Bull Trout in the Powder Basin is hampered by habitat quality and quantity and the lack of ability to express a migratory life history. The Hells Canyon Bull Trout SMU is classified “at risk” and generally passes only two of six population measurement criteria. The following bullets summarize the information from the 2005 Oregon Native Fish Status Report published by ODF&W, and the percentage of populations meeting individual criteria are reported in **Figure 2-5 (ODF&W, 2005)**:

- Bull Trout distribution in the SMU is highly fragmented and limited to short isolated segments of headwater streams. Fifty-four percent of the populations have a spawning distribution less than 4 km.
- Two populations, Clear (Brownlee Subbasin) and Anthony (Powder Subbasin), pass the distribution criterion. These populations exceed 10 km, occupy more than 50% of their historical distribution, and remain connected to migratory corridors and other populations.
- Large dams including Brownlee and Oxbow on the Snake River, and Thief Valley and Mason on the Powder River, restrict distribution and minimize connection between populations. Unscreened diversions and irrigation canals entrain Bull trout and hinder migration and connectivity.
- Annual index spawning redd counts in the Pine Creek Basin, indicate that only the Upper Pine population consistently contains the minimum number of adults necessary to pass the abundance criteria.
- All populations in the Powder River Subbasin, except the Upper Powder, fail the abundance criteria. None of the observations in these populations suggest abundance levels necessary to avoid the effects of inbreeding.
- A 1999 population survey in Silver Creek (Upper Powder) estimated the reproductive population to exceed levels necessary to avoid inbreeding and pass the abundance criterion.
- Even though data are not available to assess abundance of all populations, the SMU is considered to contain less than 1,000 reproductive adults and considered at risk of the deleterious effects of genetic drift.

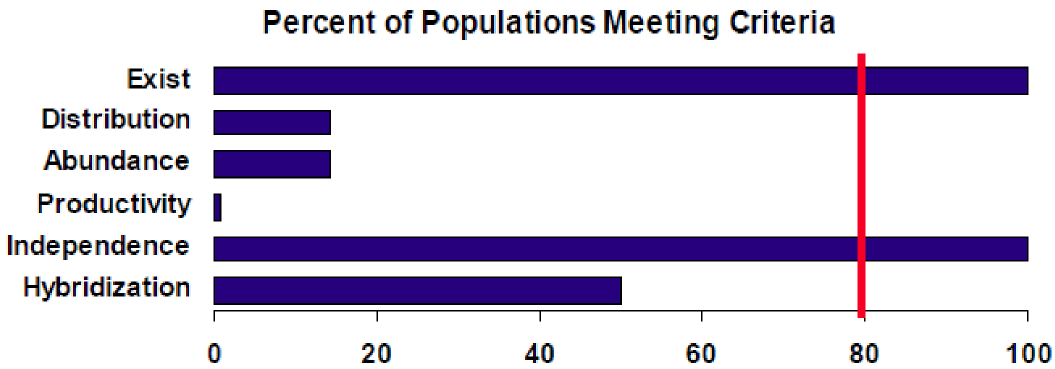


Figure 2-5. Status of Bull Trout in the Hells Canyon Species Management Unit (SMU), ODF&W, 2005

2.5 Hydrology and Beneficial Water Use

2.5.1 Hydrology

The Powder Basin contains tributaries of the Snake River located in northeastern Oregon, and is divided into three subbasins: Powder River (4th Field HUC 17050203), Brownlee (4th Field HUC 17050201), and Burnt River (4th Field HUC 1705202) **(Figure 2-1)**. The three subbasins total approximately 3,500 square miles. Elevations in range from approximately 1,700 feet at the mouth of Pine Creek in the Brownlee Subbasin, to over 9,000 feet in the Wallowa and Elkhorn Mountain ranges.

The Burnt River headwaters are located in the southern Blue Mountains near the town of Unity, from there it flows approximately 100 miles east to the Snake River near the town of Huntington. The Powder River has headwater areas in the Elkhorn Mountains west of Baker City near the town of Sumpter, where Cracker Creek and McCully Fork join to form the Powder River. It flows north through the Baker Valley, and then southeast through the Keating Valley and reaches Brownlee Reservoir on the Snake River near the town of Richland. The total length of the Powder River is approximately 144 miles. Major tributaries include the North Powder River and Eagle Creek. The Brownlee Subbasin includes all the streams that drain directly to the Snake River from an area just north of Ontario to the Hells Canyon area just north of the Wallowa County/Baker County line. The largest stream in the Brownlee Subbasin is Pine Creek, which is located in the northern portion of the subbasin near the town of Halfway **(Figure 2-6)**.

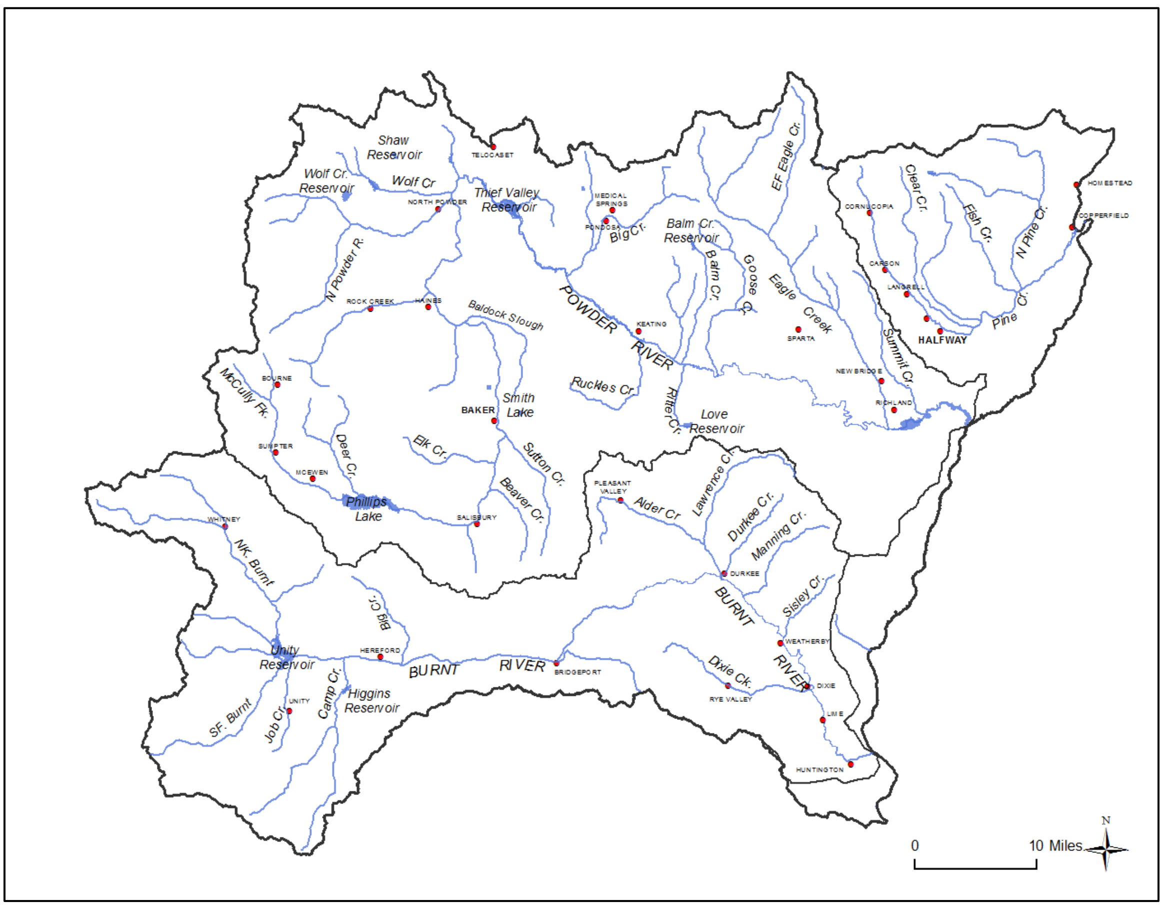


Figure 2-6. Major streams and reservoirs in the Powder Basin

2.5.2 Dams and Diversions

According to Oregon Water Resources Department (WRD) records, there are 69 dams with a height over 10 feet in the Powder Basin **(Tables 2-5, 2-6, 2-7)**. Most of the water impounded by these reservoirs is used for irrigation. There are three irrigation or water control districts in the Powder Subbasin: Baker Valley Irrigation District, Lower Powder Irrigation District, and Powder Valley Water Control District (divided into the Wolf Creek and Pilcher Creek sub-districts). Irrigation in the Burnt River Subbasin is managed by the Burnt River Irrigation District. There are no formal irrigation or water control districts in the Brownlee Reservoir Subbasin, irrigation is managed by individuals or informal user groups. Available water in the Powder Basin is fully appropriated. In low water years, reservoirs are often drawn down to minimum levels and there is not enough water to supply all users.

Table 2-5. Powder Subbasin Dams 10 Feet and Higher

Name	Stream	Dam Height (ft.)	Storage (acre-ft.)
Unnamed	First Creek and springs	10	10
Unnamed	A spring	10	25
Bacher Creek Reservoir	Bacher Creek	30	120
Baker Reservoir	Crew Springs	10	20
Balm Creek Reservoir	Balm Creek and Union Spring	65	2926
Bennett Dam	East Sutton Creek	22	206
Cranston Reservoir	Clover Creek	10	50
Crater Lake	Runoff from watershed	31	190
Eagle Lake	Eagle Lake	33	844
Echo Lake Reservoir	West Eagle Creek	10	300
Fisk Reservoir-Little Park	Thorn Creek	31	280
Goodrich Reservoir	Goodrich Creek	65	603
Haines-City Lagoon #2	City sewage	14	10
Haines-City Lagoon #3	City sewage	18	10
Haskell Reservoir	Elk Creek	10	100
Homesite 1	Not listed	22	46
Hovan-Johnson Reservoir	Big Houghton Creek	10	16
Jimmy Creek Reservoir	Jimmy Creek	42	675
Killamacue Reservoir	Killamacue Lake	11	798
Laird Reservoir	Sag Creek	20	69
Licklider Dam	Griffin Gulch	20	9
Looking Glass Lake Reservoir	Eagle Creek	13	527
Love Reservoir	Love Creek, Lawrence Creek	30	920
Mason Dam	Powder River	167	114,000
Nault Reservoir	W. Fork Sutton Creek	15	49
Pilcher Creek Reservoir	Anthony and Pilcher Creeks	110	5910
Prowell Dam	Beaver Creek	21	40
Reservoir #2	W. Fork Love Creek	10	300
Reservoir #3	W. Fork Love Creek	10	300
Rock Creek Lake	Rock Creek	28	452
Salmon Creek Reservoir	Salmon Creek	41	255
Saw Mill Gulch Reservoir	Saw Mill Gulch	30	150
Shaw Reservoir	Little, Dry and Gussie Creeks	48	504
Smith Lake	Powder River	26	580
Spalding-Vaughn Reservoir #2	Elk Creek-Burlap and Juniper Gulches	10	9
Spaulding-Vaughn Reservoir	Elk Creek-Burlap and Juniper Gulches	10	106
Stoddard Dam	Main Eagle Creek	10	40
Thief Valley Reservoir	Powder River	66	17,400
Turner Reservoir	Second Creek	10	50
Unnamed	First Creek and White Swan Gulch	10	100
Van Patton Lake Dam	N. Fork Dutch Flat Creek	25	583
Vogel Reservoir	Union Creek	15	30
Widman Reservoir	West Fork Love Creek	30	65
Wirth Reservoir	Big Creek	36	59
Wolf Creek Reservoir	Wolf and Anthony Creeks	125	10,800

(NWPCC, 2004a)

Table 2-6. Brownlee Reservoir Subbasin Dams 10 Feet and Higher

Name	Stream	Dam Height (ft.)	Storage (acre ft.)
Clear Creek Reservoir	West Fork Clear Creek	16	257
Crow-F.M. Reservoir	Deer Gulch	15	170
East Lakes Creek	E. Fork Pine Creek trib.	15	132
Fish Lake	Lake Fork Creek	22	825
Kivett 3	Birch Creek	26	45
Laird Reservoir	Sag Creek	21	67
Love Reservoir (Malheur)	Unnamed trib. Birch Creek	44	2560
Mehlhorn & Bassett	Clear Creek	20	216
Mosley Reservoir	Pine Creek trib.	20	260
Sugarloaf Reservoir	Elk Creek trib.	27	270
Twin/Pine Lake Upper	W. Fork Pine Creek	10	150
Twin/Pine Lake Lower	W. Fork Pine Creek	22	75

(WRD, 2011)

Table 2-7. Burnt Subbasin Dams 10 Feet and Higher

Name	Stream	Dam Height (ft.)	Storage (acre ft.)
Unnamed	Sisley Creek	10	15
Camp Creek/Higgins Reservoir	Camp Creek and Bull Run Creek	45	1,700
Long Creek Reservoir	Long Creek	20	70
Moore Reservoir	Manning Creek	15	50
Morfitt Reservoir	Off-channel	20	280
Munn Reservoir	Middle Fork Burnt River	23	120
Murray Reservoir	East Camp & Camp Creek	21	467
Powell Creek Reservoir	Powell Creek	16	10
Ruddell Reservoir	Beaver Dam Creek	10	50
True Blue Reservoir #2	True Blue Creek	14	13
Unity Reservoir	Burnt River	67	25,000
Whited Reservoir	South Fork Burnt River	45	520

(NWPCC, 2004b)

There are five reservoirs in the Powder Basin with a storage capacity greater than 5,000 acre feet. Unity Dam on the Burnt River, Thief Valley Dam and Mason Dam on the Powder River were constructed by the U.S. Bureau of Reclamation (USBR) and are operated by local irrigation districts. Pilcher Creek Dam and Wolf Creek Dam are owned and operated by the Powder Valley Water Control District **(Figure 2-6)**. These projects are discussed in more detail in following sections.

Burnt River Project

Unity Dam and Reservoir are located on the upper Burnt River about 40 miles southwest of Baker City **(Figure 2-6)**. Lands served by the project are scattered along the Burnt River downstream from Unity Reservoir near the towns of Hereford, Bridgeport, Durkee, Weatherby, Dixie, Lime, and Huntington. In addition, some lands upstream from the reservoir are included in the project. Based on 1992 data, 15,070 acres received project water. The primary crops grown on project lands are forage crops, covering about 13,670 acres. In addition, there are about 1,385 acres dedicated to cereal crops such as corn, and barley **(Simonds, 1997a)**.

According to BOR reports, Unity Dam is a zoned earthfill dam 82 feet high and 694 feet long. Unity Reservoir has a maximum capacity of 25,800 acre-feet (af) and a surface area of 926 acres.

Since its completion in 1937, Unity Dam and Reservoir have been operated and maintained by the Burnt River Irrigation District. The project was designed to take advantage of the existing distribution system.

Along with the irrigation, Unity Reservoir provides area residents with limited recreation benefits. Camping, fishing, and boating are popular pastimes at the reservoir. Recreational activities at Unity Dam and Reservoir are administered by the Oregon State Parks Department. There are no flood control benefits from the operation of the dam and reservoir **(Simonds, 1997a)**.

Baker Project

The Baker Project consists of two divisions; the Upper and Lower. The Upper Division furnishes irrigation water from Phillips Reservoir to 18,500 acres of land along both sides of the Powder River just north of Baker City. The Lower Division provides a supplemental water supply from Thief Valley Reservoir to about 7,300 acres of land along the Powder River in the Keating Valley about 10 miles northeast of Baker City **(Figure 2-6)**.

According to BOR reports, Thief Valley Dam is a concrete slab and buttress dam 390 feet long and 73 feet high. Thief Valley Reservoir has a maximum capacity of 17,600 acre feet (af) and a surface area of 740 acres. Water stored in Thief Valley Reservoir is released for diversion downstream into existing distribution canals and laterals. The operation of Thief Valley Dam and facilities of the Lower Division were taken over by the Lower Powder River Irrigation District on June 1, 1932 **(Simonds, 1997b)**.

Mason Dam is a zone earth and rockfill embankment dam, 173 feet high and 895 feet Long. Mason Dam impounds the Powder River near Sumpter, OR forming Phillips Reservoir. Phillips Reservoir has a maximum capacity of 95,500 af and a surface area of 2,235 acres. As with the Lower Division, water stored in Phillips Reservoir is released into the Powder River for diversion downstream into existing distribution canals and laterals. Operation and maintenance of Upper Division facilities was transferred to the Baker Valley Irrigation District on August 23, 1968 **(Simonds, 1997b)**.

Powder Valley Water Control District

The Powder Valley Water Control District owns and operates Wolf Creek and Pilcher Creek Reservoirs, which provide irrigation water to land located in the North Powder and northern Baker valleys in the vicinity of the City of North Powder **(Figure 2-6)**. Wolf Creek dam was completed in 1974, the reservoir is approximately 220 acres in area and stores approximately 12,000 acre feet. Pilcher Creek Reservoir was completed in 1984, the reservoir is approximately 222 acres in area and stores approximately 5,900 acre feet.

Wolf Creek and Pilcher Creek Reservoirs are operated as one pool. Wolf Creek Reservoir usually draws down quicker than Pilcher Creek Reservoir. To balance out the system, water is transferred via a canal between the two sites. Additional water from Pilcher Creek Reservoir is also put instream via the North Powder River for irrigation both to the North and South of the river. Due to the connectivity of the system, the project is often referred to as the Wolf Creek Reservoir Complex **(Browne Consulting, 2011)**.

2.5.3 Surface Water Beneficial Use

The beneficial uses of surface water in the Powder Basin as listed in OAR 340-41-0260:

- Public Domestic Water Supply
- Private Domestic Water Supply
- Industrial Water Supply

- Irrigation
- Livestock Watering
- Fish and Aquatic Life
- Wildlife and Hunting
- Fishing
- Boating
- Water Contact Recreation
- Aesthetic Quality

Fish and aquatic life is considered one of the most sensitive beneficial uses in the basin. The headwaters of the Powder River, North Powder River, Eagle Creek, and Pine Creek are designated Bull Trout Spawning and Rearing Habitat. The remaining streams in the basin are designated Redband Trout or Lahontan Cutthroat Trout habitat, however, Lahontan Cutthroat are not known to exist in the basin and appear to have been included by error **(Figure 2-7)**.

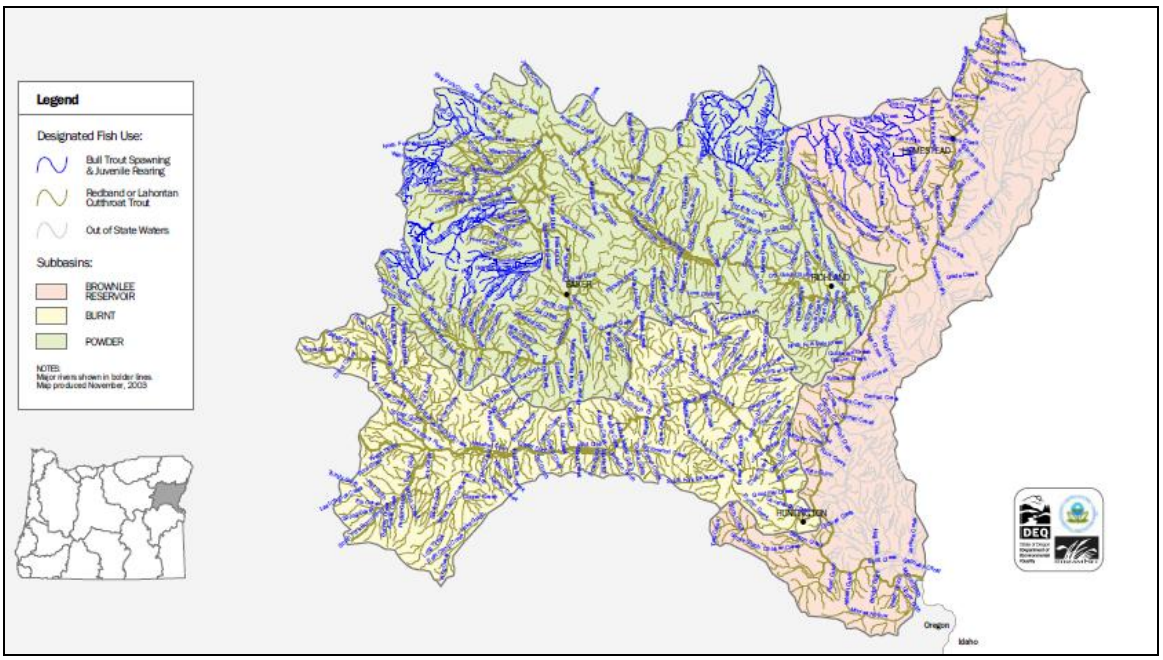


Figure 2-7. Powder Basin Fish use Designations, OAR 340-041-0260

Drinking Water Sources

There are three public drinking water systems within the Powder Basin that are supplied in whole or in part by surface water intakes **(Figure 2-8)**. These water systems serve a total population of approximately 10,000 residents in Baker City, Sumpter, and Richland. More detail on the public water systems and their intakes is provided in **Table 2-8**. This information is based on data provided by the Oregon Health Authority (OHA) Drinking Water Program.

There are 39 public water systems (PWS) in the Powder Basin (summarized in **Table 2-9**) relying on groundwater in whole or in part, serving a total population of almost 15,000 residents. Note that Baker City is served by both ground water and surface water sources and its population of 10,105 is included in the discussion on both sources.

Safe Drinking Water Act monitoring data (summarized in **Table 2-10**) indicates that all three water systems served by surface water have experienced contamination problems in finished water delivered to customers rather than source water. Contaminants of concern include arsenic (in Richland's water supply), fluoride and sodium (in Baker City's water), synthetic organic compounds (the pesticides dalapon and hexachlorocyclopentadiene in Sumpter's water supply), bacteria (at all three systems) and disinfection byproducts (trihalomethanes and haloacetic acids at Sumpter and Baker City).

As documented in Source Water Assessment reports for community public water systems in the Powder Basin, the potential sources of contamination identified within drinking water source areas that pose the greatest risk to source water for the three public water systems (PWSs) are:

- Historic mining activities, and
- Forest management activities including roads and harvesting.

The formation of disinfection byproducts is attributed to high turbidity in source water and a corresponding increase in disinfectant use during the treatment process. There are few disinfection byproduct alerts in the OHA database for Baker City (in 2004) and Sumpter (in 2005 and 2006) suggesting that turbidity is not a common issue. However, the City of Sumpter reports that prior to 2006, their intake, supplied via a municipal diversion on USFS land, was periodically impacted by sediment build-up and bedload that overburdened their diversion structures. Numerous stakeholders including the watershed council, City, USFS, and WRD obtained funding through the Oregon Watershed Enhancement Board OWEB for an enhanced water diversion project which included weirs to slow water and decrease erosion, along with a fish screen and fish passage return. The City noted a decrease in turbidity and sediment build-up after the project was implemented. http://www.bakercounty.org/Watershed/SumpterProjRpt.pdf

Additional potential sources of contamination identified only in the Richland source area include:

- Agricultural-related activities including: grazing animals, chemical applications associated with irrigated and non-irrigated crops, and an irrigation ditch
- Rural homes with septic systems
- Recreational activities including a campground

Executive summaries of the individual PWS Source Water Assessments are available at http://www.deq.state.or.us/wq/dwp/swrpts.asp.

Other potential sources of contamination to surface water may include areas of groundwater contamination discharging to surface water. Almost all of the mapped PWSs (25 out of 30) in the Powder Basin are within a quarter mile of surface waters and all but one is located within a half-mile of surface waters. Twenty-six PWSs served by groundwater have experienced groundwater contamination problems. Contaminants of concern (summarized in **Table 2-10**) include di(2-ethylhexyl)-phthalate (1 system), arsenic (6 systems), nitrate (8 systems), and bacteria (24 water systems). In addition, sodium (above a recommended level of 20 mg/L) is also present in 10 groundwater systems. This provides important insights into the potential influence from groundwater to surface waters in the Powder Basin.

Baker City maintains a watershed control program to protect their surface water source area and is one of only four unfiltered surface water systems in Oregon. Baker City is currently in the process of incorporating UV treatment to meet current requirements under the Safe Drinking Water Act to ensure the treatment system adequately protects people from cryptosporidium. Additional data or testing in Baker City's watersheds is not warranted at this time.

There are a number of historic mines located in the source area for Sumpter and Richland's drinking water. Most of these mines are listed in DEQ's Environmental Cleanup Site Information (ECSI) Database as suspect sites requiring further investigation. Safe Drinking Water Act monitoring data is required for a limited number of compounds in finished (post-treatment) water only. More data is needed to assess whether source water is being negatively impacted by mining activities.

DEQ typically evaluates *E. coli* monitoring completed by PWSs as a potential indicator for pathogenic microorganism issues. As part of the Long Term 2 (LT2) Enhanced Surface Water Treatment Rule of the Safe Drinking Water Act requirements, public drinking water systems using surface water were required to conduct up to two years of *E.coli* monitoring to determine if they are at risk from cryptosporidium or other pathogenic microorganisms entering the drinking water supply. *E. coli* counts over 50 per 100mL have **not** been reported by the three public water systems in the Powder Basin, therefore this was not identified as a surface water quality issue in this report.

DEQ also typically looks at wells or other drinking water sources that have been closed or modified due to contamination issues - North Powder Water District (served by groundwater) was the only system identified in this review. The City of North Powder closed Well #2 in 2008 due to consistent detections of coliform in the distribution system. However, Well #2 was old (drilled in 1915) and there is no information on casing construction. Well seals deteriorate over time and it is likely that coliform contamination originated from surface contamination near the wellhead and is not source related. The Water District's other well (#3 drilled in 1970) is completed at a similar depth and has not had confirmed coliform detections since well #2 was closed. Therefore coliform was not identified as a groundwater quality issue in this report.

Additional data may also be needed to help assess whether source water is being negatively impacted by forest management practices and agriculture. Important data gaps include:

- Data to assess transport of contaminants via groundwater inputs to surface water
- Data to better characterize the risks to public water systems from elevated turbidity associated with forest management practices and roads
- Data to better characterize correlations between storm events and impacts to public water systems from specific contaminants including fecal coliform and turbidity

For all drinking water source areas, continued coordination with partnering agencies to share research results, monitoring data, and mapping is recommended. Currently no known data collection is planned to address the data gaps identified for public water systems served by surface water and groundwater in the Powder Basin.

This section only addresses drinking water issues identified for <u>public</u> water systems. A recent query of WRD's water rights database for private domestic points of diversion (using a threshold of 0.005 cfs for domestic water rights that are household use only, not irrigation) identified 79 private domestic water rights in the Powder Basin. There are also numerous private groundwater wells for domestic use.

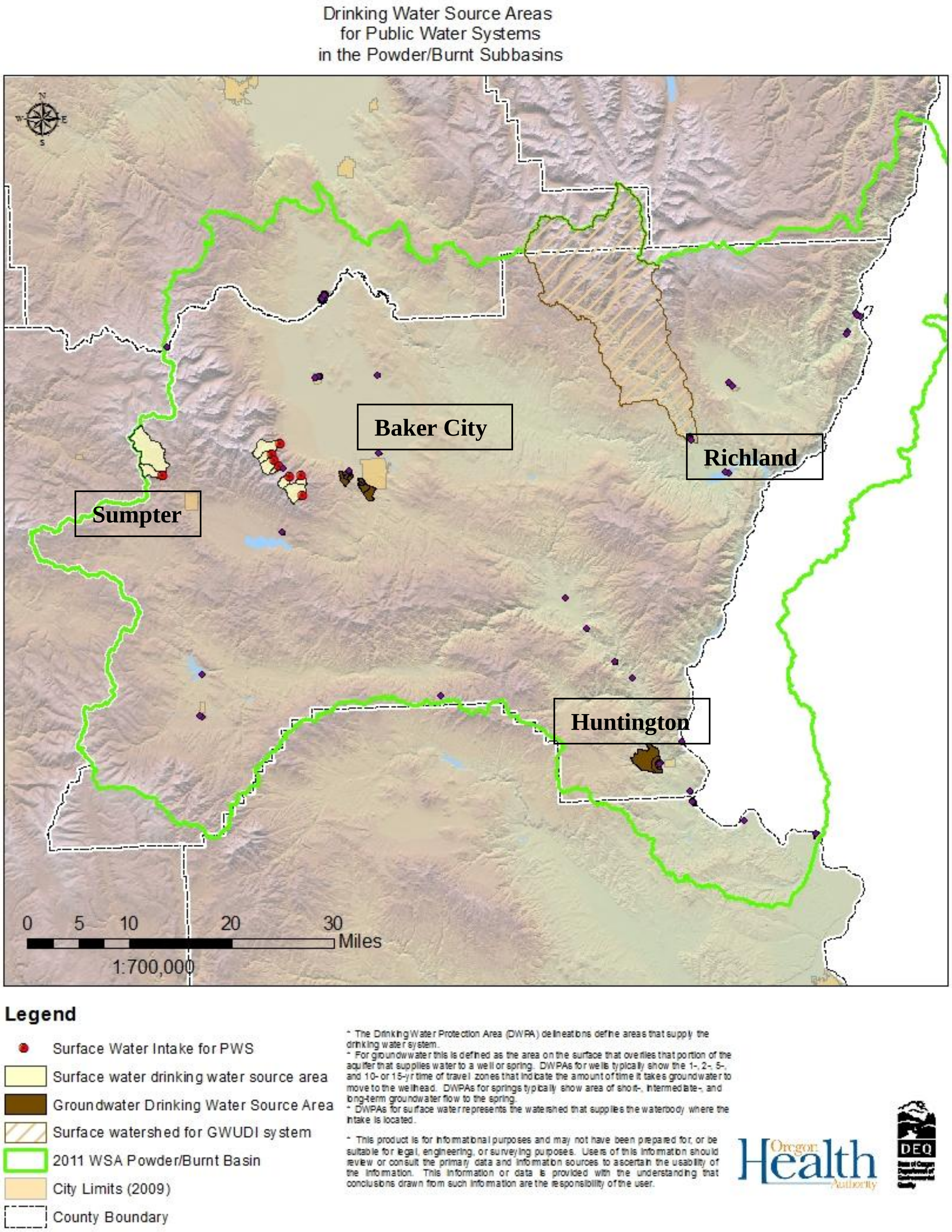


Figure 2-8: Drinking Water Source Areas for Public Water Systems in the Powder Basin.

Table 2-8. Public Water Systems served by Surface Water in the Powder/Burnt Basin
Note: Table does not include public water systems which purchase drinking water from these water systems.

Sub-Basin	Watershed	County	PWS ID	Public Water System	Drinking Water Source	Pop	System Type
Powder River	Powder River-Rock Creek	Baker	00073	Baker City	6 Intakes (Goodrich Creek, Little Marble Creek, Little Mill Creek, Little Salmon Creek, Main Salmon Creek, and Mill Creek)	10105	C
Powder River	Powder River-Sutton Creek	Baker	00073	Baker City	1 Intake (Elk Creek)	10105	C
Powder River	Upper Powder River	Baker	00845	City of Sumpter	2 intakes (McCully Fork and O'Farrel Creek)	170	C
Powder River	Eagle Creek	Baker	00703	City of Richland	Infiltration Gallery (Groundwater under the influence of surface water)	150	C

System Type:
C - "Community Water System (C)" means a public water system that has 15 or more service connections used by year-round residents, or that regularly serves 25 or more year-round residents.

NTNC - "Non-Transient Non-Community Water System (NTNC)" means a public water system that is not a Community Water System and that regularly serves at least 25 of the same persons over 6 months per year.

NC - "Transient Non-Community Water System (NC)" means a public water system that serves a transient population of 25 or more persons.

NP - "State Regulated Water System (NP)" means a public water system, which serves 4 to 14 service connections or serves 10 to 24 people. Monitoring requirements for these systems are the same as those for Transient Non-Community water systems.

Table 2-9. Public Water Systems served by groundwater in the Powder/Burnt Basin
See Table 1 notes for description of System Types

Subbasin	Watershed	County	PWS ID	PWS Name	Pop.	System Type
Brownlee Reservoir	Pine Creek	Baker	00363	City of Halfway	350	C
Brownlee Reservoir	Pine Creek	Baker	00384	Idaho Power-Oxbow Village	75	C
Brownlee Reservoir	Pine Creek	Baker	91221	Hells Canyon Sportsmans RV Park	12	NP
Brownlee Reservoir	Pine Creek	Baker	91226	Thompsons Hells Canyon Inn	25	NC
Brownlee Reservoir	Pine Creek	Baker	94284	Idaho Power-Oxbow Plant	50	NTNC
Brownlee Reservoir	Snake River-Birch Creek	Baker	91005	OPRD Farewell Bend State Park	250	NC
Brownlee Reservoir	Snake River-Birch Creek	Malheur	93459	Joy Travel Plaza	200	NC
Brownlee Reservoir	Snake River-Birch Creek	Malheur	94796	Oasis RV & Campground	50	NC
Brownlee Reservoir	Snake River-Birch Creek	Malheur	94980	Catfish Junction LLC	50	NC
Brownlee Reservoir	Snake River-Hog Creek	Malheur	90889	Annex Elementary SD #29	50	NTNC
Brownlee Reservoir	Snake River-Hog Creek	Malheur	95156	Winners Horseshoe - Annex	25	NC
Brownlee Reservoir	Snake River-Indian Creek	Baker	00384	Idaho Power-Oxbow Village	75	C
Brownlee Reservoir	Snake River-Indian Creek	Baker	94284	Idaho Power-Oxbow Plant	50	NTNC
Brownlee Reservoir	Snake River-Rock Creek	Baker	90618	BLM Spring Rec Site	25	NC
Burnt River	Burnt River-Auburn Creek	Baker	05791	BLM NHOTIC	350	NC
Burnt River	Lower Burnt River	Baker	00393	City of Huntington	560	C
Burnt River	Lower Burnt River	Baker	90004	Ash Grove Cement West-Durkee	125	NC
Burnt River	Lower Burnt River	Baker	93658	ODOT HD Weatherby Rest Area	500	NC
Burnt River	Lower Burnt River	Baker	95278	Blue Bucket RV Park	25	NC
Burnt River	Pritchard Creek	Baker	93618	Nyssa Co-Op Supply	25	NC
Burnt River	South Fork Burnt River	Baker	01450	City of Unity	95	C
Burnt River	South Fork Burnt River	Baker	91004	OPRD Unity Lake State Park	80	NC
Powder River	Lower Powder River	Baker	90751	Baker Co Parks - Hewitt	100	NC
Powder River	Lower Powder River	Baker	95356	Baker Co Parks - Holcomb	26	NC
Powder River	North Powder River	Union	00577	North Powder Water District	490	C
Powder River	North Powder River	Baker	92832	USFS Anthony Lakes CG/Ski Area	150	NC

Subbasin	Watershed	County	PWS ID	PWS Name	Pop.	System Type
Powder River	Powder River-Baldock Slough	Baker	00073	Baker City	1010 5	C
Powder River	Powder River-Baldock Slough	Baker	01358	Western Heights Water Company	70	C
Powder River	Powder River-Baldock Slough	Baker	91094	ODOT HD Baker Valley Rest Area - I84	200	NC
Powder River	Powder River-Baldock Slough	Baker	94825	Oregon Trails West RV Park	25	NC
Powder River	Powder River-Rock Creek	Baker	00073	Baker City	1010 5	C
Powder River	Powder River-Rock Creek	Baker	00362	City of Haines	435	C
Powder River	Upper Powder River	Baker	92834	USFS Union Creek CG	250	NC
(Unmapped)		Baker	01349	Idaho Power-Brownlee Village	22	NP
(Unmapped)		Baker	01454	New Bridge Water District	19	NP
(Unmapped)		Baker	05062	Keating Elementary	24	NP
(Unmapped)		Baker	05821	Idaho Power-Brownlee Trailers	10	NP
(Unmapped)		Baker	05873	Inn at Clear Creek Farm	10	NP
(Unmapped)		Baker	06168	Cornucopia Lodge	10	NP
(Unmapped)		Baker	92841	USFS Pine Ranger Station	13	NP
(Unmapped)		Baker	94957	Desert Hills Mobile Home Park	20	NP
(Unmapped)		Baker	95020	Burnt River Camp	18	NP

Table 2-10. Safe Drinking Water Act monitoring compounds detected above action levels* for Powder/Burnt Basin public water systems
Source: Oregon SDWIS Database: January 1, 2000 through June 29, 2010
***Table includes summary of detections above an "action" level. In general, the action level for volatile and synthetic organic compounds (VOCs and SOCs) is concentration > 0.** For inorganic compounds (IOCs), arsenic and nitrate, the action level used is ½ of the MCL. Action level for coliform, E. coli and fecal coliform is detection >0 in a repeat sample. For turbidity action level is >5 NTU.

Water Type	Analyte Name	PWS ID	PWS Name	Pop.	Subbasin	Watershed	Count of Detects	Min of Conc.	Max of Conc.
Surface Water Systems									
SW	Dalapon	00845	Sumpter, City of	170	Powder River	Upper Powder River	2	0.004	0.026
SW	Hexachlorocyclopentadiene	00845	Sumpter, City of	170	Powder River	Upper Powder River	1	0.0001	0.0001
GU	Arsenic	00703	Richland, City of	150	Powder River	Eagle Creek	1	0.00531	0.00531
SW	Fluoride	00073	Baker City	10105	Powder River	Powder River-Rock Creek, Sutton Creek, and Baldock Slough	1	4.9	4.9
SW	Sodium	00073	Baker City	10105	Powder River	Powder River-Rock Creek, Sutton Creek, and Baldock Slough	1	21	21
SW	Coliform, Total (TCR)	00073	Baker City	10105	Powder River	Powder River-Rock Creek, Sutton Creek, and Baldock Slough	1	present	present
GU	Coliform, Total (TCR)	00703	Richland, City of	150	Powder River	Eagle Creek	1	present	present
SW	Coliform, Total (TCR)	00845	Sumpter, City of	170	Powder River	Upper Powder River	5	present	present
SW	Total Haloacetic Acids (HAA5)	00073	Baker City	10105	Powder River	Powder River-Rock Creek, Sutton Creek, and Baldock Slough	1	0.33	0.33
SW	Total Haloacetic Acids (HAA5)	00845	Sumpter, City of	170	Powder River	Upper Powder River	2	0.055	0.076
SW	Total Trihalomethanes (TTHM)	00845	Sumpter, City of	170	Powder River	Upper Powder River	2	0.0892	0.1014
Groundwater Systems									
GW	Di(2-ethylhexyl)-phthalate	90889	Annex Elementary SD 29	50	Brownlee Reservoir	Snake River-Hog Creek	5	0.00205	0.014

Water Type	Analyte Name	PWS ID	PWS Name	Pop.	Subbasin	Watershed	Count of Detects	Min of Conc.	Max of Conc.
GW	Arsenic	00073	Baker City	10105	Powder River	Powder River-Rock Creek, Sutton Creek, and Baldock Slough	2	0.006	0.006
GW	Arsenic	00393	Huntington, City of	560	Burnt River	Lower Burnt River	4	0.00782	0.008
GW	Arsenic	05791	BLM NHOTIC	350	Burnt River	Burnt River-Auburn Creek	4	0.00959	0.0318
GW	Arsenic	90889	Annex Elementary SD 29	50	Brownlee Reservoir	Snake River-Hog Creek	2	0.0109	0.0121
GW	Arsenic	91005	OPRD Farewell Bend State Park	250	Brownlee Reservoir	Snake River-Birch Creek	3	0.0212	0.039
GW	Arsenic	93618	Valley Wide Co-Op	25	Burnt River	Pritchard Creek	4	0.00642	0.00674
GW	Nitrate	90004	Ash Grove Cement West-Durkee	125	Burnt River	Lower Burnt River	2	7.96	7.96
GW	Nitrate	90889	Annex Elementary SD 29	50	Brownlee Reservoir	Snake River-Hog Creek	3	5.5	8.28
GW	Nitrate	91094	ODOT HD Baker Valley RA I84	200	Powder River	Powder River-Baldock Slough	7	6	7
GW	Nitrate	93459	Joy Travel Plaza (currently inactive)	200	Brownlee Reservoir	Snake River-Birch Creek	10	5.21	14.2
GW	Nitrate	93618	Valley Wide Co-Op	25	Burnt River	Pritchard Creek	6	5.3	12.3
GW	Nitrate	94796	Oasis RV & Campground	50	Brownlee Reservoir	Snake River-Birch Creek	7	6.1	16.2
GW	Nitrate	94980	Catfish Junction LLC	50	Brownlee Reservoir	Snake River-Birch Creek	7	5.59	9.53
GW	Nitrate	95020	Burnt River Camp	18	(Unmapped)	(Unmapped)	1	5.39	5.39

Water Type	Analyte Name	PWS ID	PWS Name	Pop.	Subbasin	Watershed	Count of Detects	Min of Conc.	Max of Conc.
GW	Nitrate+Nitrite (As N)	90889	Annex Elementary SD 29	50	Brownlee Reservoir	Snake River-Hog Creek	1	6.02	6.02
GW	Nitrate+Nitrite (As N)	94796	Oasis RV & Campground	50	Brownlee Reservoir	Snake River-Birch Creek	7	6.48	14.7
GW	Sodium[1]	00363	Halfway, City of	350	Brownlee Reservoir	Pine Creek	1	33	33
GW	Sodium	00393	Huntington, City of	560	Burnt River	Lower Burnt River	3	46.7	48.1
GW	Sodium	01358	Western Heights Water Company	70	Powder River	Powder River-Baldock Slough	1	21.8	21.8
GW	Sodium	01450	Unity, City of	95	Burnt River	South Fork Burnt River	1	23.8	23.8
GW	Sodium	90618	BLM Spring Rec Site	25	Brownlee Reservoir	Snake River-Rock Creek	3	22	22
GW	Sodium	90889	Annex Elementary SD 29	50	Brownlee Reservoir	Snake River-Hog Creek	2	135	173
GW	Sodium	91005	OPRD Farewell Bend State Park	250	Brownlee Reservoir	Snake River-Birch Creek	1	188	188
GW	Sodium	93658	ODOT HD Weatherby Rest Area	500	Burnt River	Lower Burnt River	1	31.1	31.1
GW	Sodium	95278	Blue Bucket RV Park	25	Burnt River	Lower Burnt River	1	113	113
GW	Sodium	95356	Baker Co Pks - Holcomb	26	Powder River	Lower Powder River	1	130	130
GW	Coliform, E. Coli	00384	Idaho Power-Oxbow Village	75	Brownlee Reservoir	Pine Creek and Snake River-Indian Creek	3	present	present

[1] There is no drinking water standard for sodium; however sodium detections are noted since it is recommended that if the sodium content exceeds 20 mg/L, the system notify its customers so that anyone who is on a prescribed low-sodium diet can inform their doctor of this source of sodium in their diet.

Water Type	Analyte Name	PWS ID	PWS Name	Pop.	Subbasin	Watershed	Count of Detects	Min of Conc.	Max of Conc.
GW	Coliform, E. Coli	91094	ODOT HD Baker Valley RA I84	200	Powder River	Powder River-Baldock Slough	1	present	present
GW	Coliform, E. Coli	94980	Catfish Junction LLC	50	Brownlee Reservoir	Snake River-Birch Creek	1	present	present
GW	Coliform (TCR)	00362	Haines, City of	435	Powder River	Powder River-Rock Creek	9	present	present
GW	Coliform (TCR)	00384	Idaho Power-Oxbow Village	75	Brownlee Reservoir	Pine Creek and Snake River-Indian Creek	4	present	present
GW	Coliform (TCR)	00393	Huntington, City of	560	Burnt River	Lower Burnt River	3	present	present
GW	Coliform (TCR)	00577	North Powder Water District	490	Powder River	North Powder River	10	present	present
GW	Coliform (TCR)	01358	Western Heights Water Company	70	Powder River	Powder River-Baldock Slough	1	present	present

2.5.4 Groundwater Beneficial Use

A review of WRD records indicates that the major uses of groundwater in the Powder Basin are domestic water supply, community water supply, and irrigation. There are also some wells which are classified as being used for livestock and industry.

In the Baker Valley between Baker City and North Powder, most wells range from 20 to 300 feet in depth, with a few wells ranging up to 750 feet deep. Well yields were estimated at a few gallons per minute (gpm) up to 2000 gpm.

In the Richland area near the confluence of the Powder and Snake Rivers, most wells are used as domestic water supplies. They range from approximately 20 to 600 feet deep. Well yields were estimated at 3 to 100 gpm.

Aquifer types reported in the Powder Subbasin Report **(NWPCC, 2004a)** are shown in **Table 2-11.** Groundwater quality status and trends are discussed in **Section 5.0**.

Table 2-11: Aquifers of the Powder Subbasin (NWPCC, 2004a)

Aquifer	Square Miles	Percent of Subbasin	Rock Type
No Principal Aquifer	695	40.6	N/A
Pacific Northwest Basin-Fill Aquifers	496	29.0	Unconsolidated sand and gravel
Columbia Plateau aquifer System	355	20.7	Basalt and other volcanic rocks
Miocene Basaltic-Rock Aquifers	165	9.6	Basalt and other volcanic rocks

References

Browne Consulting, March 2011, The Ecologically Adaptive Water Management Program for Powder River, Burnt River, and Pine Creek Subbasins.

Northwest Power and Conservation Council, 2004a, Powder Subbasin Report, in Columbia River Basin Fish and Wildlife Program, Portland, OR. http://www.nwcouncil.org/fw/subbasinplanning/Default.htm

Northwest Power and Conservation Council, 2004b, Burnt Subbasin Report, in Columbia River Basin Fish and Wildlife Program, Portland, OR. http://www.nwcouncil.org/fw/subbasinplanning/Default.htm

National Land Cover Database, 2006, http://www.mrlc.gov/index.php

Natural Resources Conservation Service, 2006, 8-Digit Hydrologic Unit Profiles, Powder River, Brownlee Reservoir, Burnt River, Water Resources Planning Team, Portland, OR. http://www.or.nrcs.usda.gov/technical/huc-snake.html

Oregon Department of Fish and Wildlife, 2005, Oregon Native Fish Status Report, Salem, OR. http://www.dfw.state.or.us/fish/ONFSR/report.asp

Oregon Geospatial Data Clearinghouse, 2011, Salem, OR. http://cms.oregon.gov/DAS/CIO/GEO/docs/metadata/blmlands.htm

Oregon State University, 2011, PRISM Climate Group, Corvallis, OR.

Oregon water Resources Department, 2011, Dam Inventory, http://apps.wrd.state.or.us/apps/misc/dam_inventory/

Simonds, William, Joe, 1997a, Burnt River Project**,** Bureau of Reclamation History Program Denver, Colorado Research on Historic Reclamation Projects

Simonds, William, Joe, 1997b, Baker Project**,** Bureau of Reclamation History Program, Denver, Colorado, Research on Historic Reclamation Projects.

3. Pollutant Sources

The following section describes major surface and goundwater pollutant sources in the Powder Basin, divided by point sources and nonpoint sources.

Point sources of water pollution eminate from a descrete location or "point" such as a discharge pipe. Point sources generally require permits that regulate pollutant concentrations and discharge parameters such as location, volume, and season. The point source section is divided by type of permit.

Non-point water pollution sources are the result of broad landscape activities that contribute to water pollution through surface water runoff or infiltration into groundwater. This section is divided into the following subsections:

- Urban/Rural Residential
- Forestry
- Agriculture
- Recreational
- Reservoirs and Diversions
- Transportation
- Invasive Plant Species
- Mining
- Landslides/Stream Channel Stability

3.1 Point Sources

National Pollutant Discharge Elimination System (NPDES)

The NPDES permit is a requirement of the Federal Water Pollution Control Act (Clean Water Act) and Oregon law. DEQ has been given authority by the U.S. Environmental Protection Agency (EPA) to issue these permits. NPDES permits are required for "point source" discharges of pollutants to surface waters. The term "point source" refers to a natural or human-made conveyance such as pipes culverts, ditches, catch basins or any other type of channel. NPDES permits are issued for wastewater discharges from sewage treatment plants, pulp and paper mills, and other types of businesses. This also includes discharges to the storm sewer system or to drainage ditches that eventually reach surface waters. Certain industries and activities are also required to obtain NPDES permits for stormwater runoff. **Table 3-1** is a list of NPDES permits in the Powder Basin.

Table 3-1 NPDES Permits in the Powder Basin (2011)

DEQ Water Quality File Number	Common Name	Location	Receiving Stream	Permit Type
5324	Baker City WWTP	Baker City	Powder River	Domestic
11355	E&E Mine	Bourne	Cracker Creek	Industrial
36156	Halfway STP	Halfway	Pine Creek	Domestic
40981	Huntington STP	Huntington	Burnt River	Domestic
41299	Oxbow Power Plant	Oxbow	Snake River	Industrial
61600	North Powder STP	North Powder	Powder River	Domestic

There are four domestic Wastewater Treatment Plants (WWTPs) discharging to surface waters of the Powder Basin that are regulated by NPDES permits **(Table 3-1)**. These four WWTPs are the most significant point sources of water pollution in the Powder Basin, and are summarized in the following sections. There are also two permitted industrial dischargers, but they are relatively minor pollutant sources.

Baker City

Baker City operates a wastewater treatment facility that serves its approximately 9,400 residents and also receives septage from the surrounding area. Wastewater is treated and discharged year-around to the Powder River in accordance with NPDES Permit number 101632. The current permit expired on October 31, 2008, but is still in effect due to the timely application for renewal.

The Baker City wastewater treatment facility was constructed in 1964. It currently consists of an influent lift station and a Parshall flume and four-cell facultative lagoon system. The primary cell is approximately 70 acres, and the three remaining cells are approximately 10 acres each. Wind operated mixers were added to the ponds in 2001 to aid with sludge digestion.

The facility was designed for a monthly average dry weather flow of 2.0 million gallons per day (MGD). According to the 2003 DEQ permit review report **(DEQ, 2003)**, the monthly average effluent flow was approximately 1.7 MGD during the 2002 calendar year with a monthly high of approximately 2.4 MGD in June 2002. The current permit has effluent standards for biological oxygen demand (BOD), total suspended solids (TSS), pH, total residual chlorine, *E. coli* bacteria, BOD percent removal efficiency, TSS percent removal efficiency, and thermal load.

Recent compliance history (2007-2010) for the Baker City WWTP includes several violations of permit monitoring requirements. A mutual agreement order (MAO) relating to the 2007 permit violations was signed in April 2008. A warning letter for failing to collect required monitoring data was issued on July 23, 2010.

Review of temperature monitoring data from the City's Discharge Monitoring Reports (DMRs) and the mixing zone study **(Baker City, 2002)** indicates that the effluent temperature results in a measurable increase (0.25 degrees F or greater) in-stream during the warm summer months (**DEQ, 2003)**. The maximum weekly average of daily maximum effluent temperature reported in the study was 81.8 degrees F. It is likely that temperature will be an issue at this facility when the temperature TMDL is developed based on the current applicable temperature standard of 20 degrees C (68 degrees F) for this reach of the Powder River. In addition, the TMDL will very likely include a total phosphorus waste load allocation for the facility if Baker City continues to discharge to the Powder River during the critical period of May-September. Baker City currently discharges all year.

OAR 340-041-0615 (1) (c) requires that the effluent BOD concentration in mg/l, divided by the dilution factor (ratio of receiving stream flow to effluent flow) shall not exceed one (1) unless otherwise authorized by the permit. With a discharge limit of BOD 45 mg/l in the Baker City permit, the river water to effluent dilution ratio must be 45:1 or greater. The discharge from the City lagoons at a design flow of 2.0 million gallons/day equals 3.1 cfs, which can be more than half the flow of the Powder River during low flow conditions. The Baker City WWTP has been allowed to exceed this dilution limit due to the fact that it was constructed prior to the adoption of the minimum dilution rule. The plant will be required to meet this rule when it is upgraded or expanded **(DEQ, 2003)**.

City of Halfway

The City of Halfway operates a wastewater treatment facility located in Halfway, Oregon. Wastewater is treated and discharged to Pine Creek during the months of November through May, and land applied during June through September, in accordance with NPDES permit number 101795. The current permit expired on December 31, 2011, and a renewal application was received on July 1, 2011.

The Halfway wastewater treatment facility was originally constructed in 1967-1968, and is located approximately 1/2 mile east of the City, adjacent to Pine Creek. It serves a population of approximately 300 people. The facility consists of a gravity collection system, an in-pipe flow meter with a continuous flow recorder, a 3-cell lagoon system, chlorine contact basin with a static mixer vault, and an effluent flow meter and recorder. The average dry weather design flow is 0.116 MGD **(DEQ, 2007)**.

On June 24, 2004, DEQ authorized the use of the City of Halfway's reclaimed water system for the 2004 irrigation season with conditions. The plan was eventually approved with addendums in 2006. It remains in effect until the plan undergoes a public comment period during the permit renewal process, when any comments received will be addressed. The current permit allows the City of Halfway to discharge treated effluent to Pine Creek from November 1 through May 31. Limits are set for BOD, TSS, *E.coli* bacteria, pH, and BOD percent removal efficiency, and TSS percent removal efficiency. The November 2004 Temperature Management Plan for the facility concluded that the treatment lagoons would be capable of meeting temperature standards with the recent construction of the reclaimed water system in combination with the nature of the discharge to Pine Creek. A review of DMRs for the City of Halfway reported in the 2007 DEQ permit review report indicated that effluent temperature reached a maximum temperature of 20°C (68°F) during May 2000 and May 2006. This suggests that the site is capable of meeting the temperature standard of 20°C in Pine Creek **DEQ, 2007)**. Potential temperature impacts will be examined during TMDL development.

Effluent limits for BOD, TSS, and pH were exceeded in 2005 and 2006, resulting in the development of a compliance schedule in a MAO which was issued May 1, 2007. In addition, the TMDL will very likely include seasonal a total phosphorus waste load allocation for the facility which must be met if the City of Halfway continues to discharge during the critical period of May-September. The City of Halfway currently discharges during the months of November through May.

The City of Halfway is working with DEQ under the 2007 MAO to develop plans to upgrade the facility so that they can meet permit requirements and address flooding issues which have plagued the facility in recent years. The City is having difficulty finding adequate funding for the project, and is working to find any available grants.

City of North Powder

The City of North Powder operates a wastewater treatment facility located along the North Powder River northeast of the city. Wastewater is treated in a facultative lagoon system and piped approximately ½ mile east to the Powder River for discharge during the months of November through May. Treated effluent is used to irrigate nearby fields during June through October. The treatment facility is authorized to operate under NPDES permit number 10229. The current permit expired on May 31, 2006, but is still in effect due to the timely application for renewal.

The North Powder wastewater treatment facility was originally constructed in 1971. It consisted of a gravity collection system, a Parshall influent flume and flow recorder, two lagoon cells of approximately 2.4 acres, chlorination facilities including a 36-inch diameter contact pipe, effluent v-notch weir, and an outfall pipe that historically discharged to the North Powder River at approximately river mile (RM) 0.5. The average monthly design flow for the original facility was 0.050 MGD. During 1999, the average monthly effluent flow from the facility was approximately 0.125 MGD, which is 2.5 times the flow level used in the design **(DEQ, 2000)**.

On October 30, 2000, DEQ received a wastewater system study from the City of North Powder. The study proposed the addition of floating aspirating aerators to the primary cell, dechlorination system, reclaimed water irrigation system, and a new outfall pipe to the Powder River at approximately RM 81.75. These modifications increased the approved design average wet weather flow to 0.137 MGD. Reclaimed water irrigation was proposed for June 1 through October 1, with discharge to the Powder River the rest of the year. The permit issued in 2001 included these modifications and required that the discharge to the North Powder River terminate by November 1, 2002. Discharge to the Powder River was authorized after that date during the months of November – May. Effluent limits were set for BOD, TSS, *E. coli* bacteria, pH, BOD percent removal efficiency, TSS percent removal efficiency, and total chlorine residual. The permit also stated that an evaluation demonstrated that the discharge will not cause a measurable increase in stream temperature. Compliance with the NPDES permit was deemed to satisfy the requirement for developing and implementing a surface water temperature management plan. It is possible that temperature will be an issue at this facility when the temperature TMDL is developed based on the current applicable temperature standard of 20°C (68°F) for this reach of the Powder River. In addition, the TMDL will very likely include a total phosphorus waste load allocation for the facility if the City of North Powder continues to discharge during the critical period of May-September. North Powder currently discharges during the months of November through May.

Despite efforts to improve the facility in 2001, the City of North Powder has continued to have trouble meeting the requirements of the NPDES permit. On August 12, 2010, DEQ issued a Warning Letter to the City of North Powder instructing the City to submit a written proposal and schedule to bring the North Powder WWTP into compliance with the terms and conditions of the NPDES permit. The warning letter listed violations of the daily pH limit, as well as BOD and TSS limits which occurred between February 2009 and June 2010. On December 22, 2010 the Environmental Quality Commission signed a MAO with the City of North Powder which recognizes that the City will continue to violate the conditions of the permit until the planned upgrades to the treatment plant are completed. The MAO requires the City of North Powder to submit to a suitable Wastewater Treatment Plant Study to attain compliance with NPDES permit requirements, and to complete construction of the treatment plant upgrades.

City of Huntington

The City of Huntington owns and operates a secondary wastewater treatment facility that is located approximately ½ mile east of the City, adjacent to the Burnt River. The treatment plant discharges treated effluent year-round to the Burnt River at RM 2.0 in accordance with NPDES Permit Number 101726. The permit expired August 31, 2004, but is still in effect due to a timely application for renewal.

The City of Huntington wastewater facilities were originally constructed in 1966. The existing treatment facilities consist of a 3-cell lagoon system with an aeration cell, stabilization cell, and polishing cell, lift station, raw sewage grinder, influent Parshall flume with continuous flow recorder, chlorination (polishing cell), and effluent Parshall flume with flow recorder. The average dry weather design flow is 0.095 MGD and the peak design flow is 0.77 MGD **(DEQ, 1999)**.

The NPDES Permit includes discharge limits for BOD, TSS, *E. coli* bacteria, and pH. The permit also included requirements for a mixing zone study and temperature management plan which were submitted to DEQ on September 3, 2002. Results from the study indicated that both the river water and effluent were observed to reach temperatures over 80°F during July 2002. The study concluded that summer temperatures were high in the Burnt River and effluent, and that elimination of effluent discharges is not likely to improve stream temperatures downstream. It is likely that temperature will be an issue at this facility when the temperature TMDL is developed based on the current applicable temperature standard of 20°C (68°F) for this reach of the Burnt River. In addition, the TMDL will very likely include a total phosphorus waste load allocation for the facility if Huntington continues to discharge during the critical period of May-September. The City of Huntington currently discharges all year.

General Permits

A "general permit" is used to cover a category of similar discharges, rather than a specific site. DEQ may issue a general permit when there are several minor sources or activities involved in similar operations that may be adequately regulated with a standard set of conditions. A general NPDES permit is issued once and expires within five years. Any facility that qualifies for a general permit may be "assigned" to the permit during that five-year period. The fee for a general permit is lower than an individual permit because the cost of developing a general permit may be spread over multiple facilities. In addition, these permits usually require less oversight by DEQ. DEQ currently utilizes 29 different NPDES and WPCF general permits that regulate such discharges as boiler blowdown, non-contact cooling water, wash water from vehicle and equipment cleaning, seafood processing, petroleum hydrocarbon cleanups, small domestic onsite sewage systems, etc. General permits cannot be modified and will only be issued to facilities that are able to meet the requirements set forth in the desired permit. **Table 3-2** is a list of the 10 General Permits in the Powder Basin.

Table 3-2. General Permits in the Powder Basin (2011).

DEQ Water Quality File Number	Common Name	Location	Receiving Stream	Permit Type
102507	Ash Grove Cement Company	Durkee	Burnt River	Stormwater (12A)
102507	Ash Grove Cement Company	Durkee	Burnt River	Stormwater (12Z)
108030	Ash Grove Cement-Lime Plant Site	Lime	Burnt River	Stormwater
108108	Granite Construction Co.	Baker City	Powder River	Industrial
110232	Harney Rock and Paving	North Powder	Powder River	Industrial
118467	ODOT-Pleasant Valley Quarry	Baker County	Burnt River	Industrial
118890	ODOT-Baker City Maintenance Facility	Baker City	Powder River	Industrial
109365	Iron Dyke Project	Oxbow	Snake River	Stormwater
109278	Britt Corporation	Baker City	Powder River	Industrial
104511	Triple C Redi-Mix, Inc.	Baker City	Powder River	Industrial

Water Pollution Control Facilities (WPCF)

The WPCF permit is a state requirement for the discharge of wastewater to the ground; discharge to surface water is not allowed, therefore the risk of surfacewater pollution is low. WPCF permits are issued for land irrigation of wastewater, wastewater lagoons, onsite sewage disposal systems, and underground injection control systems (i.e., dry wells, sumps, etc.). The primary purpose of a WPCF permit is to prevent discharges to surface waters and to protect groundwater from contamination. This permit is also used to prevent nuisance conditions such as odors and mosquitoes.

An "individual permit" is site-specific; it is developed to address discharges from a specific facility. An individual permit is more expensive than a general permit because it takes more time to develop, and more review and inspection by DEQ is required to assure that the permitted facility is in compliance with its permit. Individual permits are usually issued for a period of five years. DEQ currently has over 800 facilities under NPDES and WPCF individual permits.

Approximately 70% of these permits are for the treatment and disposal of sewage. Individual permits often require more frequent monitoring by the permittee to assure that permit limitations are being met, as well as monitoring for a greater variety of pollutants. "Domestic" permits are issued to sewage and wastewater treatment plants, as well as other systems designed to treat wastewater that is primarily composed of human sewage. **Table 3-3** is a list of WPCF permits in the Powder Basin.

Table 3-3. WPCF Permits in the Powder Basin (2011)

DEQ Water Quality File Number	Common Name	Location	Watershed	Permit Type
5450	Sumpter RR Park	Sumpter	Cracker Creek	Domestic

114814	John Holcomb Park	Richland	Powder River	Domestic
112743	Cornucopia Lodge	Halfway	Pine Creek	Domestic
36005	Haines STP	Haines	Rock Creek	Domestic
111911	Oxbow Village	Oxbow	Snake River	Domestic
105305	Hells Canyon R.V. Park	Pine	Pine Creek	Domestic
109353	ODOT – Baker Valley Safety Rest Area	Baker City	Powder River	Domestic
111553	OPRD-Farewell Bend State Park	Huntington	Snake River	Domestic
75135	Richland STP	Richland	Powder River	Domestic
109365	Iron Dyke Project	Oxbow	Snake River	Industrial
103793	Sumpter STP	Sumpter	Cracker Creek	Domestic
91445	Unity STP	Unity	Burnt River	Domestic
106196	USBLM-Oregon Trail Interpretive Center	Baker City	Powder River	Domestic

3.2 Nonpoint Sources

Nonpoint source pollution is generally associated with spatially disperse land-use activities such as urban and rural development, agriculture, forestry and transportation. Sometimes it is difficult to identify specific sources of nonpoint source pollution as they are linked to land use and management practices.

Examples of nonpoint source pollution include nutrients, bacteria, sediments, pesticides and other toxics generated from some agriculture and forestry land management practices, urban and rural areas, leaking underground storage tanks, improperly operating septic systems, sediment runoff from construction sites, stream channel alteration, streambank erosion, and damage to wetland and riparian areas, polluted runoff from transportation systems, and other sources.

There are many, varied, nonpoint sources of pollution in the Powder Basin. Major nonpoint sources include:

- Urban/rural development management practices (including stormwater and construction)
- Forestry practices
- Agricultural practices
- Recreation activities
- Reservoirs and diversions
- Transportation corridors
- Invasive species
- Mining activities (legacy and current)
- Water withdrawals

The occurrence and input of each of these sources varies throughout the basin relative to the distribution of land-use and management practices in place in each of the subbasins. **Table 3-4** shows the break-down of broad land-use categories within the whole basin and within each of the subbasins. This information is discussed further in the rest of this section on nonpoint sources of pollution.

3.2.1 Urban/Rural Residential

Urban/suburban land-use totals less than 1% of the Powder Basin, however urban pollution sources can have a significant local impact on water quality. The largest portion of developed land is within Baker City. Potential impacts from urban/suburban management practices are listed in **Table 3-4**.

Table 3-4: Potential Sources of Pollution from Urban/Suburban Practices

Pollutant Source	Resulting Water Pollutant Loads
Construction Sites	Increased sediment loads from improperly maintained construction sites
Failing Septic Systems	Increased nutrient load in highly bioavailable form from failing septic systems Increased bacterial levels from failing septic systems
Auto and Yard Chemicals	Increases loading of petroleum products, metals and road/home/ lawn care chemicals transported to ground and surface waters in storm events, improper application and overwatering
Stormwater Runoff	Increased sediment from roadways and other impervious surfaces Increased sediment-bound nutrients from runoff and construction Altered hydrographs and long-term storage from increased impervious surfaces

Construction Sites

Improper construction site erosion and sediment control practices can cause loss of topsoil, increased susceptibility of erosion prone areas, elevated sediment and nutrient loads to nearby water bodies, and impaired water quality. Runoff from construction sites can be a substantial contributor of sediment in urban areas under development. Sediment-loading rates from construction sites are 5 to 500 times greater than those from undeveloped land **(EPA, 1977)**.

Erosion control consists of practices that are designed to intercept precipitation and prevent soil particles from moving. Products designed for this use include straw, mulch, ground covers, fiber blankets, hydro-seeding, etc. Sediment control consists of practices that are designed to capture soil particles after they have been dislodged and have begun to be carried away from leaving the site. Products designed for this include silt fences, straw bale check dams, sedimentation ponds, etc.

Septic Systems

Over 30 percent of Oregonians currently treat their wastewater through the use of onsite septic systems, primarily residential systems. DEQ regulates the siting, design, installation, and ongoing operation and maintenance of onsite septic systems. DEQ administers the Onsite septic Program in the Baker County, Union County, and Wallowa County portions of the Powder Basin. Malheur County administers the program in its own borders, including the portion in the Powder Basin. In addition, DEQ certifies and licenses installers, pumpers, and maintenance providers, and reviews and approves products such as septic tanks, alternative treatment technologies, and alternative drainfield products.

DEQ does not currently require existing system inspections to evaluate ongoing onsite system function. Without careful maintenance, septic systems can fail prematurely resulting in polluted streams and groundwater. Treatment failure can also occur when the system components reach the end of their lifetime and begin to degrade. For instance, metal septic tanks installed in the 1970's may have rusted through and no longer function properly. Through time soils can become less effective at treating wastewater and this is why repair areas are identified, if possible, during the siting of new systems. Many landowners do not realize the value of these repair areas and conduct incompatible activities in these areas, such as building structures or livestock confinement areas.

There are no areas of elevated nutrient concentrations or bacteria in groundwater identified in the Powder Basin that can be attributed to failing septic systems. However, DEQ On-site Program staff have identified areas where an elevated water table often makes it difficult to approve septic standard systems:

- Valley floor east of Baker City, on the east side of I-84, over to the foothills of Flagstaff (where I-86 goes to Richland). Areas of high groundwater extend north to about the ODOT rest area, which is about 10 miles north of Baker City. There are also areas of high groundwater all along the west side of I-84, north of Baker City.
- Most of the Pine Creek Valley near Halfway, including Pinetown.
- Areas of the Bowen Valley, along the Powder River (between Baker City and Sumpter).
- Areas around Richland.
- Areas around North Powder.

Stormwater Runoff

Stormwater is rain and snow melt that runs off impervious surfaces such as rooftops, streets and parking lots, often carrying substantial loads of oil, fertilizers, pesticides, soil, trash, and bacteria-laden animal waste directly into streams and rivers. Stormwater runoff from large impervious surfaces increases the peak flow of runoff, which can result in sedimentation, streambed scouring and loss of habitat. Untreated stormwater is not safe for people to drink, is often toxic to aquatic organisms, and can trigger toxic algal blooms. Landuse alterations to the watershed leading to problems with stormwater runoff, include building high density structures and clearing away vegetation.

Baker City has the largest urban area and presumably the largest stormwater system in the basin. The Baker stormwater collection system employs many sumps or dry wells which may be classified as underground injection control (UIC) systems that are subject to DEQ rules. The City is working to bring these systems into compliance. The Baker City UICs are discussed further in **Section 6.9.**

Baker City and the Baker Valley Soil and Water Conservation District (SWCD) have completed in-stream and riparian and bank stabilization projects along the Powder River in Baker City in recent years. The improved riparian conditions will help address urban stormwater issues. These projects, combined with a minimum water flow from Phillips Reservoir, have improved stream function and made the river a focal point for parks and a riverbank walkway.

3.2.2 Forestry

There are approximately 740,400 acres of forest land in the Powder Basin, which is about 33% of the total land area. Approximately 580,900 acres is publically owned and mostly under the management of the Wallowa-Whitman National Forest, and 159,500 acres is privately owned **(Table 2-1)**. Management of forests and grazing in forested areas has a strong impact on water quality. Forest condition impacts the quantity and quality of water that returns to streams in a watershed, as well as the amount of erosion. Riparian zone management is particulary critical to water quality conditions. Healthy riparian vegetation shades streams and allows for better width/depth ratios, flood plain connections, bank storage of ground water, and reduced levels of bacteria, nutrients and sediment.

The Natural Resources Conservation Service (NRCS) Hydrologic Unit Profile reports **(NRCS, 2006)** for the Powder, Burnt and Brownlee subbasins identified the following forestry resource issues and concerns:

- Approximately 75% of the forestland in the Powder Basin is grazed by livestock.
- About 10-30 percent of the private forestland in the three subbasins is managed by private industrial owners, who generally comply with State Forest Practice Act requirements, which include riparian buffers.
- Private non-industrial forestland commonly is associated with grazed woodland; it is not managed primarily for timber production. Forest Practices Act protections of streams do not apply to these activities.
- Private and public forests are subject to damage from insects and disease, overstocking, and fuel buildup. Thinning is needed to increase productivity and reduce the risk of catastrophic fire, and protect watersheds.
- Loss of riparian vegetation contributes to the warming and nutrient loading of streams.
- High cost, unreliable markets, and inadequate incentive programs, as well as declining public agency budgets limit forestland management activities. **(after NRCS, 2006)**

The U.S. Forest Service Pacific Northwest Research Station documented vegetation changes in high altitude areas (above 5,000 feet elevation) of the Powder Basin and vicinity **(Skovlin, et al., 2001)** by comparing historic photos taken before 1925 to those taken as recently as 1999. This study documented the following major landscape changes that have the potential to impact watershed function and water quality:

1. The expansion of subalpine fir into mountain grasslands (increased interception and transpiration, potentially reducing stream flows)
2. The invasion of moist and wet meadows by several tree species (reduced water storage through loss of wetlands)
3. Loss of whitebark pine from subalpine habitats (reduced biodiversity)
4. Continued soil erosion stemming from livestock grazing long since discontinued (increased sediment loads in streams)
5. A high rate of landslides (increased sediment loads in streams)

The most important factor contributing to the changes in woody vegetation has been a reduction in fire frequency. Fires that occurred before 1925 were nine times more frequent than those that occurred at the end of the 20^{th} century. **(Skovlin, et al., 2001, emphasis added)**

Figures 3-1 and 3-2 document the dramatic changes in vegetation species, distribution and density in the vicinity of the Baisley-Elkhorn Mine, which is located along the Elkhorn Ridge, west of Baker City.

Figure 3-1. Baisley-Elkhorn Mine, Around 1898

(Looking northwest) The town, which extended to the timbered ridge, included homes for more than a dozen families and several boarding houses for many single miners. The town site shows considerable disturbance of a rather open Douglas-fir forest and a heavy residual stand of mountain big sagebrush. Hunt Mountain (8,630 feet) in the background is almost devoid of trees. **(Skovlin, et al., 2001)**

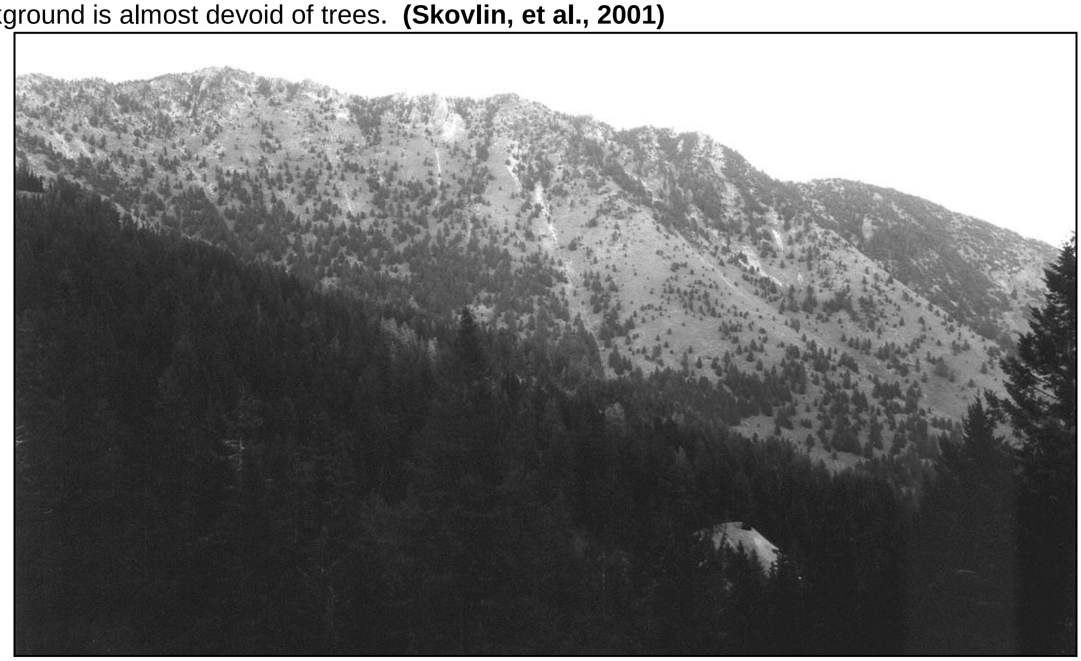


Figure 3-2: Baisley-Elkhorn Mine, 1997.

Hunt Mountain has become strikingly covered in forest, especially at the lower reaches. The mine tailings, considerably larger than 95 years earlier, make an excellent reference point for the original town and mine buildings. Charred stumps and logs attest to the hot fire that destroyed much of the town. The forest that reinvaded the town site is composed of Douglas-fir and lesser amounts of subalpine fir with mountain big sage and elk sedge throughout the understory. A scattering of young whitebark pine has succumbed. Douglas-fir bark beetle activity is evident in several patches on the far slope. **(Skovlin, et al., 2001)**

3.2.3 Agriculture

Agriculture can impact water quality through increased erosion caused by some irrigation practices, loss of riparian vegetation, channelization of streams, and other disturbances. Loading of nutrients, bacteria, sediment, and increased stream temperatures often result from these conditions. This section describes agricultural conditions and practices that impact water quality in the Powder Basin. It is divided into subsections dealing with rangeland, irrigated lands, pasture and hay, grain and row crops, and confined animal feeding operations (CAFOs).

Rangeland

Rangeland makes up approximately 47% of the land cover in the Powder Basin and totals over one million acres **(NRCS, 2006)**. There are three distinct types of rangeland in the Powder Basin:

1. Low elevation sagebrush-grass-herbaceous rangelands below timberline.
2. Rangeland under trees and as openings within timberlands.
3. High elevation subalpine and alpine rangelands.

Resource concerns associated with these rangelands that were identified by NRCS include:

- Juniper encroachment and invasive weeds reduce the health and vigor of range grasses and forbs.
- Juniper also increases evapotranspiration, reducing the availability of water for range grasses and reducing downstream subsurface discharge to the river.
- Rangeland can become infested with noxious weeds, annual grasses, and shrubs as a result of inadequate forage and grazing management.
- Loss of riparian vegetation contributes to the warming and nutrient-loading of streams.

Irrigated Lands

Irrigated agricultural land makes up approximately 7.5 % of the Powder basin and totals 166,500 acres **(NRCS, 2006)**. A breakdown of the amount and types of irrigated land in each subbasin is provided in **Table 3-5**.

Table 3-5. Irrigated Land in the Powder, Burnt and Brownlee Subbasins, NRCS, 2006

	Type of Land	ACRES	% of Irrigated Lands	% of HUC
Powder Subbasin Irrigated Lands *(1997 NRI[/3] Estimates for Non-Federal Lands Only)*	Cultivated Cropland	21,700	16%	2%
	Uncultivated Cropland	48,000	36%	4%
	Pastureland	62,300	47%	6%
	Total Irrigated Lands	**132,000**	**100%**	**12%**
	Type of Land	ACRES	% of Irrigated Lands	% of HUC
Burnt Subbasin Irrigated Lands *(1997 NRI[/3] Estimates for Non-Federal Lands)*	Cultivated Cropland	600	3%	0%
	Uncultivated Cropland	13,600	79%	2%
	Pastureland	3,100	18%	0%
	Total Irrigated Lands	**17,300**	**100%**	**2%**
	Type of Land	ACRES	% of Irrigated Lands	% of HUC
Brownlee Subbasin Irrigated Lands *(1997 NRI[/3] Estimates for Non-Federal Lands Only)*	Cultivated Cropland	4,700	27%	1%
	Uncultivated Cropland	2,900	17%	<1%
	Pastureland	9,600	56%	2%
	Total Irrigated Lands	**17,200**	**100%**	**4%**

Resource concerns associated with each type of irrigated cropland which were identified by the NRCS are presented below:

Pasture/Hay

- Better irrigation water management is practiced in areas used for alfalfa than in areas of pasture.
- In some areas of pasture, a lack of proper grazing management has lead to its poor condition.
- Areas of pasture commonly are adjacent to streams, which can contribute to streambank erosion, sedimentation, nutrient and bacteria loading, and elevated temperatures as a result of loss of riparian vegetation.

Grain and Row Crops

- Most grain is produced in rotation with other crops (potatoes, corn, alfalfa, etc.)
- Irrigation-induced erosion may occur on fields used for crops such as potatoes or corn.
- Surface-irrigated areas of grain are also prone to irrigation-induced erosion.
- Water management is always a concern with irrigated crops, but irrigation water management is better in areas used for row crops than it is in areas used as pasture.

The Oregon Department of Agriculture (ODA) is responsible for regulating agricultural activities on private lands that affect water quality. ODA uses *Agricultural Water Quality Management Area Plans* (AgWQMAP) and associated rules to protect water quality and implement TMDLs throughout the state. AgWQMAPs are reviewed on a 2-4 year schedule. The AgWQMAP documents are available at: http://oregon.gov/ODA/NRD/water_agplans.shtml.

The AgWQMAP for the Powder/Brownlee Subbasins was adopted in 2003. Biennial reviews were conducted in 2007, 2009, and 2011. The goal of the plan is to reduce identified water quality limitations on agricultural and rural lands if it is economically and technically feasible. Water quality objectives include:

- Stream bank erosion remains within expected levels.
- Maintain or improve the ability of riparian vegetation to function within the capabilities of the site.
- Continue and expand the current Baker SWCD's monitoring program.

The Burnt River Subbasin AgWQMP was adopted in 2003, and has been reviewed in 2006, 2008 and 2010. The water quality objectives of the Area Plan include:

- Stream bank erosion remains within expected levels.
- Maintain or improve the ability of riparian vegetation to function within the capabilities of the site.
- Continue and expand, if necessary, the current monitoring program as outlined in the Burnt River Temperature Study.

Confined Animal Feeding Operations

The ODA currently regulates 16 facilities in the Powder Basin under its CAFO program. A search of the ODA enforcement program database which has records going back to 1990, indicates that a total of nine Notices of Noncompliance (NONs) were issued to facilities in the Powder Basin between 2004 and 2009. All of the NONs were for record keeping and/or reporting violations and did not include water quality violations. Fifteen of the permitted CAFOs were inspected in 2011. All were found to be in compliance with permit conditions, which include prohibitions on discharges to surface water.

3.2.4 Recreational

A variety of recreational opportunities are available within the Powder Basin including boating, fishing, camping, hiking and other activities. Water-based recreational activities peak in the season between Memorial Day and Labor Day, when the rivers are utilized by boaters, swimmers, campers and fishermen. Water-side campgrounds throughout the basin are heavily utilized during the summer season.

Potential impacts from recreational uses are varied, ranging from increased erosion potential caused by irresponsible forest road and off-road vehicle use, to direct contamination of surface water by personal water craft or accidental fuel spills. Pollutants of concern generated by recreational use of the watershed include (but are not limited to) hydrocarbons from outboard motors, organic material from fish cleaning, potential bacterial contamination from human waste (improper sanitary disposal) and addition of nutrients, grease and oils from parking lot runoff at camp grounds and boat ramps/developed put ins. Sediments are also contributed by erosion of banks around popular beach areas and camping sites, and heavy use of forested roads, particularly during the wet season.

Concentrated recreational use, commonly associated with campgrounds or day use sites has resulted in the loss or some reduction in riparian vegetation and stream bank stability. Dispersed camping and recreation in localized areas also has contributed to loss of riparian vegetation and trampling and compaction of streamside soils.

3.2.5 Reservoirs and Diversions

There are multiple irrigation districts operating irrigation systems within the Powder Basin **(Section 2.5.2)**. Below are some activities that could lead to water pollution including warmer stream temperatures:

- Diversion dams are used to divert water from a stream to an irrigation ditch or canal. Diversion dams affect stream temperature by dewatering the downstream reach of the river. Reductions in stream flow in a natural channel slow the movement of water and generally increase the amount of time the water is exposed to solar radiation. Stream temperatures downstream of diversion dams can be substantially warmer than those above.

- Canals and other unpiped water conveyance systems generally are open ditches. These ditches are usually unshaded and increase the surface area of water exposed to solar radiation. Where canal waters are allowed to mix with natural stream flows, such as at diversion dams and at places where natural stream channels are used to convey irrigation water to downstream users, stream temperatures can increase. In addition, irrigation return flows will runoff of fields or pastures after irrigation. The return flows often contain increased levels of sediment, nutrients and bacteria which may end up in a stream or the irrigation ditch to be used by the next water right holder. In the Powder Basin, irrigation water often infiltrates into the ground and may return to streams as groundwater.

- Operational spills are places in the irrigation delivery system where excess unused irrigation water in the canals is discharged back into a downslope canal, a lateral stream, or a natural stream channel without being delivered to or used on an individual field. These waters may be picked up by the next water right holder. Then, when the water is returned, it can increase stream temperatures.

Dams and reservoirs may contribute to stream warming in the following ways:

Increased waterbody surface area
The reservoir water behind the dam increases the surface area of water exposed to solar radiation and may delay the movement of water through the river system. Throughout the summer months reservoirs store solar radiation as heat in the warm surface waters pooled behind the dam. These reservoirs may become thermally stratified in late summer. Accumulated heat is discharged with the stored water from each reservoir into downstream river reaches during annual draw down, which occurs in early summer and continues into late fall. Deep stratified reservoirs can also release cooler water during some periods in the summer.

Daily diel change
Dams can also dampen the daily diel temperature pattern contributing to downstream temperature increases. This is caused by the warmer daily minimum temperatures contributing to increased daily maximum temperatures 12 hours travel time downstream (DEQ 2006; Khangaonkar and Yang 2008).

Flow reductions
Another source of stream temperature increase is caused by extreme reductions in flow when the reservoirs are storing water during the non-irrigation season (roughly October to May). The downstream flow is severely reduced, decreasing assimilative capacity and contributing to downstream temperature increases. This can be of particular concern during in late spring.

Vegetation change from modified flood magnitude and frequency
Dams and diversions alter the natural hydrograph (flow pattern) and typically reduce the frequency and magnitude of flood flows thereby reducing the extent of floodplain inundation and potentially lowering the water table **(Naimen et al 2005)**. These changes interrupt the natural hydrochory of woody vegetation **(Rood and Mahoney 1995, Andersson et al 2000, Merritt and Cooper 2000, Beauchamp and Stromberg 2007)**. Hydrochory is the process of dispersal of reproductive propagules (seeds or branch fragments) by water **(Nilsson and Berggren 2000)**.

In arid regions, woody vegetation such as willows and cottonwoods rely on periodic flooding to transport branches and seeds to new locations. Dams reduce the amount of propaguls transported downstream. The altered hydrograph affects the narrow window and specific conditions needed for successful colonization during those periods. Flooding exposes new bank material, moistens the soil and stabilizes water tables – a process needed for rooting of branch fragments and seed germination **(Lisle 1989; Hughes 1990; Stromberg et al 1991)**. This process is further described in the USDA Plant Guide for coyote willow **(Stevens et al 2005)**.

As described previously, dam management can dramatically reduce the downstream frequency and magnitude of flood flows that would typically occur during the winter and spring months. Documentation of similar changes at other systems has demonstrated the distribution of riparian vegetation has been altered and often reduced **(Rood and Mahoney 1995, Merritt and Cooper 2000, Beauchamp and Stromberg 2007)** contributing to the invasion of upland species laterally over the floodplain. Changes in flow management may be necessary for riparian restoration **(Richter and Richter 2000, Rood and Mahoney 2000, Rood et al 2003**.

3.2.6 Transportation

Roads, drives and parking lots are large runoff-producing areas in the urban environment. This runoff is often contaminated with sediment, litter, petroleum, and with toxic metals from motor vehicles. Water carrying these contaminants is washed off into drains and directly into nearby watercourses. As most surface water drains are connected directly to watercourses and not sewage treatment facilities, spillage of chemicals will tend to be washed into streams and rivers.

Transportation in the Powder Basin includes federal, state, county and local roadways and streets, and railroads. Highways and railways follow along stream and river channels throughout the Basin. A railway parallels the lower Burnt River for approximately 10 miles. These highways and railways constrain the natural meanders of the river and affect riparian and aquatic habitat. In addition, culverts installed at tributary stream crossings form barriers to upstream fish migration in many areas.

Development of the transportation network in the basin also has negative impacts on the watershed and water quality. Road construction commonly occurred in stream bottoms and frequently resulted in the loss of riparian vegetation, changes in the channel configuration, filling of the stream channel, and constriction of flow at bridge sites. Road corridors frequently are a source of erosion that culminates in turbidity and sedimentation in adjacent streams. This can be a significant problem when the road is located in close proximity to the stream. Road surfaces have also reduced natural infiltration of water into the soil, which is important for groundwater and spring recharge. Roads have acted to divert and concentrate surface water flow, which can exacerbate erosion and stream sedimentation problems. Maintenance of roads and railways often involves weed treatments with herbicides along right-of-ways. When roads and railways are located along rivers and streams, herbicide drift, overspray and improper application can result in contamination of surface waters.

Potential Sources of Pollution from Transportation Corridors	
Pollutant Source	**Resulting Status of Pollutant Loads**
Roadways/ Railways	• Increased sediment from improperly maintained construction practices. • Increased petroleum-based products and automotive/railroad chemicals from storm event runoff and transportation spills. • Lack of channel complexity from constrained stream movement • Potential for herbicide contamination in waters from right-of-way weed spraying. • Leaching of chemical preservatives from track and improperly disposed waste ties.

The Wallowa-Whitman National Forest contains a road network of over 6,000 miles, and is likely the largest road network in the Powder Basin. The USFS has been working on a revised Travel Management Plan for the Forest for several years. The February 2012 travel management decision was withdrawn in April 2012 and the public consultation process has resumed.

The proposed alternative of the plan called for reducing the number of roads open to travel, and to eliminate off-road vehicle travel. One of the goals of this proposal was to protect water quality, fisheries, riparian habitat and soils. Reducing the number of designated travel routes and stream crossings is intended to reduce sediment delivery to streams. Roads that are eliminated from floodplain areas will allow regeneration of riparian vegetation.

3.2.7 Invasive Plant Species

Invasive plant species are a concern throughout the Powder Basin. Many low elevation rangelands have had significant alteration of plant communities due to invasion by non-native plants. The most intense species invasions are present in the lower elevation rangelands adjacent to the Snake River especially in the vicinity of Brownlee Reservoir. Some areas in the vicinity of Huntington have plant communities which are approximately 90% non-native (**Figure 3-3)**. Common invasive species in this area include bulbous bluegrass, whitetop, cheatgrass, medusahead rye, mustard, and burr buttercup. These plant community changes are believed to have increased the frequency and intensity of wildfires as well as increasing the levels of erosion and the sedimentation of streams **(Tim Bliss, per. Comm., 2011a)**.

Figure 3-3. Upper Benson Creek watershed near Huntington, private and BLM lands dominated by the invasive species, bulbous bluegrass and whitetop, May 2010. (Powder Basin Watershed Council, 2010).

3.2.8 Mining

Approximately three-fourths of the gold produced in Oregon has come from deposits in the Blue Mountains of Northeast Oregon. This gold mining area is approximately 50 miles north-south and 100 miles east-west, extending from John Day to the Snake River. The major mining areas are located in Grant and Baker Counties with some mining in adjacent Malheur and Union Counties **(Brooks, 1968)**.

During the 1850s small groups of prospectors found placer gold deposits in stream gravels in the Burnt and John Day River valleys. In 1861, Henry Griffin, along with other prospectors from Portland, found gold in what became known as Griffin Gulch, a few miles south of present-day Baker City. In early 1862, a large mining settlement named Auburn was established nearby. By the end of 1862, Auburn had approximately 5,000-6,000 residents. A similar camp also sprang up in present-day Canyon City near the John Day River in Grant County **(Brooks, 1968)**.

Miners spread out from Auburn and Canyon City in all directions, exploiting numerous placer deposits in the region. Supplies were hauled into the area from The Dalles. Water for working the placer gravel deposits was scarce in some areas so large ditches were constructed to carry water to them. The Auburn Ditch was completed in 1863, Rye Valley Ditch in 1864, and the Sparta and Eldorado Ditches in 1873. The Sparta ditch was later used for irrigation and the Auburn Ditch was used as part of the water supply system for Baker City **(Brooks, 1968)**. Placer mining and ditch construction caused significant changes to stream hydrology and riparian vegetation that still has effects to this day.

The placer gold mining period was followed by underground mining of lode deposits as mining technology improved and transportation of heavy equipment became possible. Major lode deposits were exploited in the vicinity of Sumpter in the Upper Powder River watershed and Cornucopia in the Pine Creek watershed above Halfway. Sumpter's lode mining peaked during the years of 1896-1908 after the Sumpter Railroad was constructed. The boom was short-lived, by 1916 most of the lode mines in the Elkhorn Mountains near Sumpter were being shut down. Production the Cornucopia Mines near Halfway lasted until 1941, when the U.S. Government shut down many mines across the country to save on labor and materials during World War II **(Brooks, 1968)**. Most of the lode mines in the region have been abandoned since that time. However, recent high gold prices have sparked renewed interest in gold mining.

Historic gold lode mining has caused significant impacts to watersheds in the Powder Basin. Many trees were harvested to supply the mines and towns with building materials and fuel, mill tailings were discharged to streams, and stream channels were altered. A discussion of investigations of mining-related metals contamination of streams in the upper Powder River Basin is included in **Section 4.3.9** of this report.

Large-scale exploitation of placer gold deposits in stream gravel materials continued well into the 20th century with the use of dredge machinery. The first successful large-scale bucket line dredge in Eastern Oregon began operation in the Sumpter Valley in 1913. Other bucket line and drag line dredges were operated in the Powder Basin on the Burnt River near Whitney and Clarks Creek and Burnt River near Bridgeport. Similar dredges were also operated in the John Day basin **(Brooks, 1968)**.

The Sumpter Valley dredge area was by far the largest operation in the region. Dredging occurred on approximately 2,000 acres between 1913 and 1954 **(Figure 3-4)**. Dredging involved excavation of the valley sediments, separation by size of material, and washing of finer sands and gravels to recover gold. The valley sediments were left in inverted piles, with the fine soil materials at the bottom and coarse materials (boulders and cobbles and gravel) on top. The dredge worked its way back and forth across the valley leaving alternating channels filled with groundwater and windrows of dredged materials **(Figure 3-5)**. Smaller scale placer mines and suction dredge operations are still in operation in the Sumpter area as well as other areas of the Burnt and John Day watersheds.

Oregon Watershed Enhancement Board (OWEB) technical assistance funds were used by the Powder Basin Watershed Council to contract a Light Detection and Ranging (LIDAR) flight over the Sumpter Valley dredge tailings (~2,000 acres). LIDAR is an optical remotsensing technology which can generate detailed 3-dimension images of the land surface. The topographical information from this flight will be compiled and interpreted, summarized and prioritized to draft a floodplain needs-based action plan. This plan will be used by the Baker County Parks and Recreation Department to manage the biological and social needs of this area. It will also be used by other private and government stakeholders, e.g. USFS, ODF&W, USBR, Powder Basin Watershed Council, etc. in collaboration to restore the floodplain to the highest level of ecological functioning possible within economic constraints.

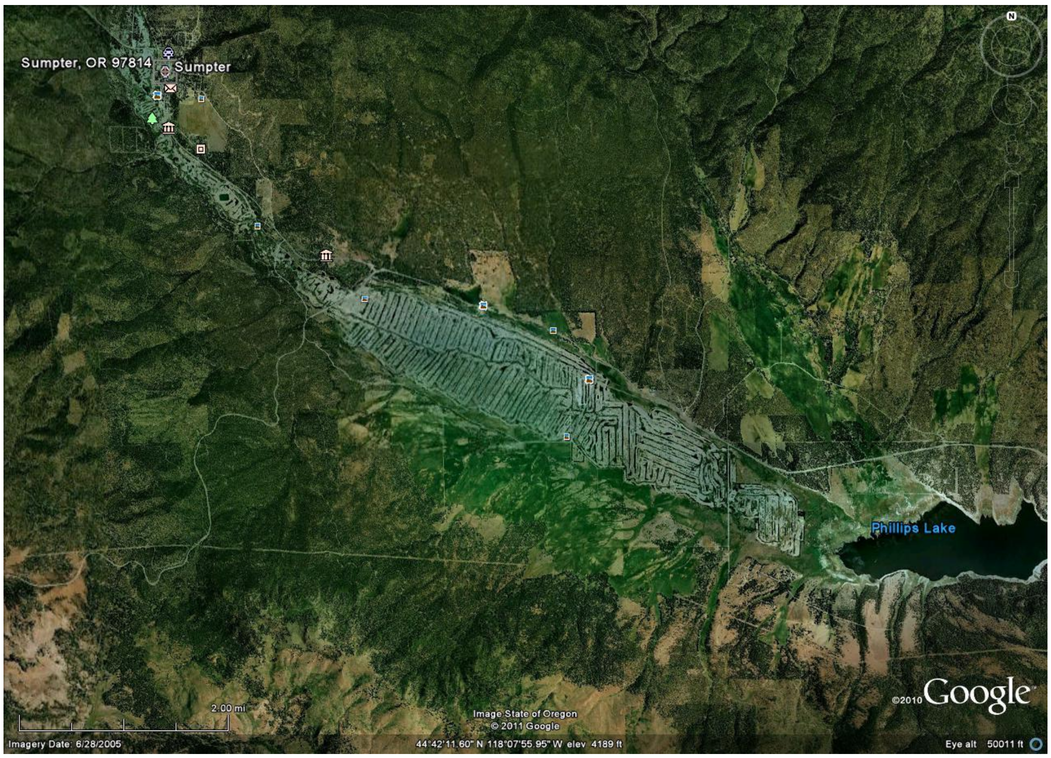


Figure 3-4. Sumpter Valley dredge mining area (2005)

Figure 3-5. LIDAR aerial photograph of Sumpter Valley floodplain restoration site showing ponds and rows of gravel deposits created by dredging (Powder Basin Watershed Council 2011).

3.2.9 Landslides/Stream Channel Stability

One of the primary chronic and most devastating geologic hazards in Oregon is landslides. As population growth continues to expand and development into increased landslide susceptible terrain occurs, greater losses are likely to result.

In order to improve our understanding of the landslide hazard in Oregon the Statewide Landslide Information Database of Oregon (SLIDO) was created by the Oregon Department of Geology and Mineral Industries (DOGAMI). The four main objectives of this study were 1) identify previously mapped landslide deposits statewide, 2) improve the understanding of landslide hazards throughout Oregon, 3) improve the abilities of communities to begin effective landslide management and risk reduction activities, and 4) recommend future improvements and updates to the database.

The goals of SLIDO Release 2 were 1) update SLIDOr1, 2) improve historically active landslide portion of the database through review of local municipality (city or county) data, 3) compile references that have detailed data on regionally significant or typical landslides, 4) add non-spatial data related to landslides such as landslide type, activity, certainty of identification, process, estimated age, etc. in specified areas, 5) populate and convene an Oregon Framework Implementation Team (FIT) landslide element subcommittee to develop standards for the statewide landslide theme, and develop the landslide element stewardship standard. **Figure 3-6** is a map of landslide deposit areas in the Powder Basin that was produced by DOGAMI using the SLIDO database. The presence of these deposits indicate that landslides have occurred in the past and may have current slide activity.

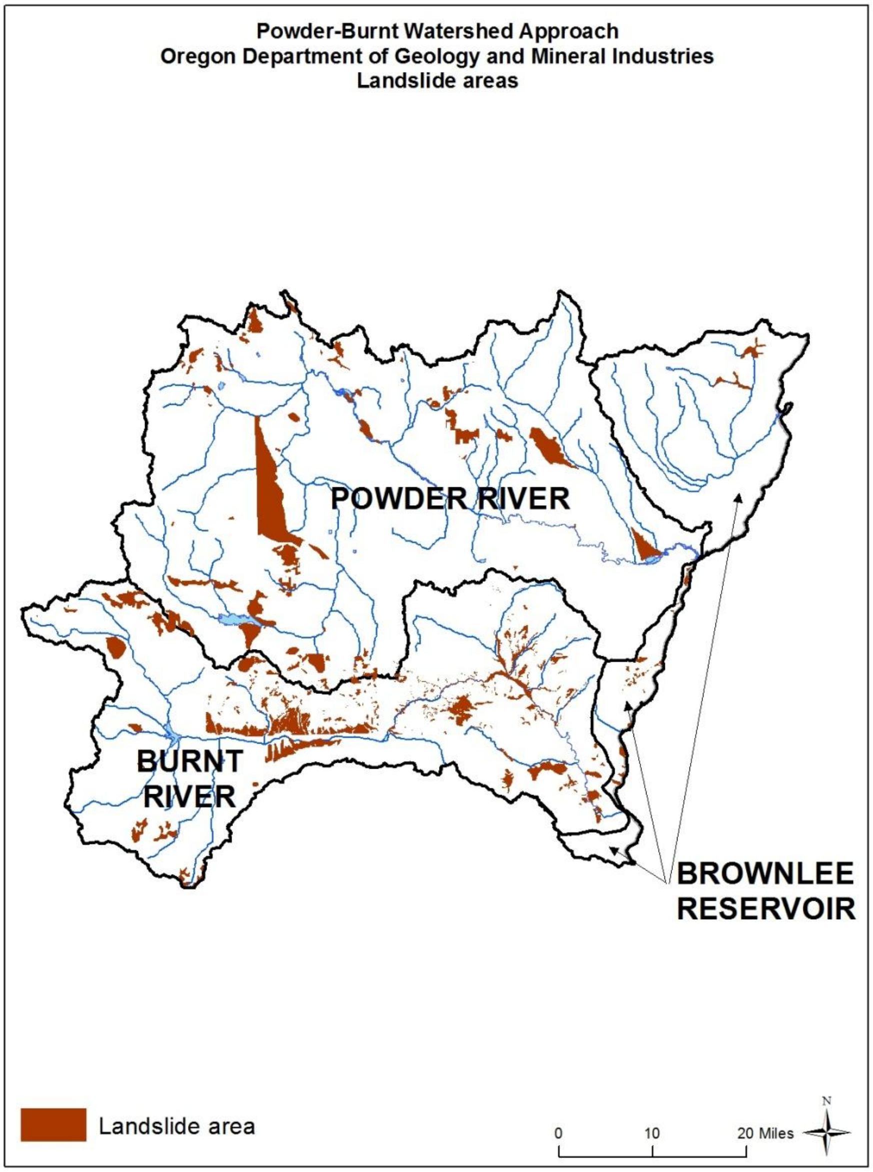


Figure 3-6. Landslide Areas in the Powder Basin (DOGAMI, 2011)

There are many historic and active landslides in the Powder Basin. Examples include one along Highway 30 near Huntington, a large slump near the National Forest trailhead on upper Eagle Creek, and several other slump features along the lower Powder River and Highway 86 near Richland **(Tim Bliss, personal comm., 2011b)**.

The area of the southern Wallowa Mountains in the Eagle Creek and Pine Creek watersheds has many recent and historic landslide events which have significantly increased the bed load in local streams. The steep terrain, and large winter snowpacks which can melt quickly during spring rain storms, make the area prime for landslides and debris flows. Flood waters move the sediment from landslides downstream into populated valleys where channels can fill with sediment and rapidly change course, causing extreme flooding and erosion problems. The City of Halfway wastewater treatment lagoons and effluent discharge line have been threatened by floodwaters from Pine Creek several times in recent years. The stream channel adjacent to the lagoon levee is being built higher (aggrading) through the deposition of sediment from flood events. The highway bridge located above the lagoons is trapping large amounts of sediment and reducing tha capacity of the channel to pass high water flows **(Figure**

3-7). Formation of a new channel through the waste water treatment plant property or the adjacent field appears to be imminent.

Figure 3-7. Highway 414 bridge located immediately upstream of the City of Halfway wastewater treatment plant. Channel under the bridge has filled with gravel and cobble stream sediment leaving only a few feet of space for passing flows in Pine Creek. (DEQ, 2010)

Figure 3-8 is a photograph of a washed out road culvert crossing on East Pine Creek, a tributary of Pine Creek above the City of Halfway, showing the erosive power of the recent floods.

Figure 3-8. Washed out culvert on East Pine Creek approximately 5 miles north of Halfway, OR. Recent floods have caused similar damage throughout the Pine Valley. (DEQ 2010)

References

Anderson E, Nilsson C, Johansson ME. 2000. Effects of river fragmentation on plant dispersal and riparian flora. *Regul River* 16(1): 83–89.

Bliss, Timothy, 2011, Powder Basin Watershed Council, Baker City, Oregon.

DEQ, 1999, Huntington NPDES Waste Discharge Permit Evaluation.

DEQ, 2000, North Powder NPDES Waste Discharge Permit Evaluation.

DEQ, 2003, Baker City NPDES Wastewater Discharge Permit Evaluation.

DEQ, 2007, Halfway NPDES Wastewater Discharge Permit Evaluation.

Baker City, 2002, City of Baker Oregon Mixing Zone Study.

Brooks, Howard, C., 1968, Gold and Silver in Oregon, State of Oregon, Department of Geology and Mineral Industries, Portland, Oregon.

Beauchamp VB, Stromberg JC. 2007. Flow regulation of the Verde River, Arizona encourages taramix recruitment but has minimal effect on populous and salix stand density. *The Society of Wetland Scientists* 27(2): 381-389.

Hughes FM. 1990. The influence of flooding regimes on forest distribution and composition in the Tana River floodplain, Kenya. *Journal of Applied Ecology* 27: 475-491.

Khangaonkar T. and Yang Z. 2008. Dynamic Response of Stream Temperatures to Boundary and Inflow Perturbation due to Reservoir Operations, *River Research and Applications*, 24(4):420-433.

Lisle TE. 1989. Channel-dynamic control on the establishment of riparian trees after large floods in northwestern California. US Forest Service General Technical Report PSW-110

Merritt DM, Cooper DJ. 2000. Riparian vegetation and channel change in response to river regulation: a comparative study of regulated and unregulated streams in the Green River Basin, USA. *Regulated Rivers: Research and Management* 16(6): 543-564.

Naiman RJ, Decamps H, McClain ME. 2005. Riparia: ecology, conservation, and management of streamside communities. Amsterdam: Elsevier. p. 212-213.

Natural Resources Conservation Service, 2006, 8-Digit Hydrologic Unit Profiles, Powder, Burnt, and Brownlee Subbasins: http://www.or.nrcs.usda.gov/technical/huc-snake.html
Nilsson C and Berggren K. 2000. Alterations of riparian ecosystems caused by river regulation. *BioScience* 50(9): 783–792.

Oregon Department of Agriculture, Agricultural Water Quality Management Area Plans, http://oregon.gov/ODA/NRD/water_agplans.shtml

Oregon Department of Environmental Quality. 2006. Assessment Methodology for Oregon's 2004/2006 Integrated Report on Water Quality Status. Accessed at: http://www.deq.state.or.us/wq/assessment/rpt0406.htm

Oregon Department of Geology and Mineral Industries (DOGAMI), 2011, SLIDO database, Portland, OR.

Powder Basin Watershed Council, 2011, Lidar Investigation of Sumpter Valley Dredge Mining Area.

Richter BD, Richter HE. 2000. Prescribing flood regimes to sustain riparian ecosystems along meandering rivers. *Conservation Biology* 14(5): 1467–1478

Rood SB, Gourley CR, Ammon EM, Heki LG, Klotz JR, Morrison ML, Mosley D, Scoppettone GG, Swanson S, Wagner PL. 2003. Flows for floodplain forests: a successful riparian restoration. *BioScience* 53(7):647-656

Rood SB, Mahoney JM. 1995. River damming and riparian cottonwoods along the Marias River, Monatna. *Rivers* 5(3): 195–207.

Rood SB, Mahoney JM. 2000. Revised instream flow regulation enables cottonwood recruitment along the St. Mary River, Alberta, Canada. *Rivers* 7(2): 109–125.

Skovlin, Jon M., Strickler, Gerald s., Peterson, Jesse L., Sampson, Arthur W., 2001, Interpreting Landscape Change in High Mountains of Northeast Oregon from Long-Term Repeat Photograghy. Gen. Tech. Rep. PNW-GTR-505. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 78 p.

Stevens M, Fenchel G, Hoag C. 2005. Plant Guide for Coyote Willow *Salix exigua* Nutt, United States Department of Agriculture, Natural Resources Conservation Service. Accessed at http://plants.usda.gov.

Stromberg JC, Patten DT, and BD. Richter. 1991. Flood flows and dynamics of Sonoran riparian forests. *Rivers* 2:221-235.

U.S. Environmental Protection Agency, 1977, Guidelines for the Pollution Classification of Great Lake Harbor Sediments. Region 5, Chicago, IL.

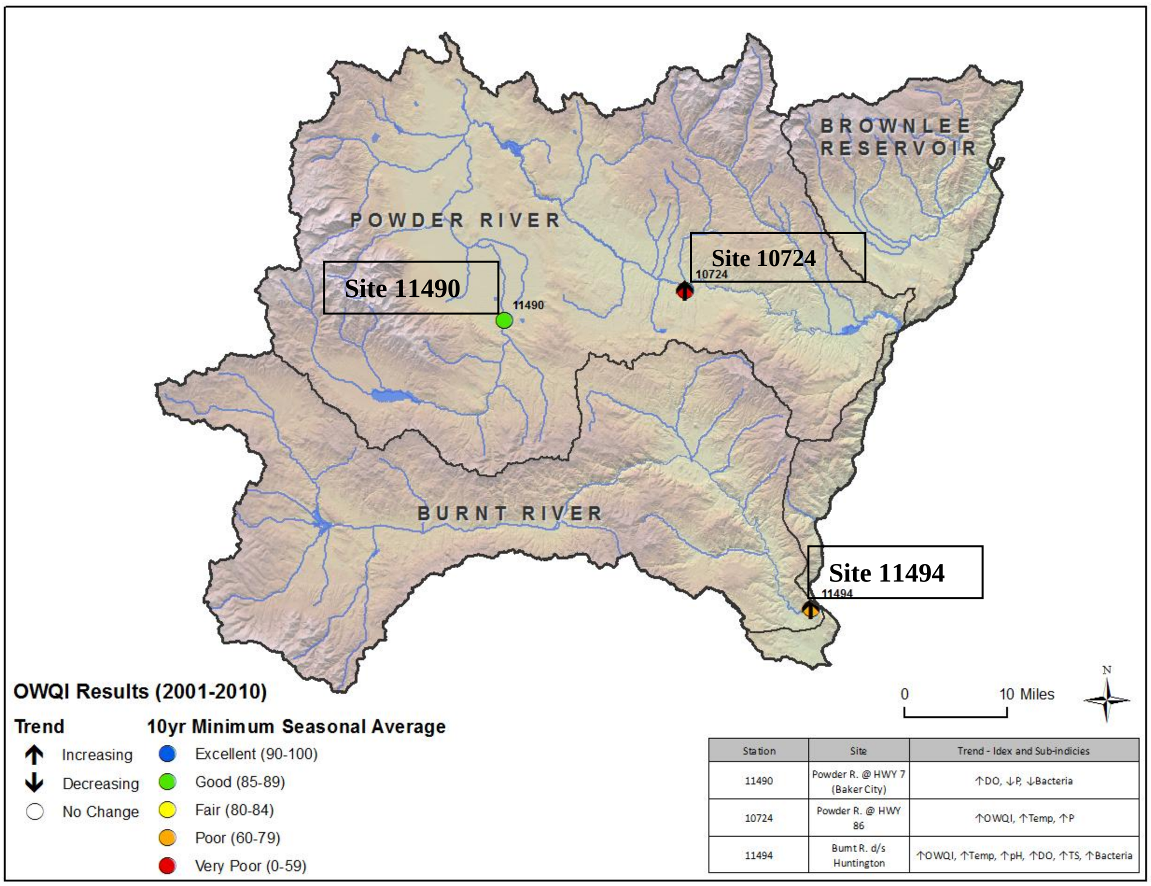
4. SURFACE WATER QUALITY STATUS AND TRENDS

4.1 Water Quality Monitoring

4.1.1 DEQ Ambient Sites

DEQ currently maintains over 100 ambient water quality sites throughout the state. These sites are generally sampled on a bi-monthly basis. Water quality results from the ambient water quality sites are used to calculate Oregon Water Quality Index (OWQI) results at each station. The water quality indices are evaluated to determine long-term water quality trends.

Three ambient water quality sites are currently being monitored in the Powder Basin. Two are located on the Powder River, site 11490 in Baker City (RM 113), and site 10724 at the lower end of the Keating Valley (RM 37). The third site (11494) is located near the mouth of the Burnt River in Huntington (RM 1.5) **(Figure 4-1)**.



Station	Site	Trend - Idex and Sub-indicies
11490	Powder R. @ HWY 7 (Baker City)	↑DO, ↓P, ↓Bacteria
10724	Powder R. @ HWY 86	↑OWQI, ↑Temp, ↑P
11494	Burnt R. d/s Huntington	↑OWQI, ↑Temp, ↑pH, ↑DO, ↑TS, ↑Bacteria

Figure 4-1. DEQ Powder Basin Ambient Water Quality Monitoring Sites/OWQI Results 2001-2010

Data from the Powder Basin ambient water quality monitoring sites, along with data from many other monitoring sites are presented in following sections of this report.

4.1.2 Oregon Water Quality Index

The Oregon Water Quality Index (OWQI) uses a defined set of water quality variables to produce a general water quality score. The water quality variables used in the OWQI are temperature, dissolved oxygen (concentration and percent saturation), biochemical oxygen demand, pH, total solids, ammonia and nitrate nitrogens, total phosphorus, and bacteria.

The data used in the OWQI calculations is gathered from a network of ambient water quality monitoring sites. These sites were selected to provide representative statewide geographical coverage, and to include major rivers and streams throughout the state. There are currently three monitoring sites in the Powder Basin **(Figure 4-1)**. Two are located in the Powder River subbasin and one is located in the Burnt River subbasin. These three sites were described previously in **Section 4.1.1**. Ambient water quality sites are generally sampled on a bi-monthly basis.

Data from the ambient water quality sites are analyzed to determine which subindices influence general water quality during various seasons. Each site is analyzed for the presence of significantly increasing or decreasing trends. The nonparametric Seasonal-Kendall test is used for trend analysis to ensure that the significant trends that exist are not due to normal seasonal variation. Significant trends are reported at the 80% or greater confidence level.

Seasonal OWQI averages are calculated for the summer season (June-September) and FWS (fall, winter, spring: October-May). The minimum of these seasonal averages at each site is used for ranking purposes and takes into account seasonal variability between different river systems. OWQI results for the period 2001-2010 are discussed below. Long term OWQI scores are presented in **Figures 4-2, 4-3, and 4-4**. More information regarding the OWQI can be found at:
http://www.deq.state.or.us/lab/wqm/wqimain.htm.

Site 11490 located on the Powder River at Highway 7 in Baker City is rated as Good water quality **(Figure 4-2)**. No trend for the OWQI was evident during the 2001-2010 time period **(Figure 4-1)**. The dissolved oxygen sub-index shows an improving trend, while phosphorus and bacteria had decreasing trends. The major drivers of impaired water quality were determined to be Biological Oxygen Demand, Total Phosphorus, and pH.

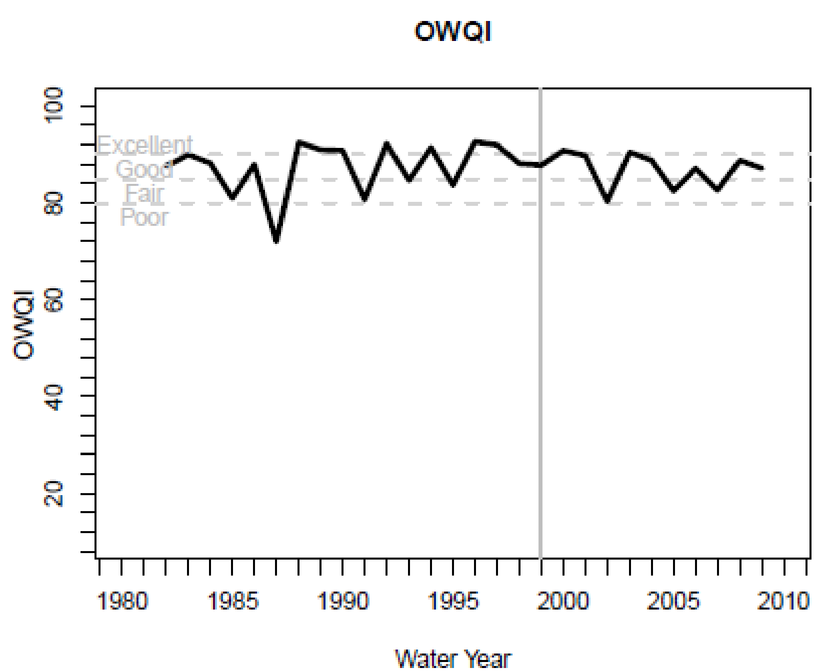


Figure 4-2. Long-Term OWQI for site 11490 on the Powder River at Hwy. 7 in Baker City, OR.

Site 10724 located on the Powder River at the Highway 86 crossing below Keating is rated as Very Poor water quality **(Figure 4-3)**. A positive trend was detected for the 2001-2010 time period **(Figure 4-1)**. The major drivers of water quality impairment at this site were determined to be Total Phosphorus and Biological Oxygen Demand. The temperature and phosphorus sub-indices show a significant improving trend during the period.

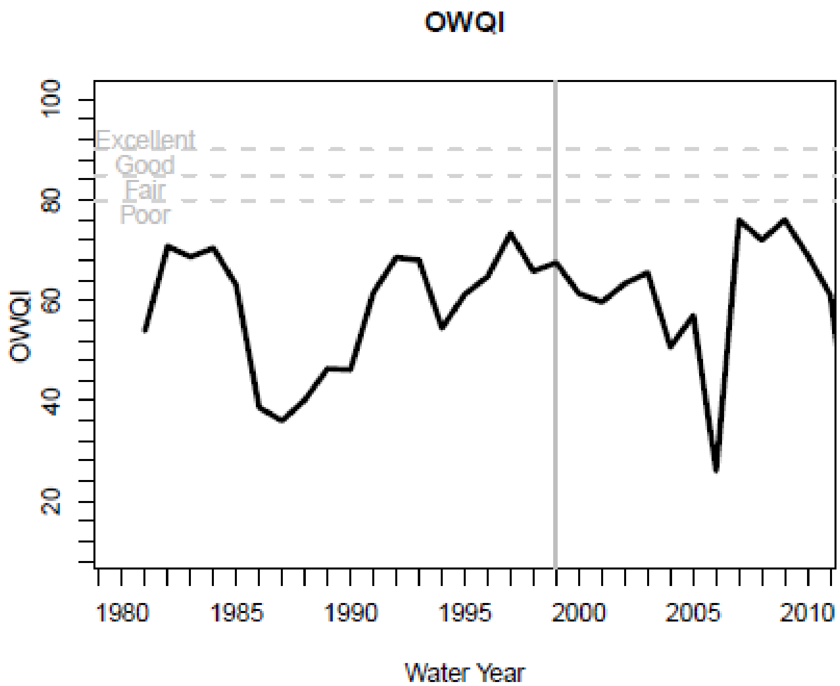


Figure 4-3: Long-Term OWQI for site 10724 on the Powder River at Hwy. 86 below Keating, OR.

Site 11494 located on the Burnt River near its mouth in Huntington is rated as Poor water quality **(Figure 4-4)**. A positive trend was observed for the 2001-2010 time period **(Figure 4-1)**. The major drivers of decreased water quality appear to be Total Phosphorus, Biological Oxygen Demand, and Temperature. Temperature, pH, dissolved oxygen, total solids, and bacteria sub-index scores had significant improving trends during the period.

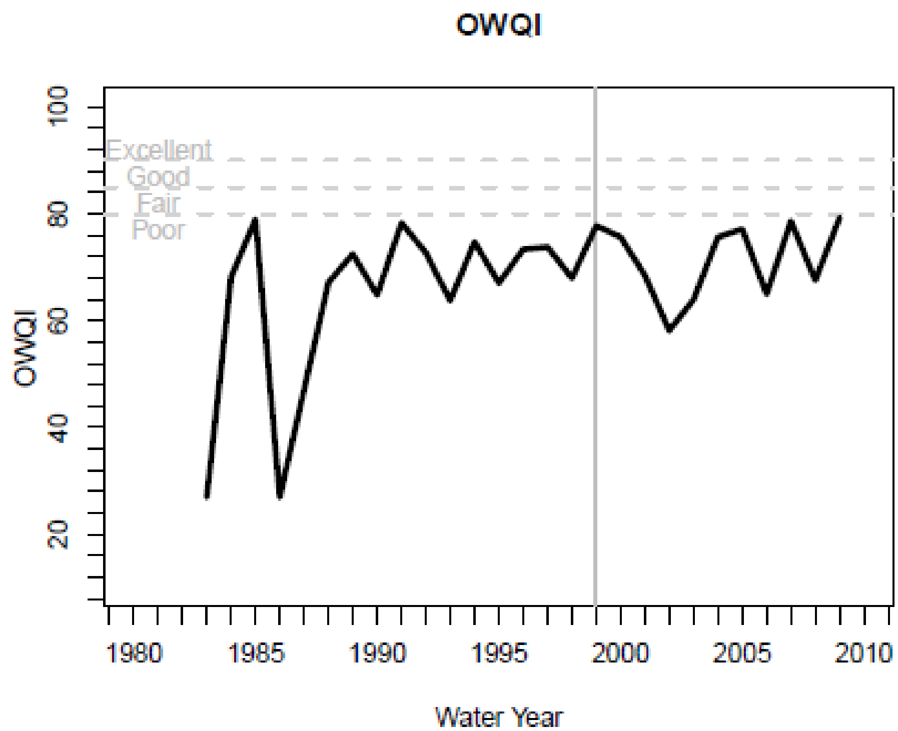


Figure 4-4. Long-Term OWQI for site 11494 on the Burnt River near Huntington, OR.

4.1.3 Flow/Temperature Monitoring Sites

The following flow and/or temperature monitoring sites have been identified in the basin **(Table 4-1)**. Numerous additional temperature monitoring sites have been maintained by the USFS and BLM. The Powder Basin Watershed Council is also planning to establish temperature monitoring sites, and Idaho Power and local irrigation districts have been working to establish flow and temperature monitoring sites. DEQ is eager to work with partners in the basin to establish more monitoring sites that will be used to support water modeling as part of TMDL development, as well as stakeholder goals such as water quality project prioritization and implementation.

Table 4-1 Powder Basin Flow/Temperature Monitoring Sites

BOR REAL TIME

Station code	Location	Lat	Long	Parameters
PRHO	Powder R above Phillips Res.	44 41 4.909	118 5 32.438	flow, air/water temp.
DRCO	Deer Cr. above Phillips Res.	44 41 30.941	118 3 50.962	flow
PHL	Powder R. below Phillips Res.	44 40 20.1	117 59 42.742	flow, air/water temp.
PWDO	Powder R. @ Baker City	44 46 6.251	117 49 54.592	flow
NPDO	Powder R. above Thief Valley Res.	45 3 24.66	117 50 31.261	flow, air/water temp.
THF	Powder R. below Thief Valley Res.	45 0 19.44	117 46 53.861	flow, air/water temp.
PRRO	Powder R. near Richland	44 46 40	117 17 30	flow
UNY	Burnt R. below Unity Dam	44 30 13.252	118 10 39.079	flow, air/water temp.

OWRD NEAR REAL TIME

13269300	NF Burnt R. near Whitney	44 36 2.0	118 15 24.994	flow
13274020	Burnt R. near Bridgeport	44 30 13.005	117 43 41.997	flow
13274400	Burnt R. above Durkee	44 34 30.992	117 32 2.992	flow
13275000	Burnt R. @ Huntington (mouth)	44 21 19.001	117 16 17.014	flow
13281200	Rock Cr. near Haines	44 54 36.162	118 3 22.781	flow
13282550	North Powder R. @ Miller Rd	45 0 46.508	118 3 12.301	flow

ID POWER

13288200	Eagle Cr. near New Bridge	44 52 50	117 15 10	flow
13288300	Eagle Cr. @ Richland (mouth)			flow
13290190	Pine Cr. near Oxbow (mouth)	44 46 40	117 17 30	flow
	Pine Cr. @ Halfway WWTP			Flow, water temp.

4.1.4 TMDL Bacteria, Nutrient and Sediment Sampling Sites

DEQ Sites

Sampling conducted by DEQ in 2007/2008 for the Powder Basin was based on the 303(d) listed parameters for bacteria and turbidity. This monitoring was planned and carried out in collaboration with the Wallowa Whitman National Forest to assist in the future development of Total Maximum Daily Loads. In this project Thief Valley Reservoir was chosen as a likely control boundary and no sampling was conducted below the reservoir.

Bacteria samples and field parameter measurements were taken at 7 sites (**Table 4-2**) in addition to one duplicate each day and one blank per week. Due to remote sample locations all bacteria samples were analyzed using the Colilert method in the DEQ Mobile lab. A minimum of 5 samples were collected in a 30-day period during 5 sampling events (April 07, June 07, August/September 07, October 07, and April 08). This schedule allowed the data to be evaluated using the 30-day log mean criteria for *E coli* bacteria.

Turbidity field measurements and TSS samples were collected from four sites on Phillips Ditch and East Fork Goose Creek **(Table 4-2)**. East Fork Goose Creek has been placed on the 303 (d) list for turbidity **(Figure 4-5)**. This sampling area is entirely in the Wallowa Whitman National Forest and was not physically accessible until May or June after the snow melt. Phillips Ditch, which potentially impacts the East Fork Goose Creek, becomes dry later in the summer months so timing sampling of this area is critical.

Additional water sample locations were developed during 2010 at a total of 10 locations in the Powder River and Burnt River subbasins **(Table 4-3)** with the intent of filling data gaps and supporting water quality modeling for the TMDL. Water samples from all 10 locations were analyzed for field parameters, bacteria, and nutrients. Bacteria samples were collected 5 times in a 30-day period during 5 sampling rounds in 2010/2011. The five samples in the Burnt River Subbasin were also analyzed for chlorophyll *a* in response to listings for dissolved oxygen and chlorophyll *a* in the Burnt River below Unity Reservoir. Continuous datasonde measurements of dissolved oxygen, pH, conductivity, and temperature were also made at two locations in this reach of the Burnt River during each sampling round.

In spring 2011, the Brownlee Reservoir site was dropped from the monitoring program and a location at the mouth of Pine Creek (Brownlee Subbasin) was added to the bacteria and nutrients sampling rounds. This sampling will continue for all sites through winter 2012. Waste water treatment plant effluent samples as well as two sample locations located upstream of waste water treatment plants and a site near the mouth of Dixie Creek (Burnt Subbasin) were also added in 2011 **(Table 4-3)**. Water samples from these locations will be analyzed for nutrients, chlorophyll and field parameters in order to support future TMDL water quality modeling efforts.

Table 4-2. DEQ Bacteria Sample Locations 2007/2008

LASAR #	SITE NAME	RM	LATITUDE	LONGITUDE	FIELD *	BACT	TURBID.	TSS
34249	Cracker Creek above Wind Creek confluence at bridge crossing	~4	44.79608 N	118.19886 W	x	x		
34250	Powder River at Huckleberry Loop Road above Phillips Reservoir Dam	138.5	44.6991 N	118.1199 W	x	x		
34251	Phillips Reservoir at USFS boat dock off Hwy. 7	~134	44.6775 N	118.0066 W	x	x		
26601	Powder River @ WRD gage below Mason Dam (Phillips Lake)	131	44.67237 N	117.99639 W	x	x		
10725	Powder River 3 mi south of Baker City	117	44.73770 N	117.83205 W	x	x		
11490	Powder River @Baker City Bridge Xing. (Amb. Site)	113	44.7819 N	117.8267W	x	x		
34252	Powder River upstream of North Powder confluence	~88	44.9822 N	117.8894 W	x	x		
34418	Phillips Ditch u/s confluence with East Fork Goose Creek	--	45.0015	117.4483			x	x
34419	East Fork Goose Creek u/s Ditch	~1.5	45.0013	117.4493			x	x
34420	East Fork Goose Creek @ mouth	0	44.9686	117.4321			x	x
34421	East Fork Goose Creek @ bridge on NFD 70	~0.02	45.9690	117.4317			x	X

Table 4-3 DEQ Bacteria/Nutrient Sample Locations 2010-2012

LASAR #	SITE NAME	RM	LAT	LONG	FIELD *	BACT	NUTRIENTS	CHLO A	CONTDS
36191	N. Powder R. @ Hwy. 30 Br.	2	45.0185	-117.9216	x	x	x		
36192	N. Powder R.@ Miller Rd. Br.	10	45.0130	-118.0540	x	x	x		
12624	Powder R. @ Deane Bidwell Rd.***	84	45.0138	-117.8839	x	x	x		
11857	Powder R. @ Snake R. Rd.	10	44.7463	-117.1718	x	x	x		
36193	Eagle Cr. @ Snake R. Rd.	0.5	44.7547	-117.1730	x	x	x		
36194	Brownlee Res. @ Hewitt Park **	7.5	44.7594	-117.1218	x	x	x		
34256	Burnt R. @ Clark Cr. Rd. Br.	45.8	44.5038	-117.7274	x	x	x	x	x
36195	Burnt R. @ Unity Res. Dam	77	44.5038	-118.1773	x	x	x	x	x
36196	S. Fk Burnt R. @ Rouse Ln.Br.	1	44.4880	-118.2016	x	x	x	x	
36197	Mid. Fork Burnt R. @ Rice Road Bridge	1.5	44.5073	-118.2158	x	x	x	x	
36198	W.Fk. Burnt R.@ Rice Rd Br.	2.5	44.5268	-118.2230	x	x	x	x	
36382	Pine Cr. @ Hwy. 71 near mouth***	0.1	44.9718	-116.8563	x	x	x	x	
12617	Baker City WWTP Effluent***	--	44.81708	-117.828528	x		x	x	
12627	N. Powder WWTP Effluent***	--	45.03472	-117.90078	x		x	x	
19918	Halfway WWTP Effluent***	--	44.08765	-117.10018	x		x	x	
36383	Pine Cr. @ Hwy. 414, Halfway, OR***	19.7	44.8773	-117.0992	x		x	x	
31914	Huntington WWTP Effluent***	--	44.35652	-117.25549	x		x	x	
36385	Burnt R. @ Hwy. 30 u/s of Huntington, OR***	3.5	44.3627	-117.3302	x		x	x	
36384	Dixie Cr. @ Hwy. 30***	0.1	44.4456	-117.7274	x		x	x	

***Dissolve Oxygen, pH, temperature, conductivity**
****sampled in 2010/winter 2011 only**
*****added to sampling network in 2011**

Monitoring Conducted by Powder Basin Stakeholder Groups

The Powder Basin Watershed Council (PBWC) received a 319 grant in 2011/2012 which has been used to hire a monitoring coordinator and develop a local volunteer-based monitoring program in the Powder Basin beginning in the Spring of 2013. Monitoring will include temperature, dissolved oxygen, pH, conductivity, and turbidity in the first year. Nutrients and bacteria will be added in the second year. BLM is also proposed to monitor nutrients and bacteria in a 2012 319 proposal. Local SWCDs have conducted water quality monitoring in the past and may consider participating in monitoring again. A Powder Basin Monitoring Workgroup composed of diverse stakeholders in the basin is starting to form and could be and excellent way to pool limited resources for water quality monitoring.

4.1.5 Biomonitoring Sites

A search of the DEQ LASAR database resulted in the recovery of macroinvertebrate (aquatic insect) sampling results from 15 locations in the Powder Basin **(Table 4-4)**. Macroinvertebrate samples were collected from sites on smaller wadeable streams from 2000-2002. The results of these sampling efforts are presented in **Section 4.3.11**. According to DEQ monitoring staff, the macroinvertebrate sample size is quite small, and sites were chosen as parts of various different projects with no real intent to characterize the Powder Basin as a whole. At this point in time, DEQ has little understanding of the level of support for the Fish and Aquatic Life beneficial use at the basin scale. The status of this beneficial use should be considered as a “data gap”.

Table 4-4: DEQ Powder Basin Marcroinvertebrate Sample locations 2000-2002

LASAR #	Longitude	Latitude	Sample Date	Stream
24043	-117.191580	45.024670	8/16/2000	E. Pine Cr.
24047	-118.103430	44.886390	8/17/2000	Rock Cr.
24423	-117.367860	44.447850	8/15/2000	Dixie Cr.
25389	-117.424250	44.898480	7/11/2001	Sawmill Cr.
26954	-117.514130	44.429700	7/18/2002	SF Dixie Cr.
26966	-117.318930	45.158490	9/13/2002	EF Eagle Cr.
35628	-118.244650	44.826080	8/1/2000	Silver Cr.
35809	-118.126000	44.959000	8/23/2001	Dutch Flat Cr.
35810	-117.440000	45.041000	7/2/2002	Eagle Cr.
35817	-118.327000	44.402000	8/21/2001	Elk Cr.
35829	-118.283000	44.513000	8/17/2000	MF Burnt R.
35831	-116.896000	45.087000	8/7/2000	Pine Cr.
35878	-117.170000	44.999000	7/5/2002	Meadow Cr.
35879	-117.108000	44.945000	7/4/2002	E. Pine Cr.
35880	-116.950000	45.078000	7/6/2002	Duck Cr.

4.2 Water Quality Limited Streams

Section 303(d) of the federal Clean Water Act requires each state to develop a list of waterbodies that do not meet water quality standards, and submit this list to the U.S. Environmental Protection Agency. The list is updated every two years. Streams segments in the Powder Basin listed as Water Quality Limited on the 303(d) list for 2010 are presented by subbasin in **Table 4-4**. These listings are also presented in the following section **Figure 4-5** (Bacteria, Turbidity and Sedimentation), **Figure 4-6** (Chlorophyll a and Dissolved Oxygen), and **Figure 4-7** (Temperature).

Table 4-4. Water Quality Limited Streams in the Powder Basin (DEQ, 2010)

Brownlee Reservoir Subbasin

Record ID	Waterbody Name	River Mile	Parameter	Season	Criteria	List Date	Listing Status
3871	Aspen Creek	0 to 1.6	Temperature	Summer	10.0^{o}C*	1998	303(d) List
3875	Beecher Creek	0 to 2.4	Temperature	Summer	17.8^{o}C**	1998	303(d) List
3872	Big Elk Creek	0 to 2.1	Temperature	Summer	10.0^{o}C*	1998	303(d) List
3532	Clear Creek	0 to 8.7	Temperature	Summer	10.0^{o}C*	1998	303(d) List
3543	East Pine Creek	0 to 12.2	Temperature	Summer	17.8^{o}C**	1998	303(d) List
3544	East Pine Creek	12.2 to 18.7	Temperature	Summer	10.0^{o}C*	1998	303(d) List
3873	Elk Creek	0 to 9.5	Temperature	Summer	10.0^{o}C*	1998	303(d) List
3539	Lake Fork	0 to 10.4	Temperature	Summer	17.8^{o}C**	1998	303(d) List
3467	Meadow Creek	0 to 3.3	Temperature	Summer	10.0^{o}C*	1998	303(d) List
12549	Morgan Creek	0 to 6.1	Temperature	Year Around	20.0^{o}C	2004	303(d) List
3542	Okanogan Creek	0 to 1.3	Temperature	Summer	17.8^{o}C**	1998	303(d) List
12534	Pine Creek	0 to 30.2	Temperature	Year Around	20.0^{o}C	2004	303(d) List
12542	Quicksand Creek	0 to 3.6	Temperature	Year Around	20.0^{o}C	2004	303(d) List
3879	Trail Creek	0 to 1.6	Temperature	Summer	10.0^{o}C*	1998	303(d) List

*Bull Trout spawning and rearing criterion of 12^{o}C currently applies.
**Redband Trout criterion of 20^{o}C currently applies.

Burnt River Subbasin

Record ID	Waterbody Name	River Mile	Parameter	Season	Criteria	List Date	Listing Status
12573	Auburn Creek	0 to 6.6	Temperature	Year Around	20.0°C	2004	303(d) List
3849	Burnt River	45.1 to 77.3	Chlorophyll a	Summer	0.015mg/l*	1998	303(d) List
20847	Burnt River	0 to 77.9	Dissolved Oxygen	January 1 to May 15	11.0mg/l** 95% sat	2004	303(d) List
13675	Burnt River	0 to 45.1	E Coli	Summer	126/406 org/100ml	2004	303(d) List
12550	Burnt River	0 to 77.9	Temperature	Year Around	20.0°C	2004	303(d) List
3829	Camp Creek	0 to 6.9	Sedimentation	Undefined	High embed.	1998	303(d) List
3451	China Creek	0 to 7.7	Temperature	Summer	17.8°C***	1998	303(d) List
12572	Clarks Creek	0 to 8	Temperature	Year Around	20.0°C	2004	303(d) List
12568	Cottonwood Creek	0 to 5	Temperature	Year Around	20.0°C	2004	303(d) List
12569	Dark Canyon	0 to 5.9	Temperature	Year Around	20.0°C	2004	303(d) List
12551	Dixie Creek	0 to 6.9	Temperature	Year Around	20.0°C	2004	303(d) List
3447	East Camp Creek	0 to 8	Temperature	Summer	17.8°C***	1998	303(d) List
3853	Geiser Creek	0 to 4.9	Sedimentation	Undefined	High embed.	1998	303(d) List
12559	Lawrence Creek	0 to 17.7	Temperature	Year Around	20.0°C	2004	303(d) List
3442	NF Burnt River	1.9 to 28.7	Temperature	Summer	17.8°C***	1998	303(d) List
12556	NF Dixie Creek	0 to 11.2	Temperature	Year Around	20.0°C	2004	303(d) List
3730	Patrick Creek	0 to 1.3	Sedimentation	Undefined	High embed.	1998	303(d) List
3468	Patrick Creek	0 to 1.3	Temperature	Summer	17.8°C***	1998	303(d) List
12557	SF Dixie Creek	0 to 9.6	Temperature	Year Around	20.0°C	2004	303(d) List
3856	Trout Creek	0 to 8.8	Sedimentation	Undefined	High embed.	2004	303(d) List
3477	Trout Creek	0 to 8.8	Temperature	Summer	17.8°C***	1998	303(d) List

* based on uncorrected USBR Chlorophyll a data.
**Cold Water Dissolved Oxygen criterion of 8.0 mg/l currently applies.
*** Redband Trout criterion of 20° C currently applies.

Powder River Subbasin

Record ID	Waterbody Name	River Mile	Parameter	Season	Criteria	List Date	Listing Status
3480	Anthony Creek	0 to 16	Temperature	Summer	10.0°C*	1998	303(d) List
3488	California Gulch	0 to 4.4	Temperature	Summer	17.8°C**	1998	303(d) List
3495	Dean Creek	0.4 to 5.2	Temperature	Summer	17.8°C**	1998	303(d) List
3867	East Fork Goose Creek	0 to 2.7	Turbidity	Spring/ Summer	10% increase	1998	303(d) List
3503	Elk Creek	0 to 7.7	Temperature	Summer	17.8°C**	1998	303(d) List
3507	Indian Creek	0 to 5.2	Temperature	Summer	10.0°C*	1998	303(d) List
3512	North Powder River	0 to 18.3	Temperature	Summer	17.8°C**	1998	303(d) List
3843	Powder River	115.6 to 130	Fecal Coliform	Fall/Winter/ Spring	200/400 org/100ml	1998	303(d) List
3551	Powder River	115.6 to 130	Fecal Coliform	Summer	200/400 org/100ml	1998	303(d) List
3513	Powder River	0 to 69	Temperature	Summer	17.8°C**	1998	303(d) List
3514	Powder River	71.9 to 115.6	Temperature	Summer	17.8°C**	1998	303(d) List
12554	Sawmill Creek	0 to 2.5	Temperature	Year Around	20.0°C	2004	303(d) List
3521	Silver Creek	0 to 6.1	Temperature	Summer	10.0°C*	1998	303(d) List
12578	Sutton Creek	0 to 15.9	Temperature	Year Around	20.0°C	2004	303(d) List

*Bull Trout spawning and rearing criterion of 12°C currently applies.
** Redband Trout criterion of 20°C currently applies.

4.3 Pollutant-Specific Surface Water Quality Conditions and Water Quality Standards

The following section is a summary and discussion of Powder Basin surface water quality data that are available in the DEQ LASAR database. The data are presented in maps, and various graphs and tables. Comparisons to applicable water quality standards are made and 303(d) listings are discussed. This section is intended to be a snapshot of water quality conditions in the basin based on data that was available through 2011.

4.3.1 Bacteria

There are only two stream segments listed as water quality limited for bacteria in the Powder Basin **(Figure 4-5)**. The Powder River is listed as water quality limited for bacteria from River Mile (RM) 115.6 to RM 130, which is located between Baker City and Phillips Reservoir. This listing is based on the Fecal Coliform Criteria which was in effect until 1996. The Burnt River is listed as water quality limited for bacteria from RM 0 at Huntington to RM 45.1 below Bridgeport, based on the current *E. coli* criteria. Monitoring locations for bacteria and nutrients have been added on Pine Creek for 2011 and 2012 providing the only data from the Brownlee Subbasin. Most of the other bacteria and nutrient monitoring sites will also continue to be sampled through winter 2012.

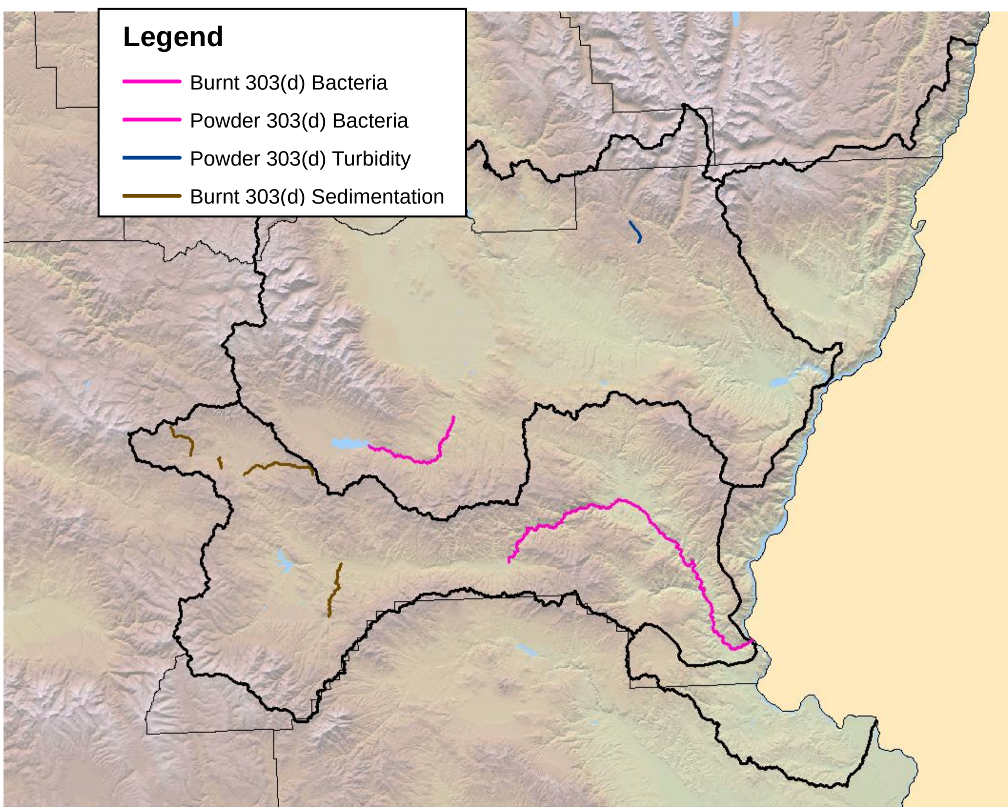


Figure 4-5. Bacteria, Sedimentation, Turbidity 303(d) Listed Streams in Powder Basin (DEQ, 2010).

Bacteria data are presented in scatter plots showing individual sample results and trend lines and box plots which show ranges of data from individual sample locations. Box plots are described in **Figure 4-6**. The rectangle shows the interquartile range (IQR); it goes from the first quartile (the 25th percentile) to the third quartile (the 75th percentile). The whiskers go from the minimum value to the maximum value unless the distance from the minimum value to the first quartile is more than 1.5 times the IQR. In that case the whisker extends out to the smallest value within 1.5 times the IQR from the first quartile. A similar rule is used for values larger than 1.5 times IQR from the third quartile. A special symbol shows the values, called outliers, which are smaller or larger than the whiskers.

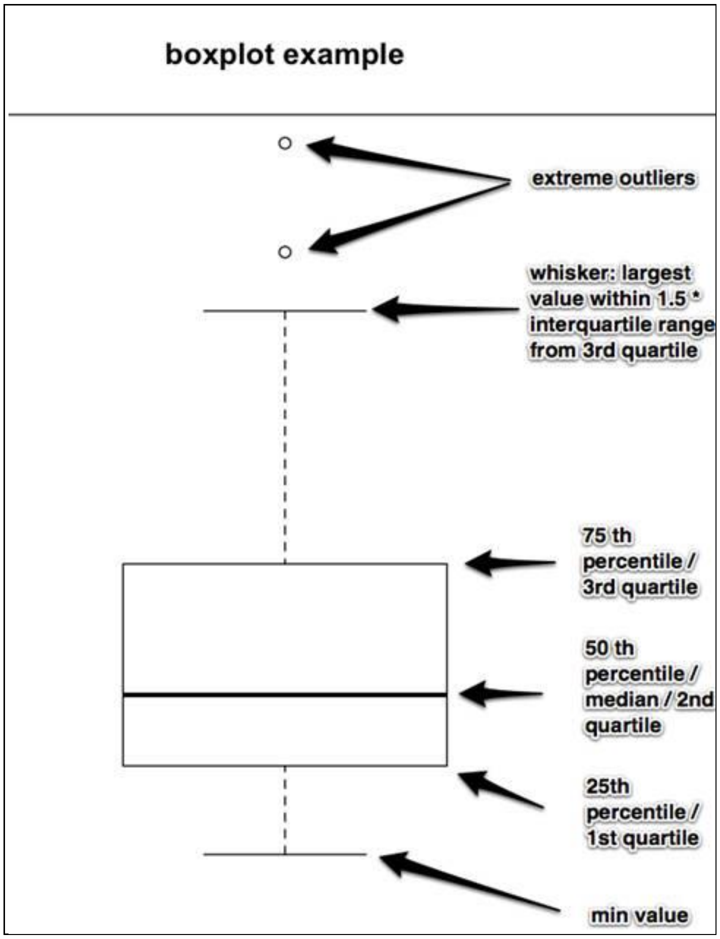


Figure 4-6. Box and whisker plot example

Figure 4-7 is a box and whisker plot of bacteria data from the three active ambient water quality stations in the Powder Basin. Samples from the Powder River ambient station located east of Baker City near Keating had the highest levels of bacteria with the median falling near the log-mean criterion of 126, however, use of the log-mean criteria requires at least 5 samples collected within a 30 day period. Some of these data do not meet that requirement but they will be divided by season and used as a surrogate for data collected in a 30-day period later in this section to determine the general distribution of bacteria concentrations in the basin. Bacteria concentrations are reported as colony forming units (CFU) per 100 milliliters (ml) of water collected in a sample.

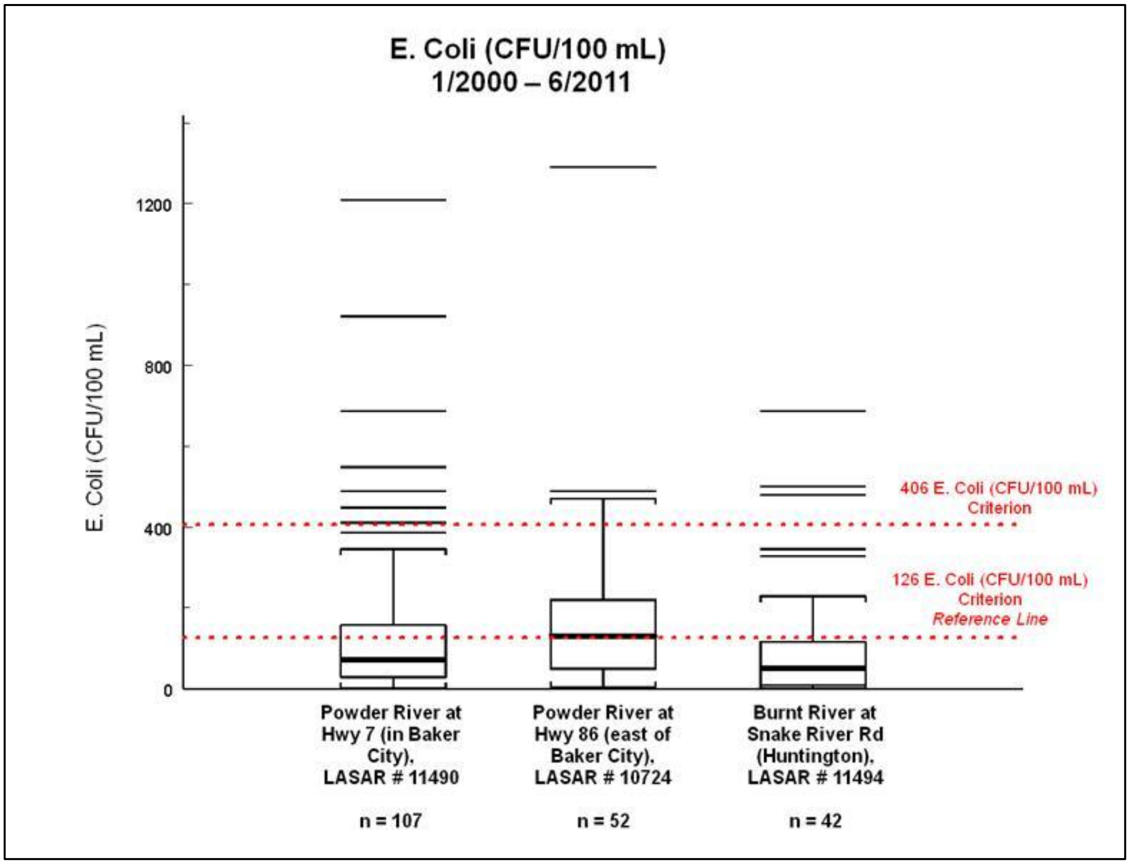


Figure 4-7. Box plot of *E. coli* bacteria data from DEQ ambient water quality monitoring locations in the Powder Basin (2000-2011). Extreme outlier concentrations are represented by horizontal lines out side of "whiskers".

Bacteria data collected at the three ambient water quality station in the basin are plotted on scatter and box and whisker plots in **Figures 4-8 through 4-13**. The scatter plots include all available E coli data for the station and include a trend line (seasonal kendall). The box and whisker plots include data from period of 2000-2011 organized by month. As mentioned previously, these data do not meet the 5 samples in a 30 day period requirement for comparison to the log-mean *E.coli* criterion. Comparisons to the log-mean criterion are informational only, and are intended to give a sense of the maginitude and frequency of the violations for the *E. coli* criteria.

The scatter plot of *E. coli* data from the Powder River site in Baker City (11490) **(Figure 4-8)** show some exceedances of the single sample criteria (406 CFU/100ml) and an increasing trend in the 1997-2011 time period. The box plot of monthly data **(Figure 4-9)** shows that the highest bacteria levels were measured in June, the only month where median values exceeded the log-mean criterion of 126 CFU/100ml.

The scatter plot data of *E. coli* data from the Powder River site located at the Highway 86 crossing east of Baker City (downstream of Keating) show a few exceedances of the single sample criteria and a decreasing trend **(Figure 4-10)**. The box plot of monthly data **(Figure 4-11)** shows that the highest concentrations were measured April through October when the median values are over the log-mean criterion of 126 CFU/100ml.

The scatter plot of *E. coli* data from the Burnt River site located downstream of Huntington **(Figure 4-12)** shows a few exceedances of the single sample criterion prior to 2003 and none after that point. *E. coli* concentrations have a decreasing trend. The box plot of monthly data **(Figure 4-13)** shows that the highest bacteria levels were measured in June, the only month where median values exceeded the log-mean criterion of 126 CFU/100ml.

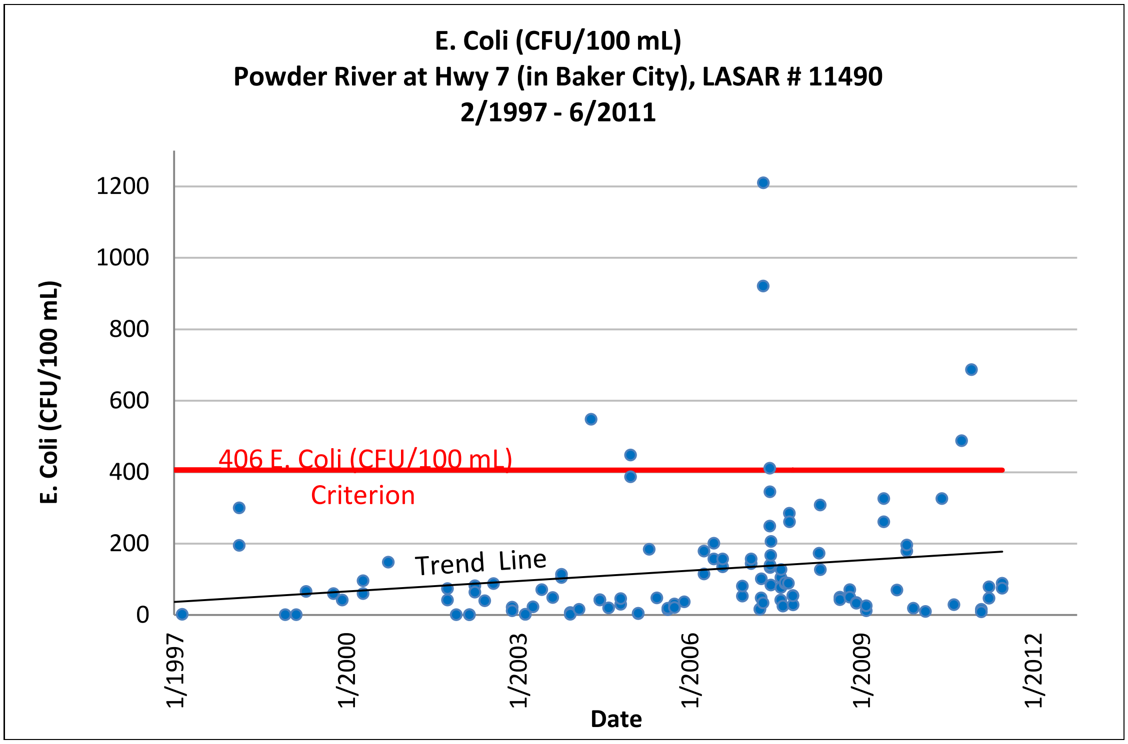


Figure 4-8. Scatter plot of *E. coli* data from ambient water quality station 11490, Powder River @ Hwy. 7 in Baker City 1997-2011

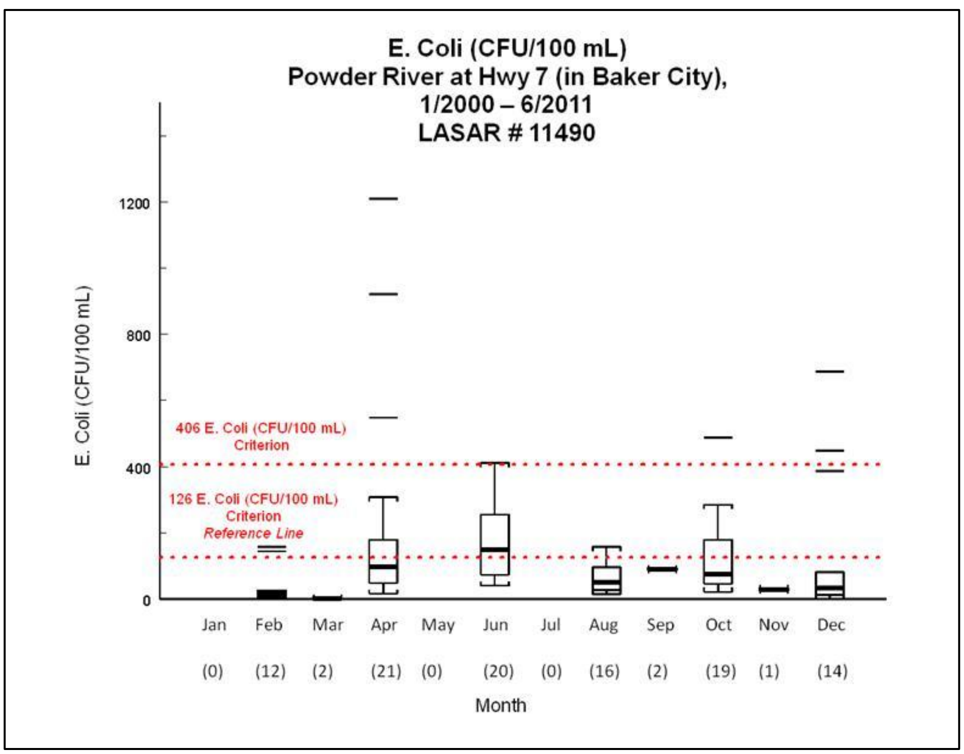


Figure 4-9. Monthly box and whisker plot of *E. coli* data from ambient water quality station

11490, Powder River @ Hwy. 7 in Baker City 2000-2011

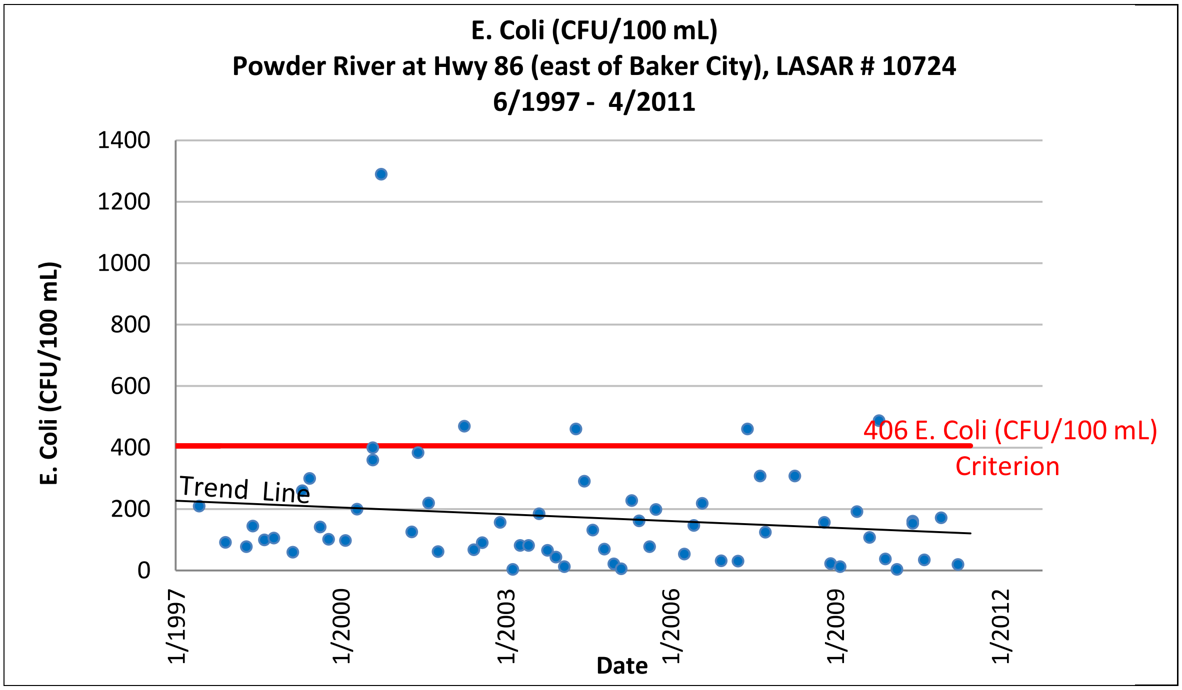


Figure 4-10. Scatter plot of *E. coli* data from ambient water quality station 10724, Powder River @ Hwy. 86 east of Baker City 1997-2011

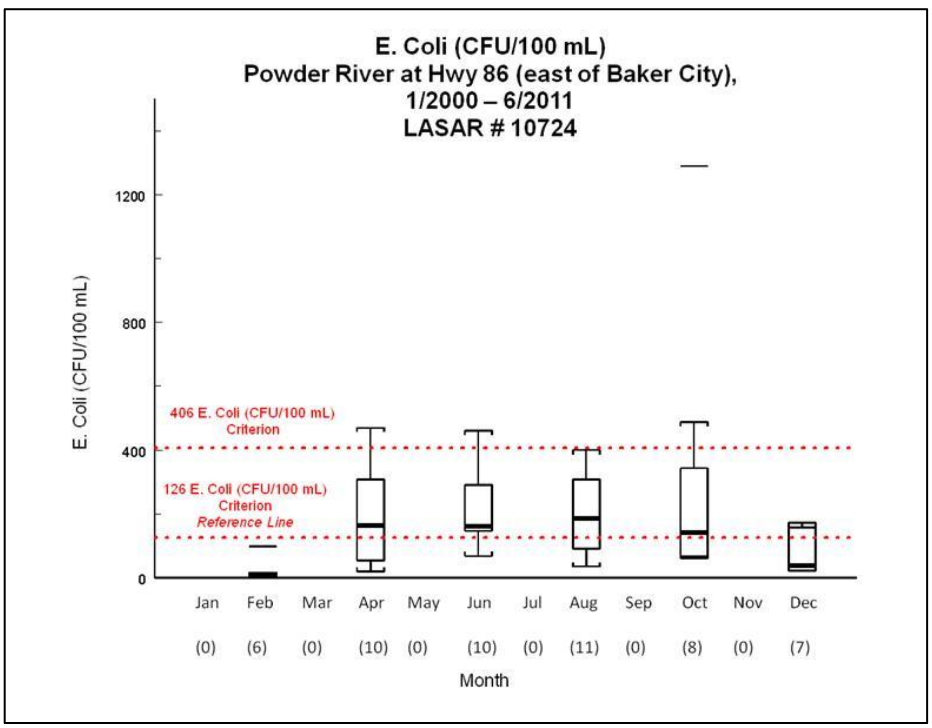


Figure 4-11. Monthly box and whisker plot of E. coli data from ambient water quality station 10724, Powder River @ Hwy. 86 east of Baker City 2000-2011

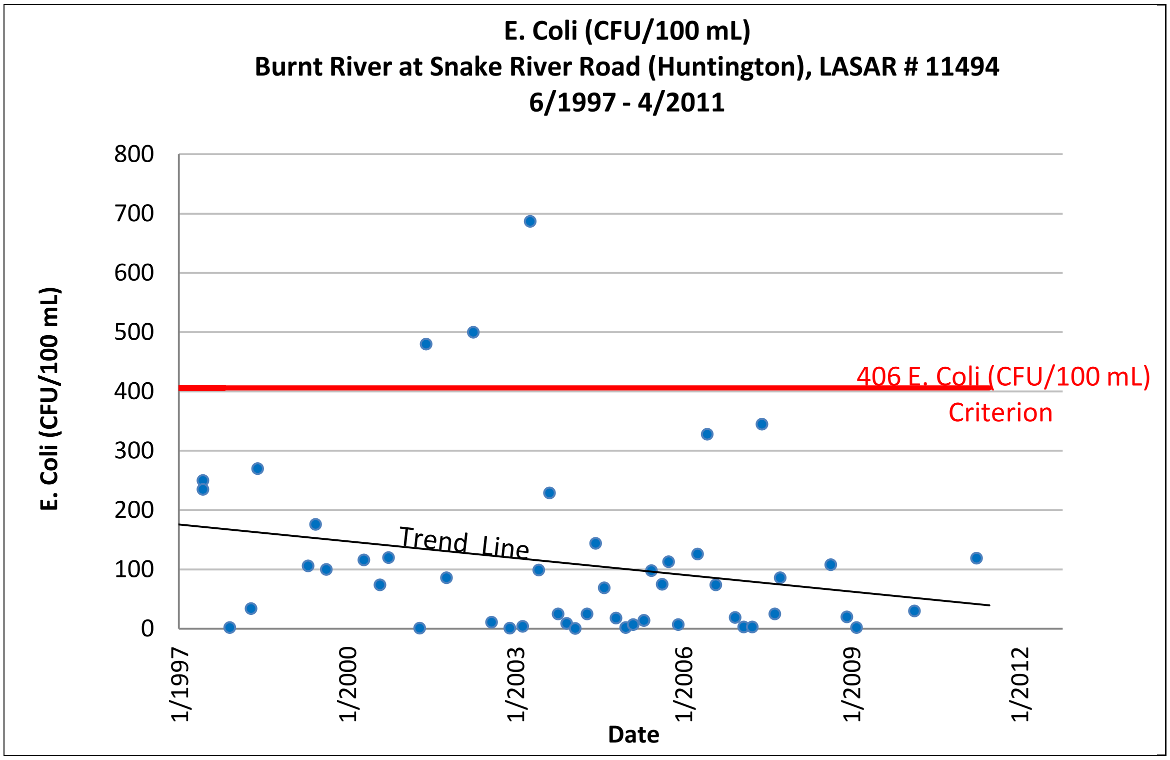


Figure 4-12. Scatter plot of *E. coli* data from ambient water quality station 11494, Burnt River @ Snake River Road, Huntington 1997-2011

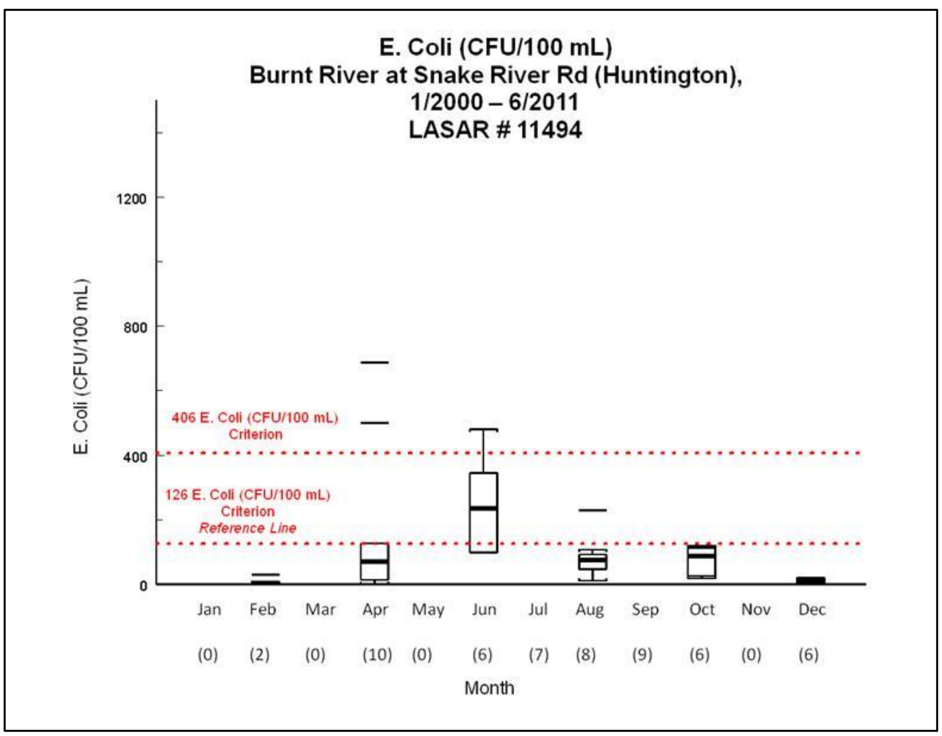


Figure 4-13. Monthly box and whisker plot of E. coli data from ambient water quality station 11494, Burnt River Snake River Road, Huntington 2000-2011

The data from recent TMDL-related sampling and long-term ambient water quality monitoring are presented in **Table 4-5 and 4-6**. They are divided by irrigation season verses non-irrigation season to give a seasonal picture of bacteria concentrations. Due to the fact that five *E.coli* samples are rarely collected within 30 days at a given sample site, values over a 6-month season can be used as a surrogate for the 30-day period in determining the log mean.

Table 4-5. Powder River Bacteria Data

			Irrigation Season 4/1-9/30				Non-irrigation Season 10/1-3/31			
Station Name	**Sample Years**	**River Mile**	**Number of Samples**	**Log Mean**	**Max.**	**%> 406**	**Number of Samples**	**Log Mean**	**Max.**	**%> 406**
Cracker Cr. abv. Wind Cr.	07	4	19	4	40	0%	5	1	2	0%
Powder R. abv. Phillips Res.	07-08	138.5	25	14	272	0%	8	6	23	0%
Powder R. blw. Phillips Res.	07-08	131	28	1	4	0%	22	1	3	0%
Powder R. South of Baker City	07-08	117	22	138	1414	14%	5	135	727	20%
Powder R. @ Baker City*	99-10	113	56	95	2420	5%	52	32	488	4%
Powder R. nr. Keating*	97-10	37	37	166	600	11%	24	54	1290	8%
Powder R. nr. N. Powder	07-08	88	21	224	1986	38%	7	30	78	0%
N. Powder R. @ Miller Rd.	10	10	16	69	2417	25%	7	380	921	71%
N. Powder R. @ Hwy. 30	10	2	16	457	1553	50%	5	525	980	80%
Eagle Cr. @ Richland	10	0.5	16	40	512	12%	5	63	236	0%
Powder R. @ Richland	10	10	17	245	1046	24%	5	123	191	0%
Powder Arm Brownlee Res.	10	7.5	25	19	517	4%	8	110	248	0%

*DEQ ambient water quality site
Data reported as organisms/100ml, non-detect results reported as 1 org./100ml, results that exceed Quantification Limit (QL) reported at QL.
Shaded results exceed WQ Criteria (log mean 126 org/100ml, single sample maximum of 406 org/100ml)

Table 4-6: Burnt River Bacteria Data

			Irrigation Season 4/1-9/30				Non-Irrigation Season 10/1-3/31			
Station Name	**Sample Dates**	**River Mile**	**Number of Samples**	**Log Mean**	**Max.**	**%> 406**	**Number of Samples**	**Log Mean**	**Max.**	**%> 406**
WF Burnt	10	2.5	18	30	1732	6%	6	63	101	0%
MF Burnt	10	1.5	15	302	2419	33%	5	64	148	0%
SF Burnt	10	1	19	1175	2420	84%	6	371	770	67%
Burnt@ Unity Dam	10	77	15	10	59	0%	6	4	11	0%
Burnt@ Clarks Cr.	10	46	15	389	1553	60%	5	316	517	40%
Burnt@ Huntington*	97-10	0	45	78	800	13%	39	9	120	0%

* DEQ Ambient Water Quality Site
Data reported as organisms/100ml, non-detect results reported as 1 org./100ml, results that exceed Quantification Limit (QL) reported at QL.
Shaded results exceed WQ Criteria (log mean 126 org/100ml, single sample maximum of 406 org/100ml)

Data from these sites located throughout the Powder Basin indicate that exceedences of bacteria criteria are much more widespread than suggested by these two listed stream segments. Exceedances of the log mean criterion of 126 organisms/100 ml, as well as the single sample maximum criterion of 406 organisms/100 ml, appear to occur year around in many areas. Irrigation season bacteria levels are generally higher than non-irrigation season levels, with the exception of the two North Powder River sites where non-irrigation season levels are higher. The TMDL that is currently being developed will address bacteria pollution in the entire basin throughout the year and will use data collected during 30 day periods.

4.3.2 Sedimentation

Portions of Camp Creek, Geiser Creek, Patrick Creek, and Trout Creek in the Burnt River Subbasin are listed as water quality limited due to sedimentation **(Figure 4-5)**. The listings are based on a watershed analysis conducted by the USFS in 1995. The stream channels were observed to have embedded gravel conditions where the space between gravel particles is filled with fine sediment. Many other stream segments in the Powder Basin were entered into the DEQ Water Quality Assessment database due to concerns about sedimentation. Most of these segments were determined to have insufficient data for a 303(d) water quality limited designation. Many were originally identified as having water quality concerns related to nonpoint source pollution in DEQ's 1988 *Assessment of NPS-Related Water Quality Problems* **(DEQ, 1988)**. The major nonpoint source water quality problems identified in this report were related to riparian vegetation removal and associated high stream temperatures, and increased erosion leading to sedimentation problems in streams.

The Snake River-Hells Canyon Sedimentation TMDL established a total suspended solids load capacity for Snake River tributaries based on a monthly average water column concentration of 50 mg/l. This allocation applies to the Powder River, Burnt River, and the Brownlee Subbasin tributaries.

4.3.3 Turbidity

A segment of the East Fork of Goose Creek in the Powder River Subbasin **(Figure 4-5)** is listed as water quality limited for turbidity. The listing is based on data collected by the USFS. This reach of stream is influenced by a discharge from an irrigation ditch with some bank erosion problems. Additional water quality sampling performed in 2007 indicated that there was a significant increase in turbidity in the lower portion of the East Fork Goose Creek during the spring. No significant increase was observed in August of 2007, however this was a drought year and water levels in the ditch and creek were low.

ODF&W has also reported turbidity problems in East Fork Goose Creek over several years **(Tim Bailey pers. Comm., 2011)**. East Fork Goose Creek has been observed in a turbid condition throughout the spring summer, and early fall, with the likely source being the lower steep and entrenched portion of the Phillips Ditch. ODF&W also reported that the presence of Interior Redband Trout has been documented in East Fork Goose Creek, and that the stream system is generally in fair to poor condition from historic and current grazing, as well as legacy mining impacts.

4.3.4 Chlorophyll *a*

The Burnt River is listed as water quality limited for chlorophyll *a* from RM 45.1 below Bridgeport, to RM 77.3 at the Unity Reservoir Dam **(Figure 4-13)**. This is the only chlorophyll listing in the Powder Basin. The listing is based on a chlorophyll *a* action level of 15µg/l. This action level is intended to be used to identify water bodies where the growth of phytoplankton may be impairing beneficial uses. The 303(d) listing was based on data collected by the USBR at the Unity Dam between 1986 and 1995 (STORET sample site BUR001). These data were not corrected for pheophytin *a*, a break-down product of dead algae, as required by DEQ protocol. The validity of this listing will be re-evaluated during development of the Powder Basin TMDL based on the data acquired by DEQ in 2010-2013.

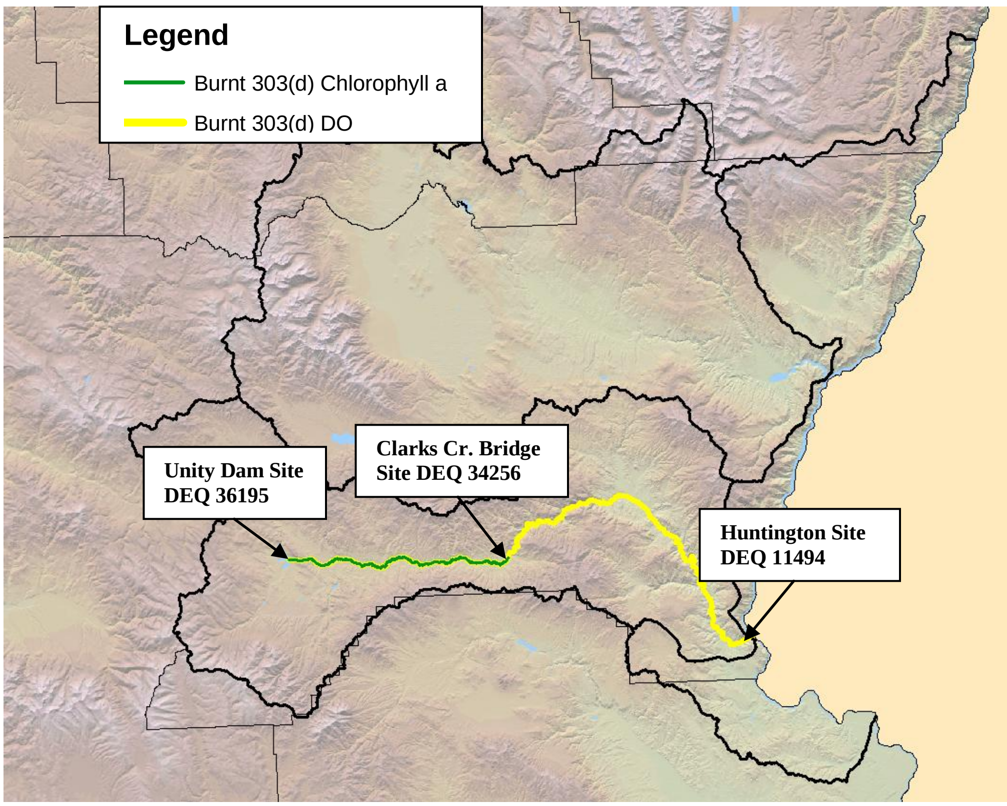


Figure 4-13. Chlorophyll *a* and Dissolved Oxygen 303(d) Listed Streams in the Powder Basin, and Burnt River sample locations (DEQ, 2010)

Additional chlorophyll a analyses were conducted using DEQ protocol on samples collected in 2010 and 2011 in this reach of the Burnt River. Continuous measurements of dissolved oxygen (DO), pH, conductivity, and temperature were also collected periodically, in order to conduct a thorough investigation of water quality conditions.

Figures 4-14 and 4-15 display the corrected chlorophyll a concentrations from samples collected in the listed reach. Water samples were collected in May, June, August, and October 2010 in the Burnt River at the outlet of Unity Dam and at the Clarks Creek Bridge, just below Bridgeport. These sample locations bracket the area of the chlorophyll *a* 303(d) listing. Water samples are also collected on a bi-monthly basis at the DEQ Ambient Water Quality site downstream in Huntington. Chlorophyll *a* analyses are generally performed on samples which are collected during the months of June, August, and October. With the exception of the sample collected at the Unity Dam location in October 2010, all chlorophyll *a* concentrations are well below the chlorophyll *a* action level of 15 ug/l. The concentration of chlorophyll a of 33 mg/l measured at the Unity Dam in October 2010 is likely the result of high algae concentrations in Unity Reservoir. This effect does not appear at the downstream sample locations.

The chlorophyll *a* action level of 15 µg/l is intended to trigger further investigation of water bodies where excess phytoplankton may impair the recognized beneficial uses. Dissolved oxygen, pH and nutrient levels are generally reviewed during this investigation. These parameters are discussed in following sections of this document.

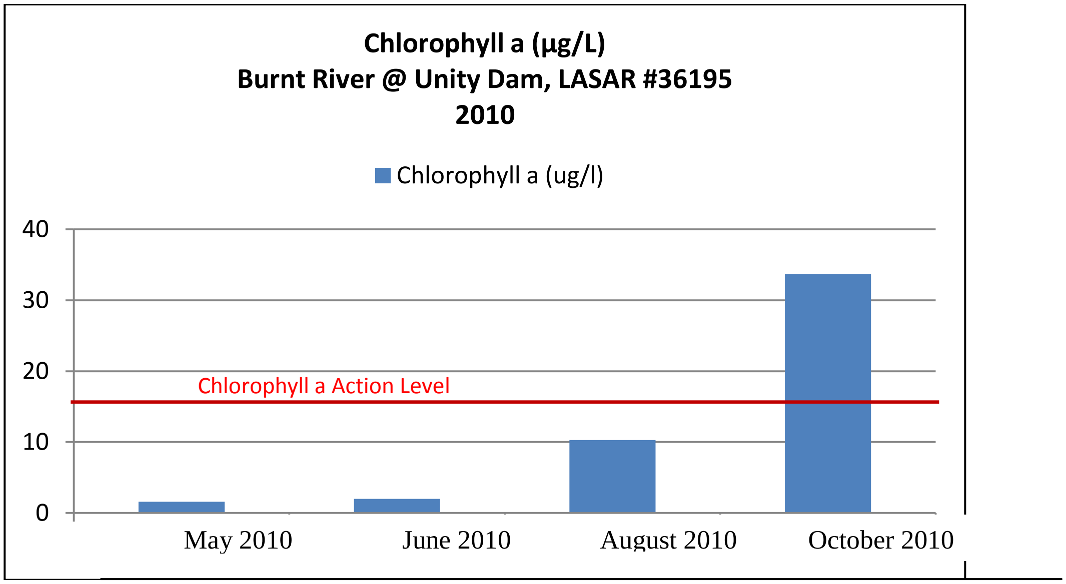


Figure 4-14. DEQ Chlorophyll *a* results (corrected for pheophytin a), Burnt River at Unity Dam, 2010

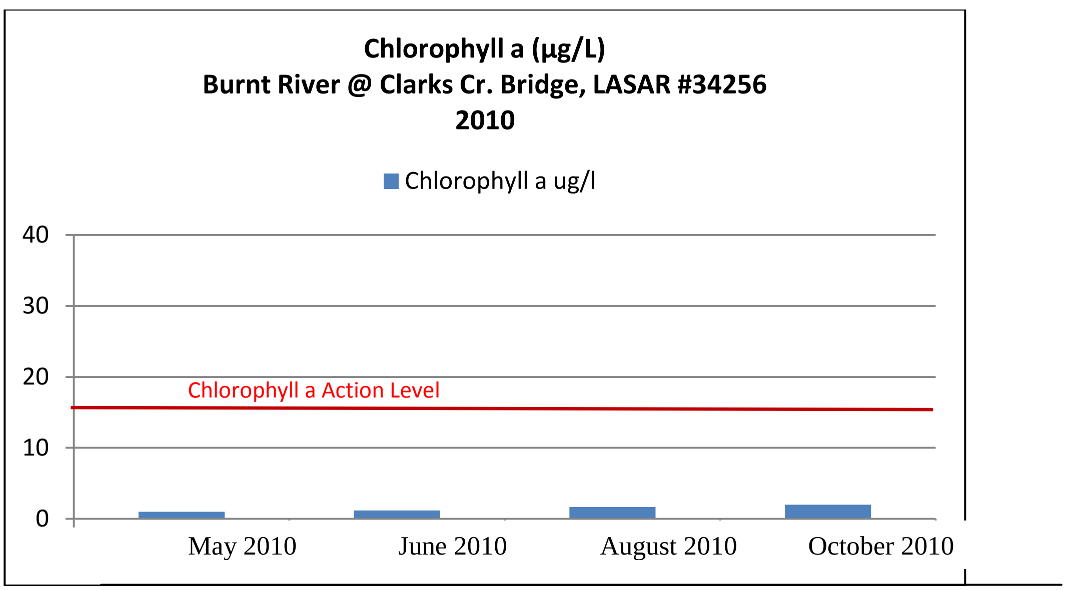


Figure 4-15. DEQ Chlorophyll *a* results (corrected for pheophytin a), Burnt River at Clarks Creek Bridge, 2010

Chlorophyll *a* data from the three DEQ ambient water quality monitoring locations on the Burnt River and Powder River are presented in **Figures 4-16, 4-17, 4-18, 4-19, 4-20, 4-21 and 4-22**. Recent chlorophyll *a* concentrations are all well below the action level of 15µg/l. Chlorophyll *a* concentrations at the Burnt river site in Hunting to are generally low, and have a slight downward trend. The chlorophyll *a* concentrations are very low (<4 µg/l) in water samples from the Baker City monitoring location, and the data show a modest upward trend. At the Hwy 86 monitoring location near Keating, chlorophyll a concentrations were between 10 µg/l and 14 µg/l a few times prior to 1999, and have been in steady decline during the period of record (1978-2011).

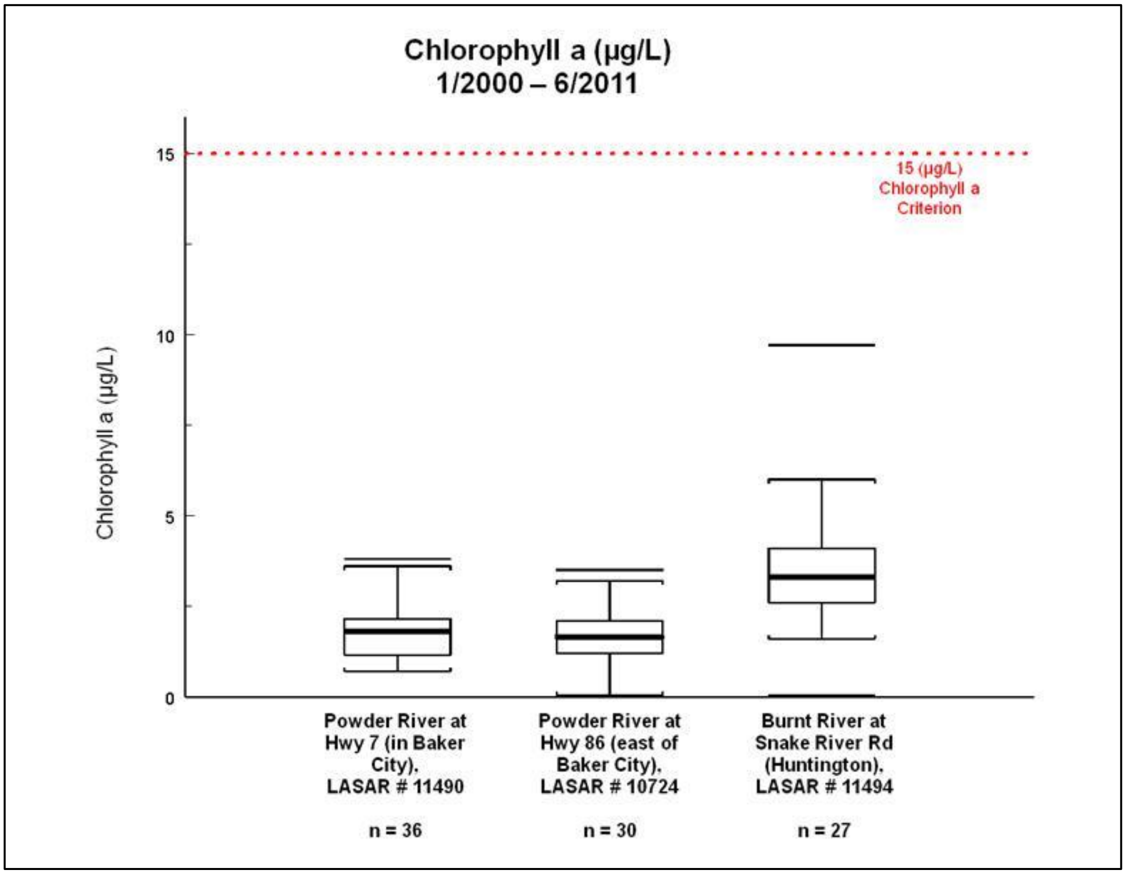


Figure 16. Box and whisker plot of Chlorophyll *a* concentrations at Powder Basin Ambient Water Quality Sites, 2000-2011

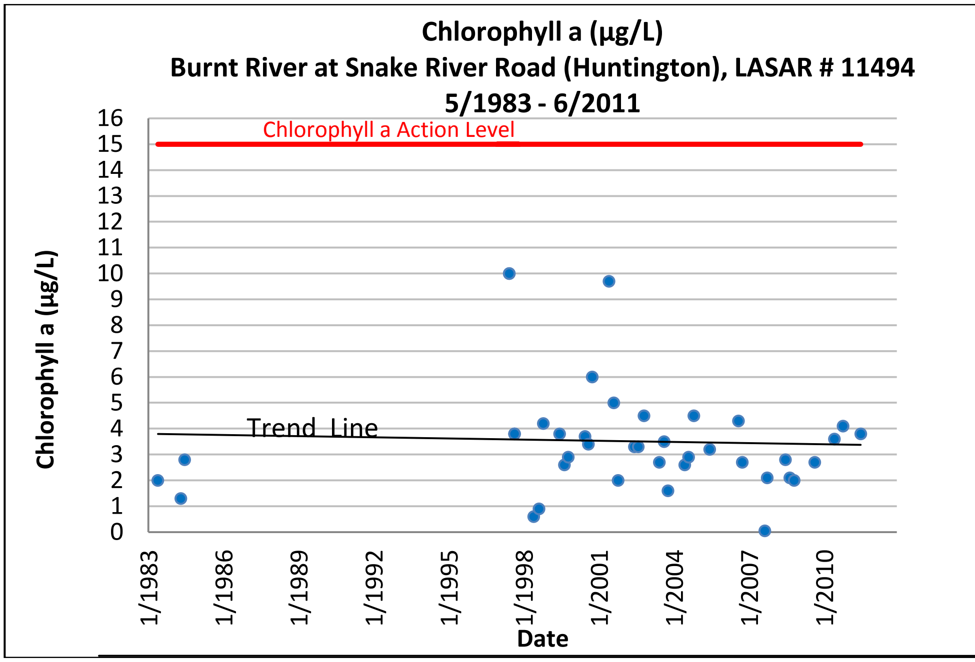


Figure 4-17. DEQ Chlorophyll *a* results (corrected for pheophytin a), Burnt River at Huntington, 1983-2011

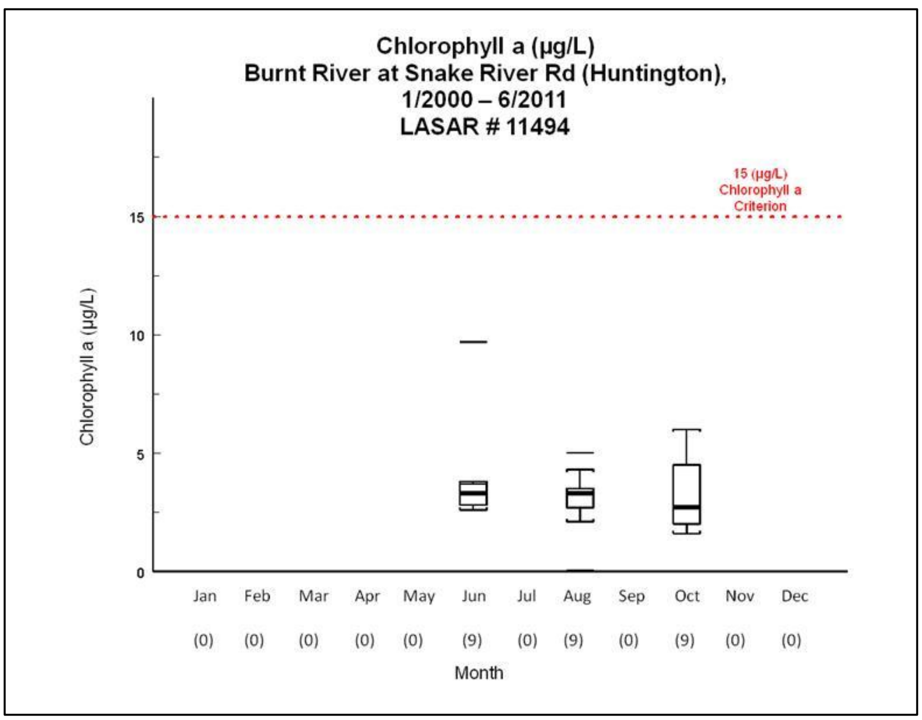


Figure 4-18. Monthly box and whisker plot of Chlorophyll *a* results (corrected for pheophytin a), Burnt River at Huntington, 2000-2011

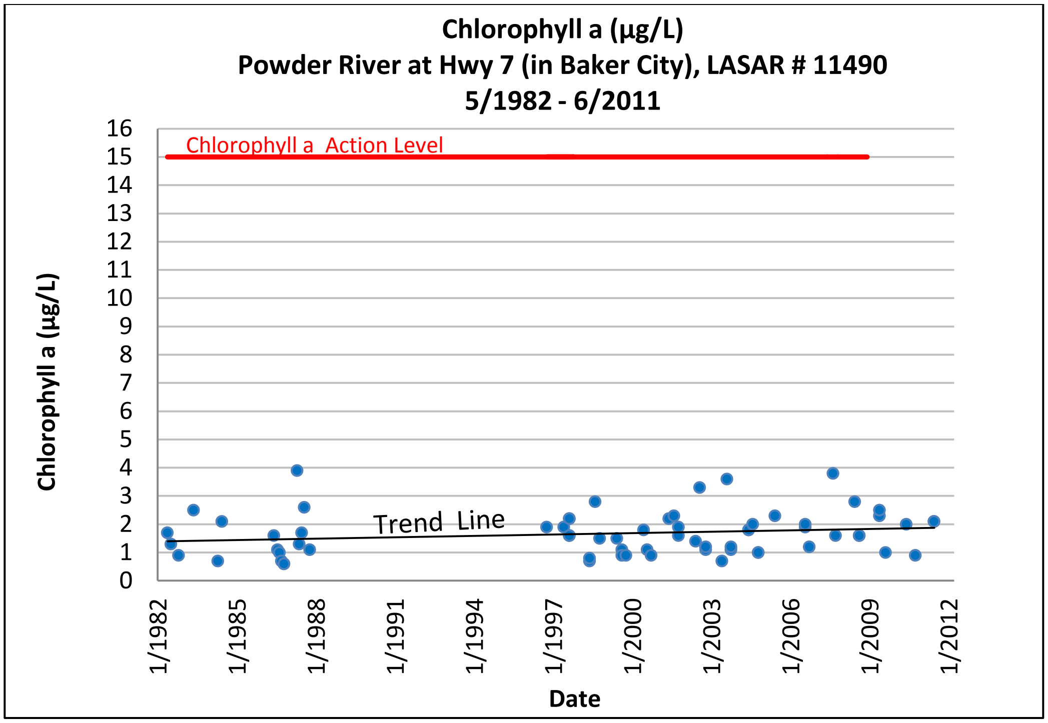


Figure 4-19. DEQ Chlorophyll *a* results (corrected for pheophytin a), Powder River at Baker City, 1982-2011

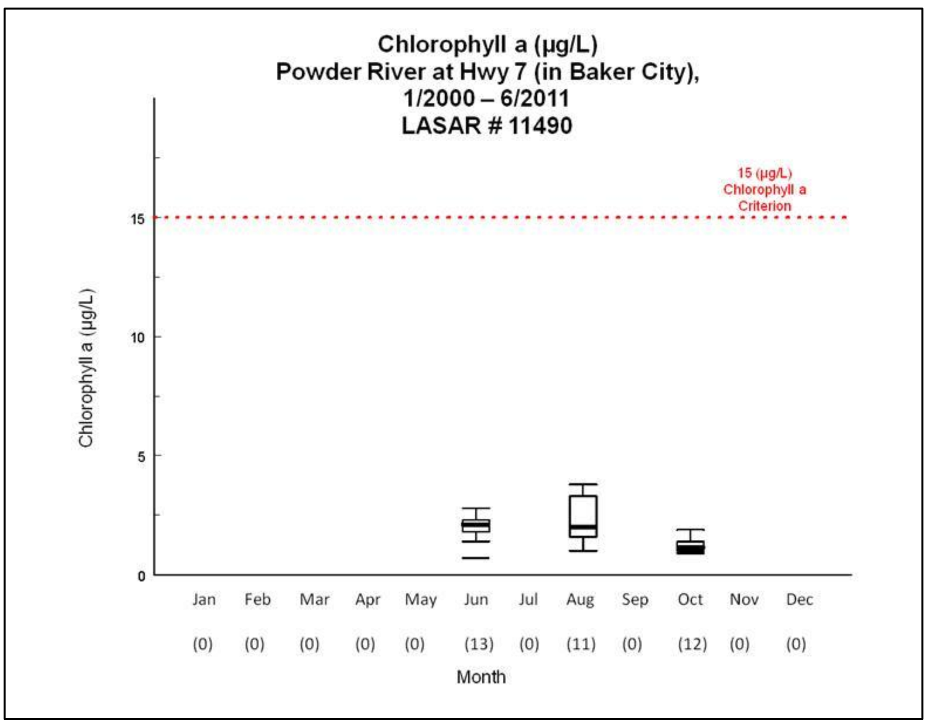


Figure 4-20. Monthly box and whisker plot of Chlorophyll *a* results (corrected for pheophytin a), Powder River at Baker City, 2000-2011

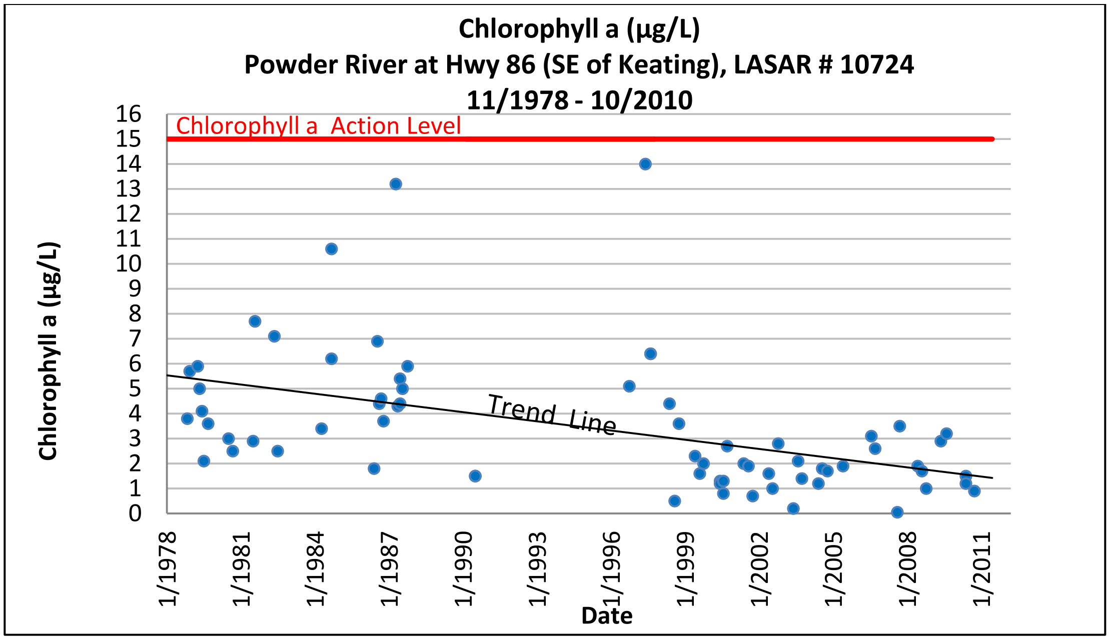


Figure 4-21. DEQ Chlorophyll *a* results (corrected for pheophytin a), Powder River SE of Keating, 1978-2010

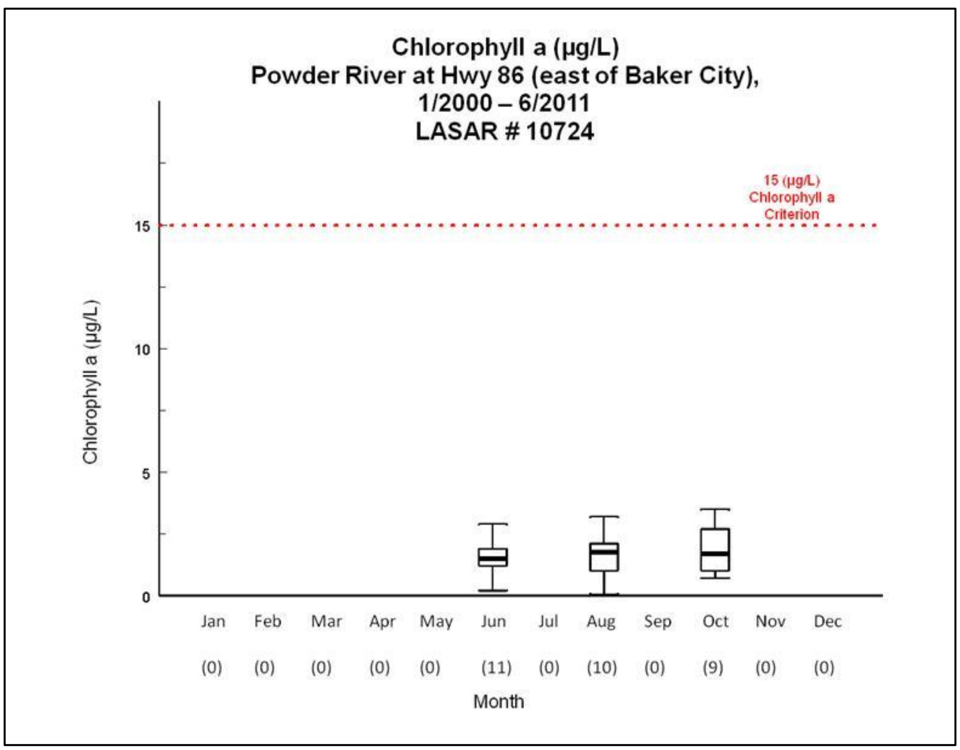


Figure 4-22. Monthly box and whisker plot of Chlorophyll *a* results (corrected for pheophytin a), Powder River SE of Keating, 2000-2011

4.3.5 Dissolved Oxygen

Most perennial streams in the Powder Basin are classified as Redband Trout habitat **(Figure 2-7)**. The cold-water aquatic life dissolved oxygen criteria applies to the higher elevation Redband Trout habitat areas of the basin. The cold-water aquatic life criterion generally requires that the dissolved oxygen level may not be less than 8.0 mg/l as an absolute minimum. *Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/l, dissolved oxygen may not be less than 90 percent of saturation. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 8.0 mg/l as a 30-day mean minimum, 6.5 mg/l as a seven-day minimum mean, and may not fall below 6.0 mg/l as an absolute minimum.*

In the lower elevation areas of major valleys, the cool-water aquatic life criteria applies. The cool-water aquatic life criterion generally requires that dissolved oxygen may not be less than 6.5 as an absolute minimum. *At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 6.5 mg/l as a 30-day mean minimum, 5.0 mg/l as a seven-day minimum mean, and may not fall below 4.0 mg/l as an absolute minimum.*

Bull Trout spawning and rearing areas are also shown on **Figure 2-7** in upper portions of the Powder, North Powder, Eagle Creek and Pine Creek watersheds. The salmonid spawning criterion for dissolved oxygen of 11.0 mg/l would apply in these areas, and would also apply seasonally (January 1 to May 15) to Redband Trout spawning areas.

Figure 4-23 is a box and whisker plot of the dissolved oxygen data from the three DEQ ambient water quality monitoring locations in the Powder Basin. The available data indicate that applicable cool water dissolved oxygen criterion of 6.5 mg/l has been met at these locations. The cold-water criterion is also shown in the graph for comparison. These data are single sample grab data and do not necessarily characterize the full daily distribution of oxygen concentrations.

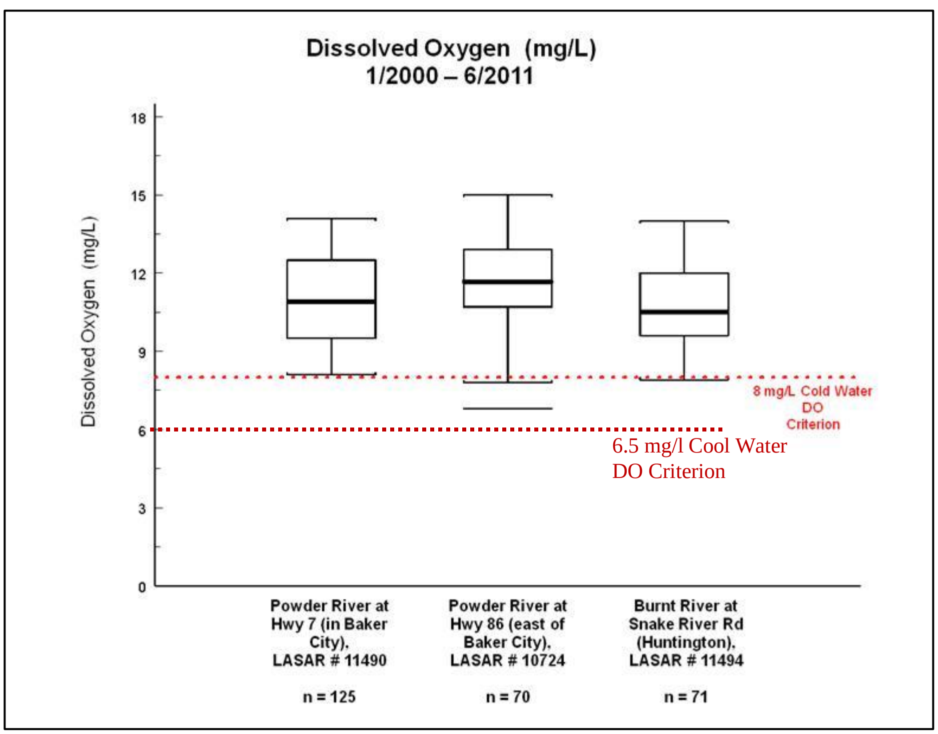


Figure 4-23. Box and whisker plot of dissolved oxygen data from the Powder Basin ambient water quality sites on the Powder and Burnt Rivers, 2000-2011.

Figures 4-24 through 4-27 are scatter and box and whisker plots of the dissolved oxygen data from the Powder River ambient water quality monitoring sites. Dissolved oxygen concentrations at the Baker City site meet the cold water criterion, but show a slightly decreasing trend **(Figure 4-24)**. The lowest values measured were in the month of August **(Figure 4-25)**. Dissolved oxygen concentrations measured at the Hwy. 86 site located east of Baker City near Keating met the cold water criterion most of the time with an increasing trend **(Figure 4-26)**. The lowest dissolved oxygen concentrations were observed in June **(Figure 4-27)**.

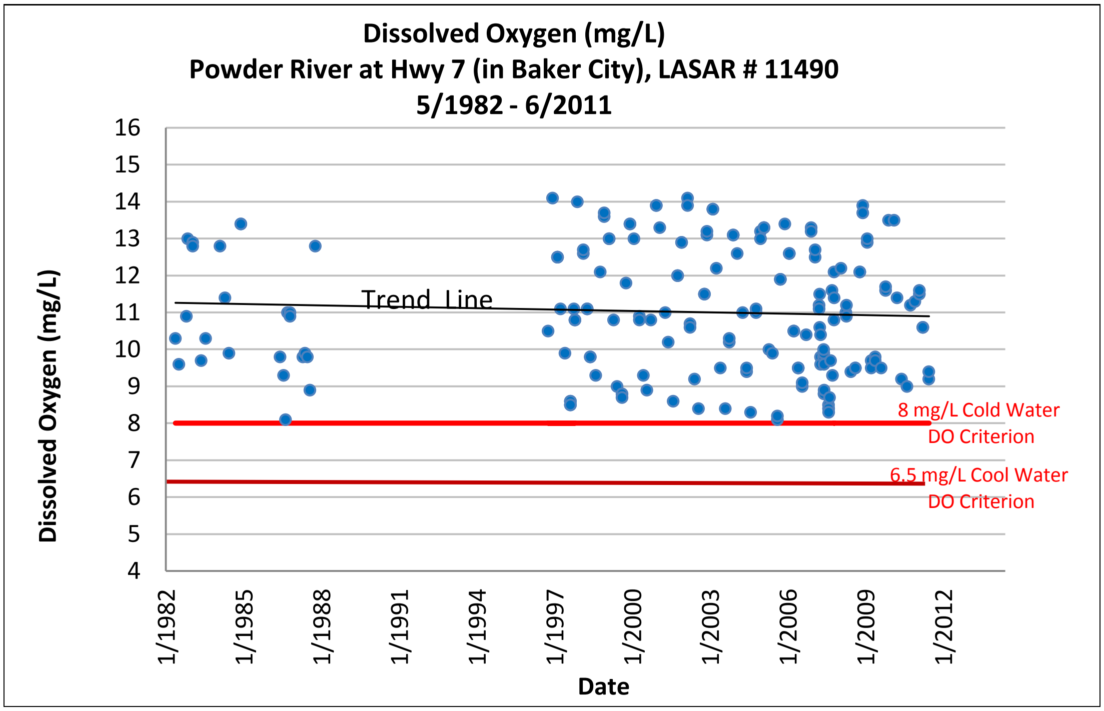


Figure 4-24. Dissolved oxygen concentrations from the Powder River at Hwy. 7 in Baker City, 1982-2011

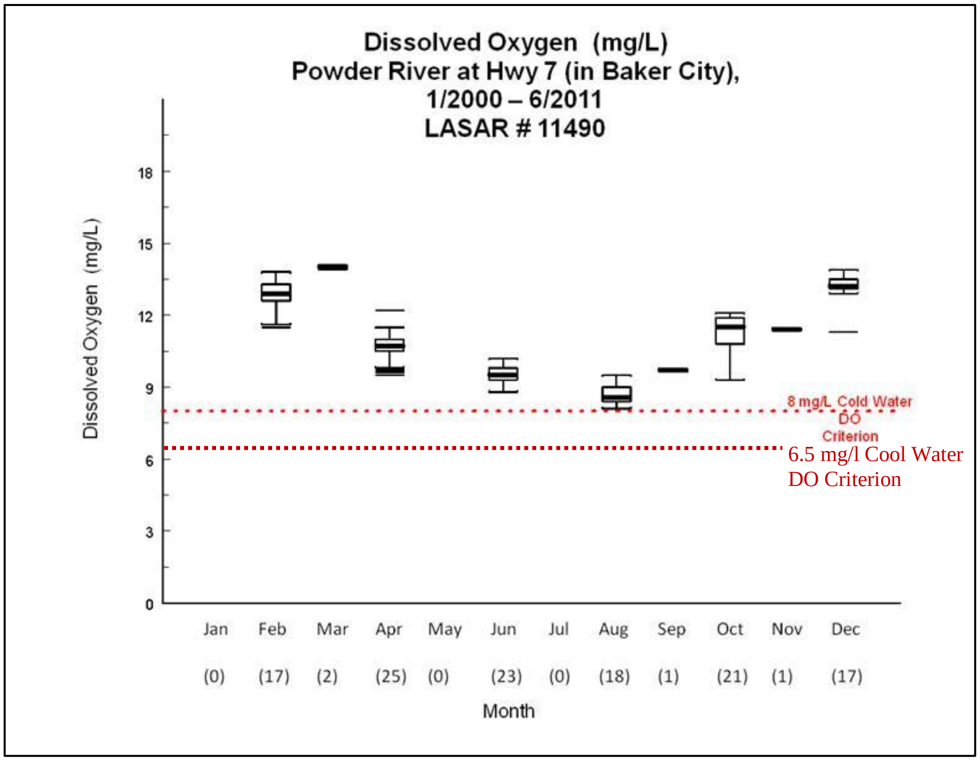


Figure 4-25. Monthly box and whisker plot of dissolved oxygen data from the Powder River at Hwy. 7 in Baker City 2000-2011

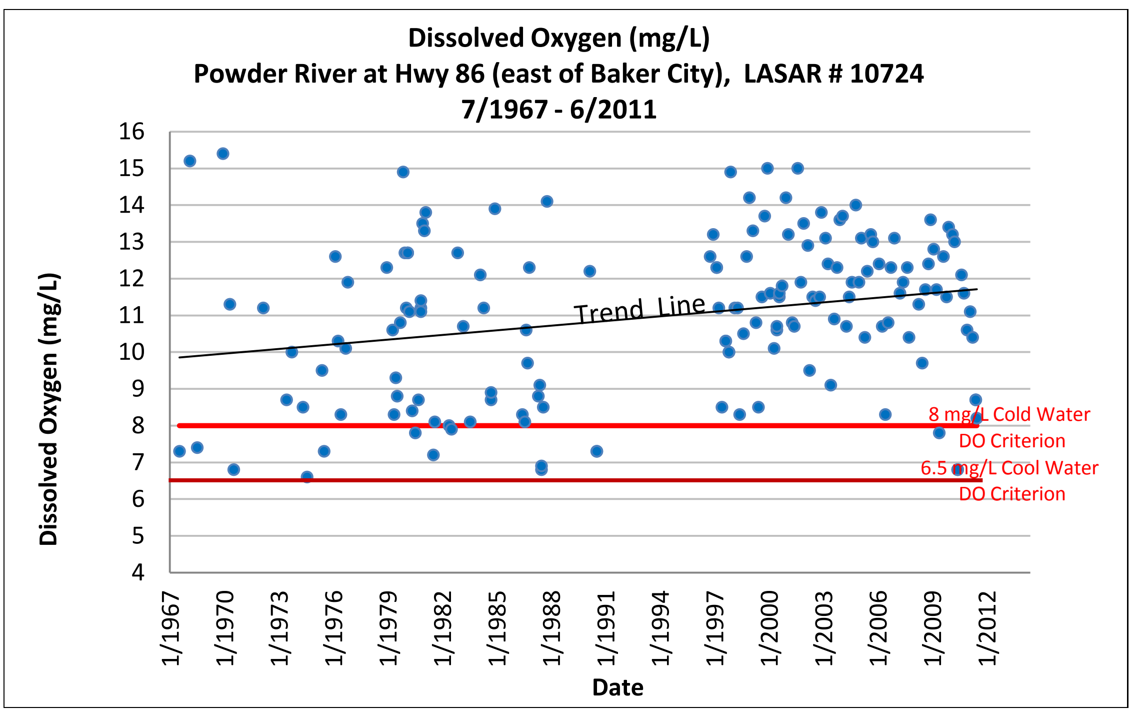


Figure 4-26. Dissolved oxygen concentrations from the Powder River at Hwy. 86 east of Baker City, 1967-2011

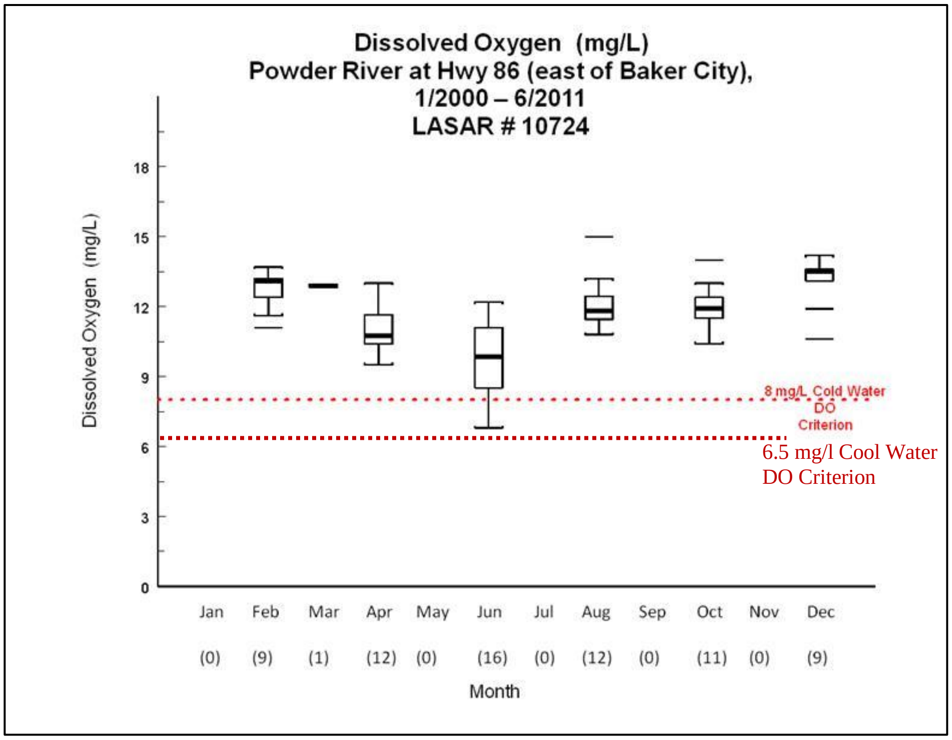


Figure 4-27. Monthly box and whisker plot of dissolved oxygen data from the Powder River at Hwy. 86 east of Baker City 2000-2011

The Burnt River is listed as water quality limited for dissolved oxygen from RM 0 at Huntington to RM 77.3 at the Unity Reservoir Dam **(Figure 4-6)**. This is the only dissolved oxygen listing in the Powder Basin. The 303(d) listing was based on DEQ and ODA data collected between 1997 and 2003 from a location near the mouth of the Burnt River. The dissolved oxygen criterion applied corresponds to a salmonid spawning criterion of 11 mg/l dissolved oxygen during the spawning period of January 1 to May 15. The DO listed reach of the Burnt River is currently mapped as Redband Trout habitat where the Cool Water dissolved oxygen criterion of 6.5 mg/l (absolute minimum) would apply May 16 to December 31 **(Figure 2-7)**. The applicability of these criteria will be examined during TMDL development, along with the additional DO data being collected in 2010-2012 at sample locations in the Unity – Bridgeport reach and the DEQ ambient water quality station located downstream near Huntington. **Figures 4-28 and 4-29** are scatter and box and whisker plots of the dissolved oxygen data from the Burnt River ambient water quality monitoring site near Huntington. Available data indicate that the issolved oxygen concentrations at this location meet the cool water criterion. The slightly decreasing trend shown in **Figure 4-28** appears to be due to the inclusion of a few scattered high readings from the 1980s.

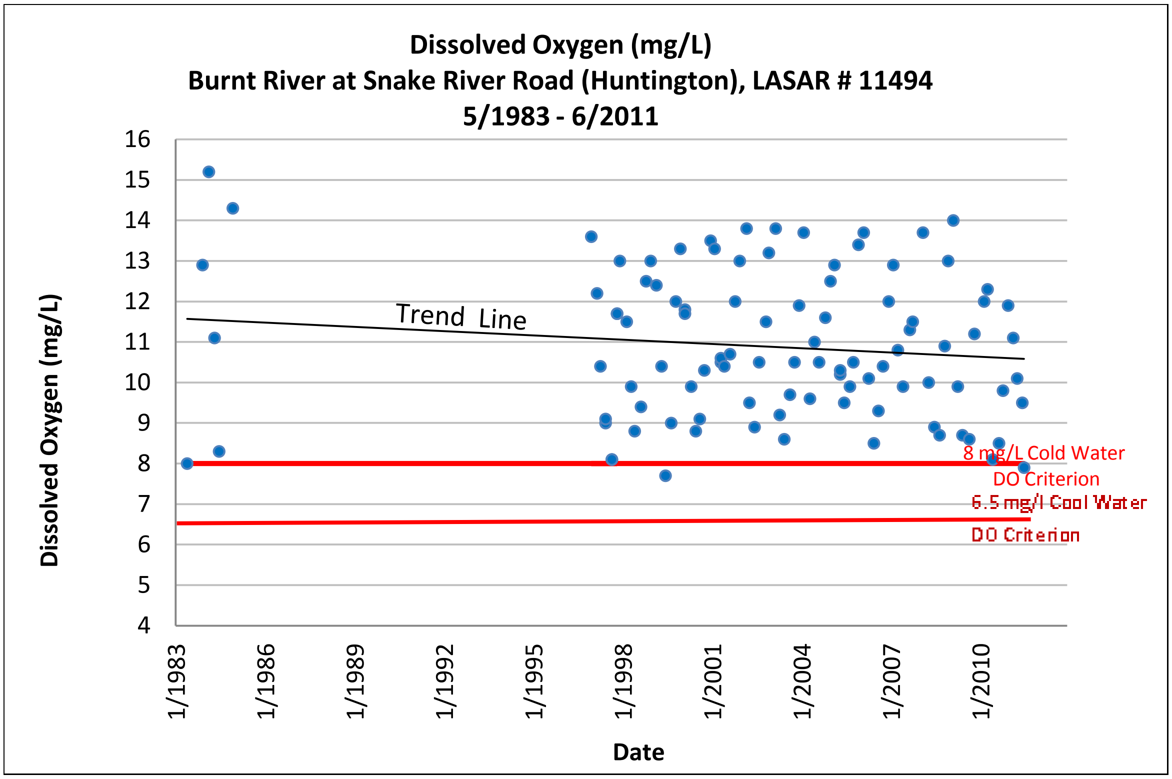


Figure 4-28. Dissolved oxygen concentrations from the Burnt River near Huntington, 1983-2011

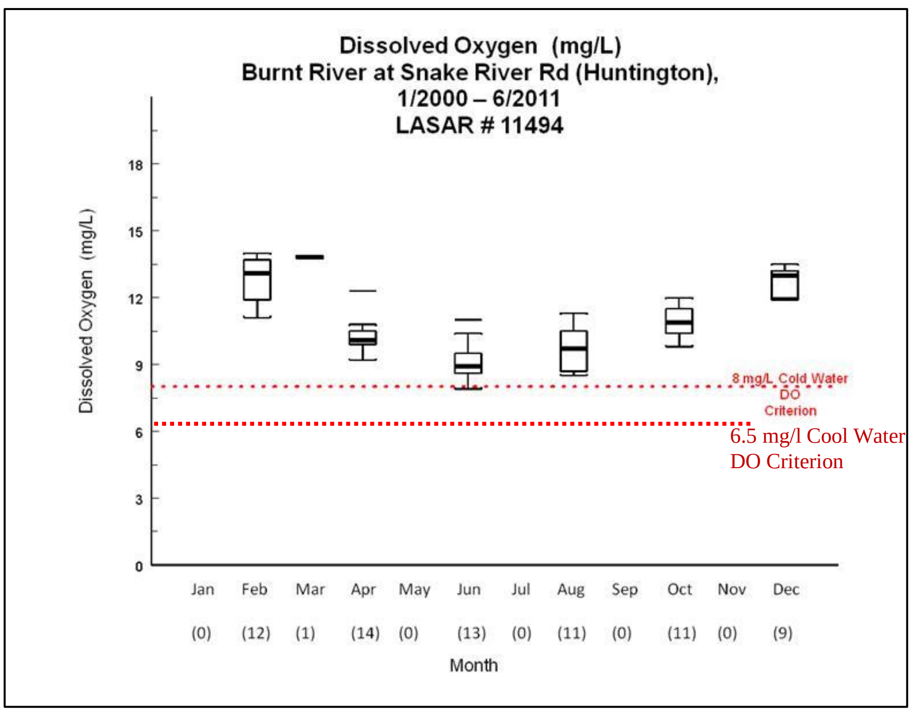


Figure 4-29. Monthly box and whisker plot of dissolved oxygen data from the Burnt River near Huntington, 2000-2011

Continuous measurements of dissolved oxygen along with other parameters have been made at the DEQ monitoring locations below Unity Dam and at the Clarks Creek Road bridge during the periodic bacteria and nutrient monitoring events in 2010-2012. Data from August 2010 are presented in **Figure 4-30**. The dissolved oxygen concentrations below Unity Dam are fairly steady ranging between approximately 7.75 and 8.75 mg/l. The dissolved oxygen concentrations at the Clarks Creek Bridge site show higher daily variation, ranging between approximately 7.0 and 10.0 mg/l. Data from the Clarks Creek Bridge site suggest that there is a higher level of algae growth which can cause a high daily variation in dissolved oxygen and pH. Dissolved oxygen data will be further evaluated for compliance with the applicable criteria during TMDL development.

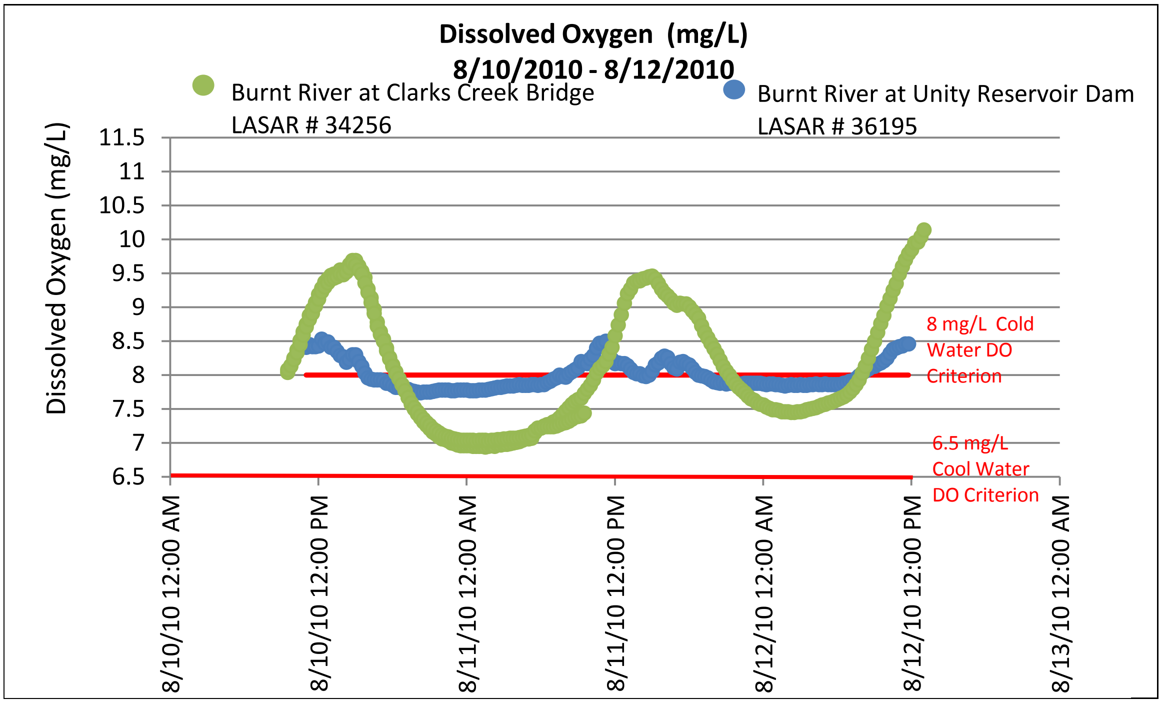


Figure 4-30. Continuous dissolved oxygen data, Burnt River at Unity Dam and Clarks Creek Bridge, August, 2010

4.3.6 pH

Measurements of pH from the three DEQ ambient water quality stations in the Powder Basin are plotted on a box and whisker plot **(Figure 4-31)**. The pH criterion of 9.0 was exceeded once at each of the stations in the Powder and Burnt Rivers during the period of record (2000-2011). A review of the scatter and whisker and box plots for the individual stations **(Figures 4-32 through 4-37)** indicates that these exceedances all took place during low-flow conditions in October of 2005. These data points are shown as outliers or points that are the end of the whisker (largest value within 1.5 times the interquartile range of the box values).

The pH criterion for the Powder Basin appears to be met at the ambient stations except in extreme events associated with low water conditions. There are increasing trends at all three monitoring stations, which should be tracked in future evaluations of data.

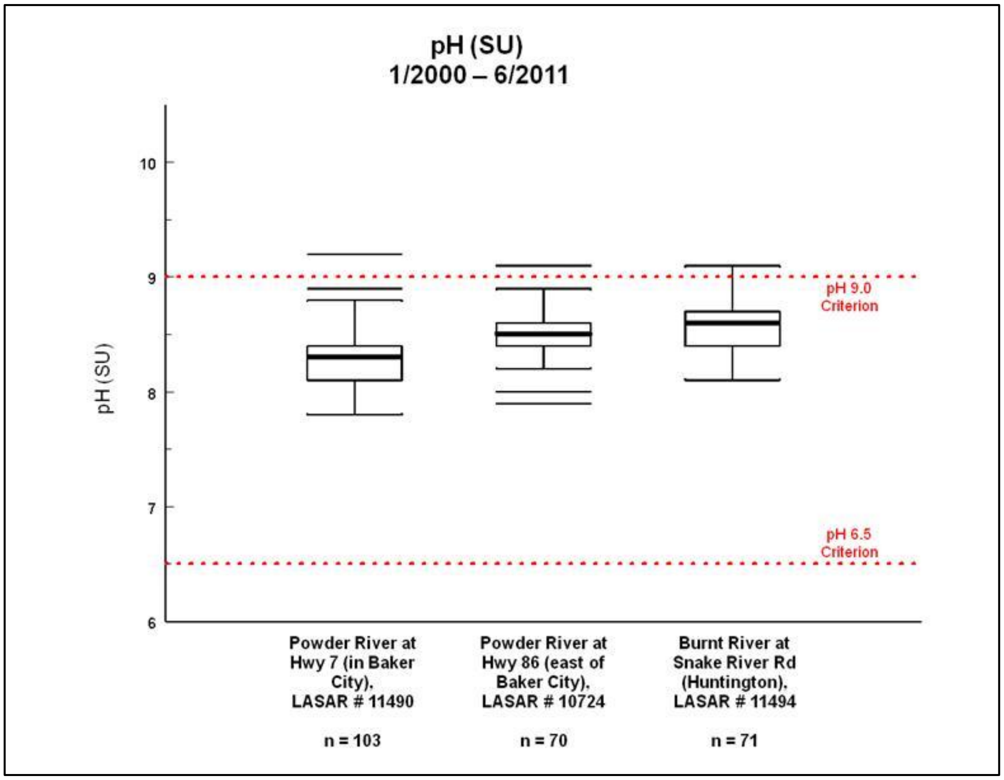


Figure 4-31. Box and whisker plot of pH at Powder Basin ambient water quality sites 2000-2011

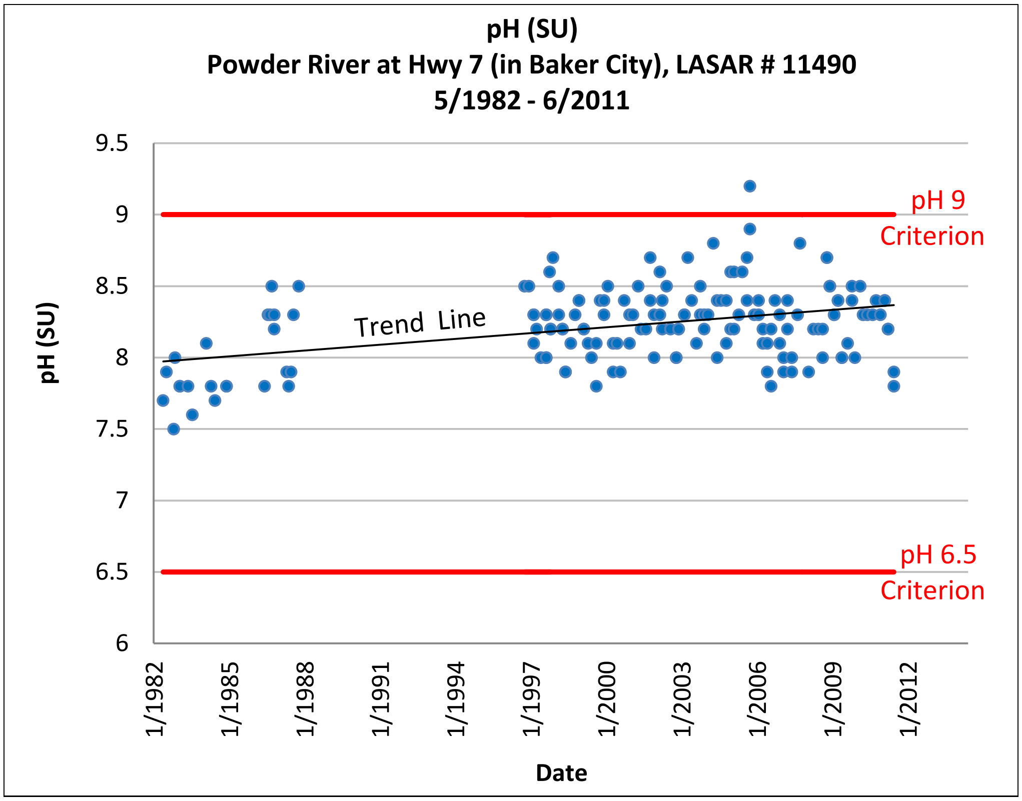


Figure 4-32. Scatter plot of pH data from the Powder River at Hwy. 7 in Baker City, 1982-2011

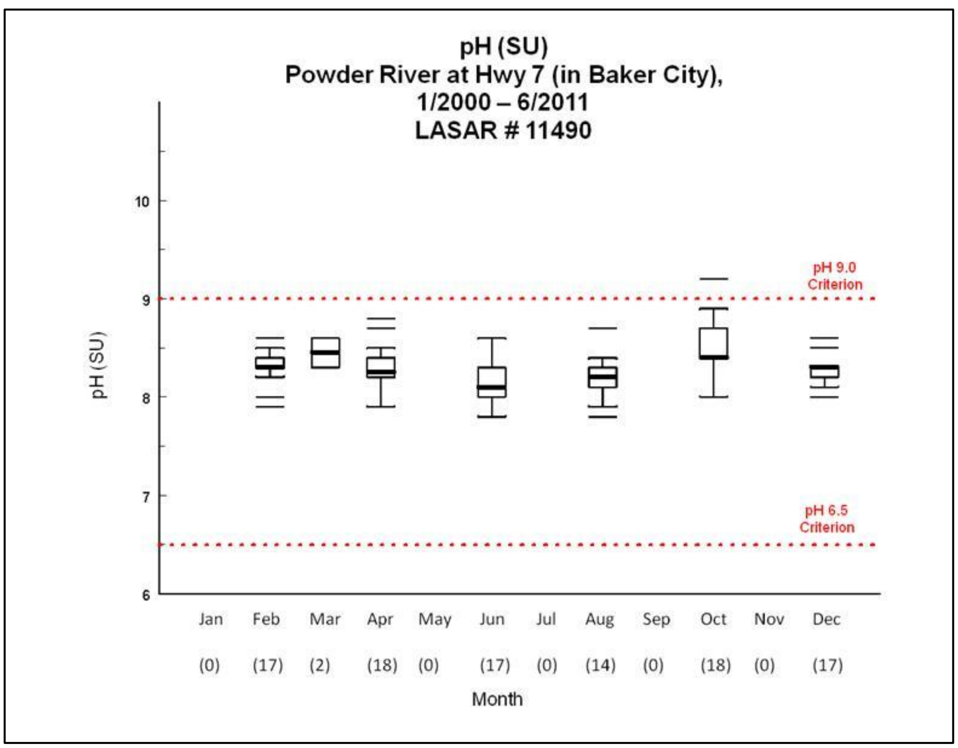


Figure 4-33. Monthly box and whisker plot of pH from the Powder River at Hwy. 7 in Baker City, 2000-2011

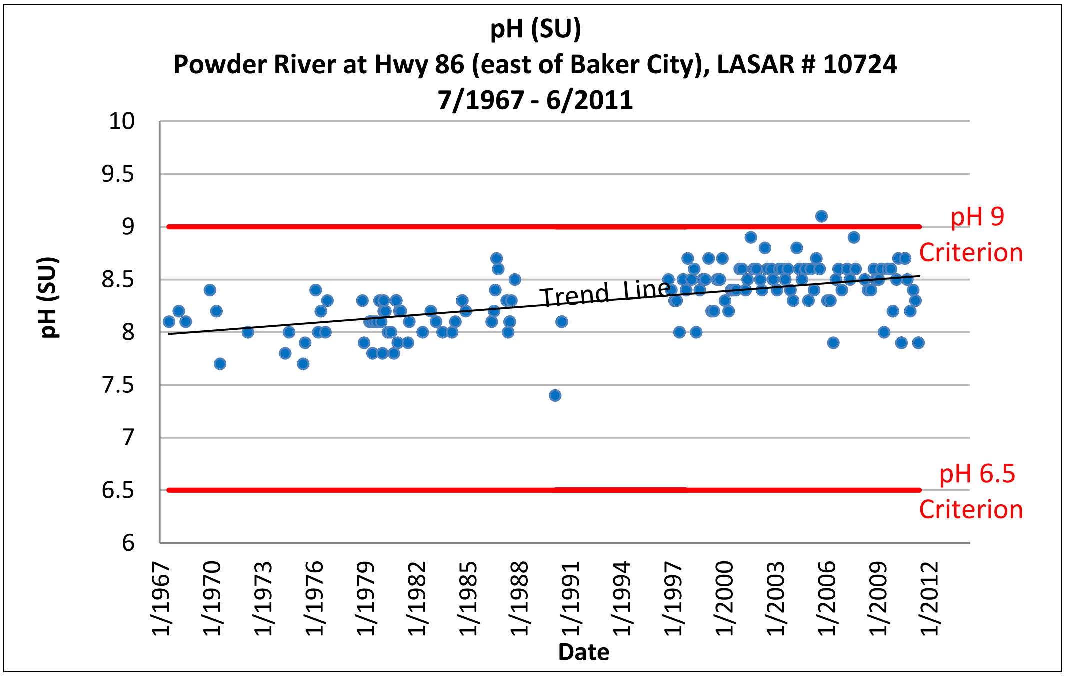


Figure 4-34. Scatter plot of pH data from the Powder River at Hwy. 86 east of Baker City, 1967-2011

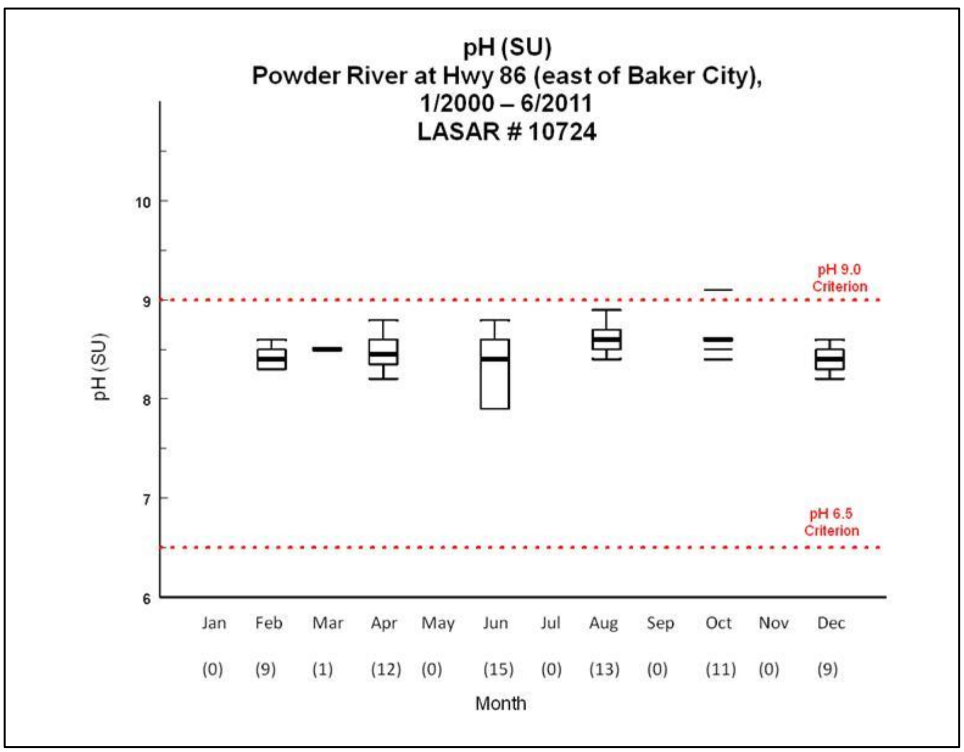


Figure 4-35. Monthly box and whisker plot of pH from the Powder River at Hwy. 86 east of Baker City, 2000-2011

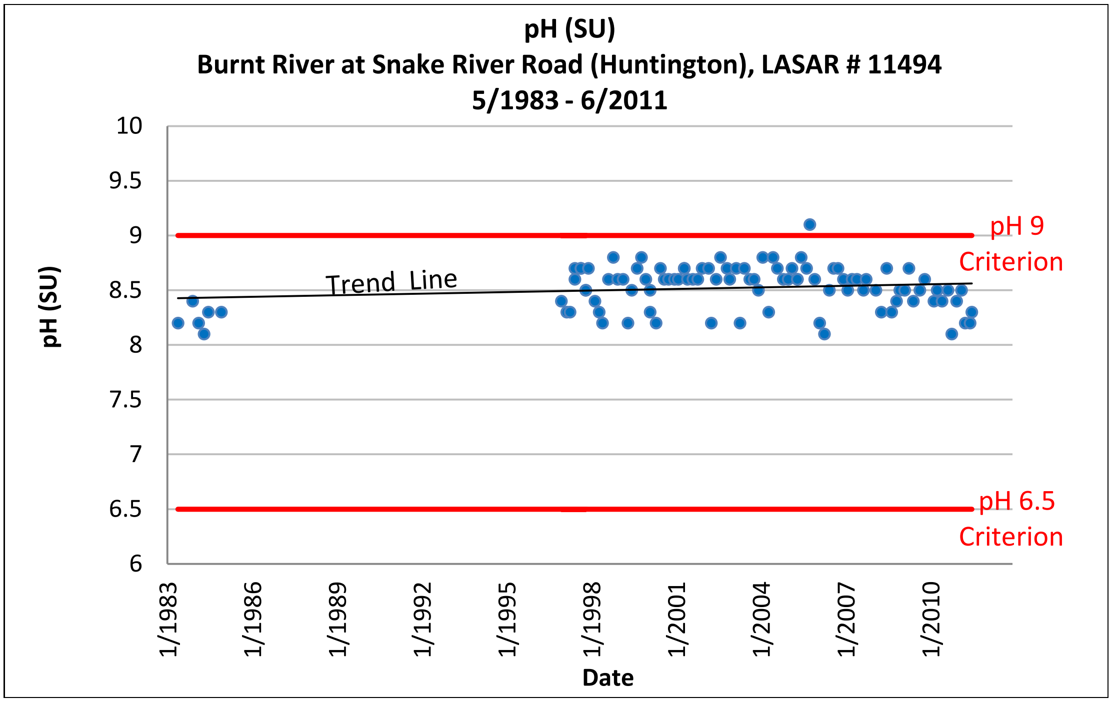


Figure 4-36. Scatter plot of pH data from the Burnt River near Huntington, 1983-2011

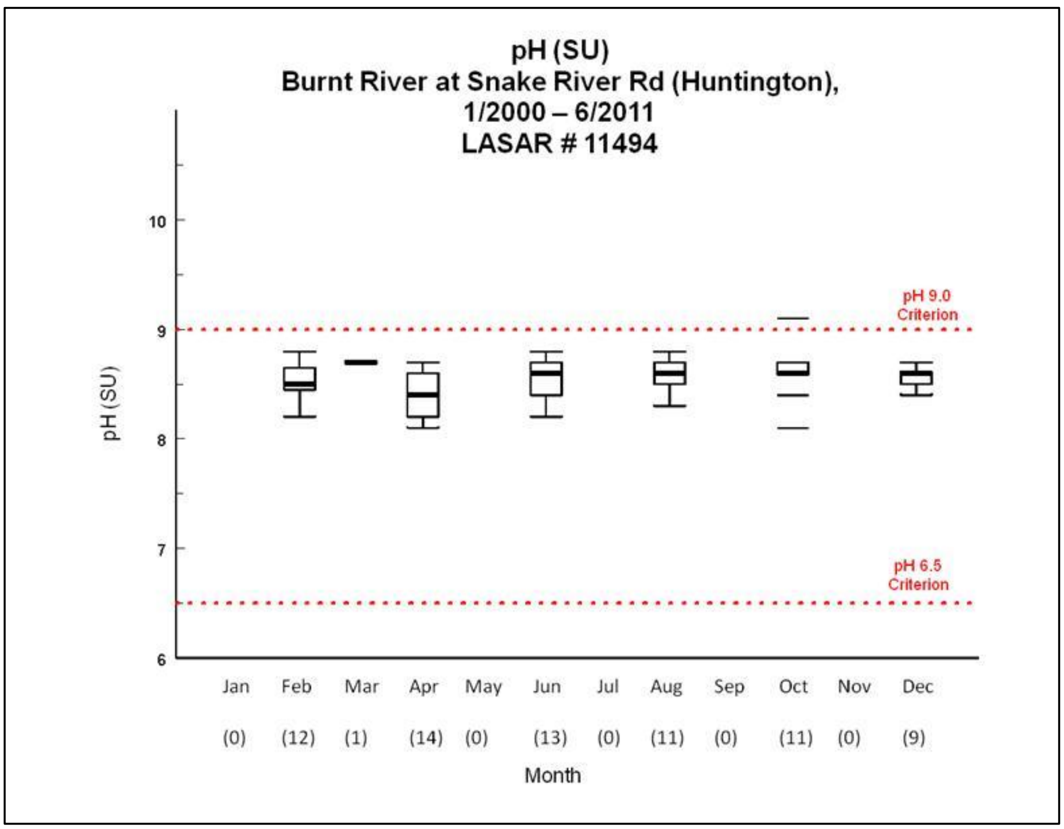


Figure 4-37. Monthly box and whisker plot of pH from the Burnt River near Huntington, 2000-2011

4.3.7 Phosphorus

The Powder River was allocated a load of 33 kg/day of phosphorus to the Snake River in the Snake River-Hells Canyon TMDL. This allocation was based on a 0.07 mg/l total phosphorus concentration limit. The Burnt River was also allocated a phosphorus load of 21 kg/day based on a total phosphorus concentration limit of 0.07 mg/l. Total phosphorus data from the DEQ ambient water quality sites on the Powder River and Burnt River are presented in **Figures 4- 38**.

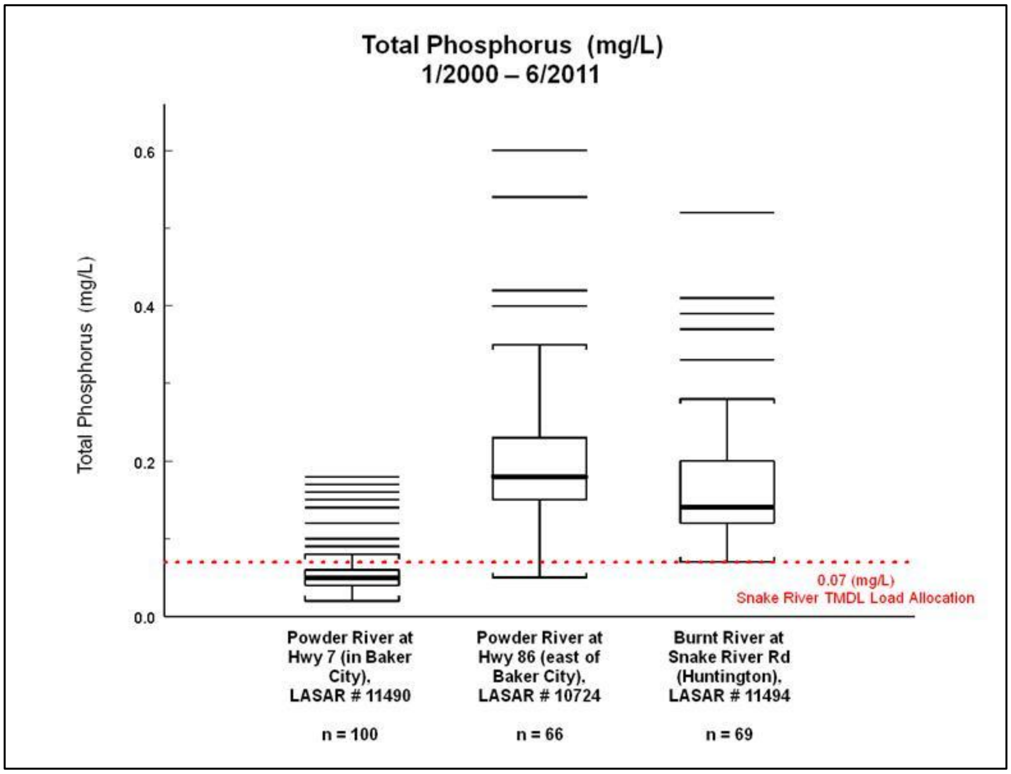


Figure 4-38. Box and whisker plot of total phosphorus concentrations at the Powder River and Burnt River DEQ ambient water quality sites, 2000-2011

The total phosphorus data from the DEQ ambient water quality site in Baker City (Lasar #11490) shown in **Figure 4-39 and 4-40** indicate relatively low levels of total phosphorus in the range of the 0.07 mg/l concentration limit most of the year, with spring/summer peaks ranging from approximately 0.1 mg/l to approximately 0.18 mg/l. The trend in total phosphorus concentrations at this site is decreasing.

Total phosphorus concentrations increase downstream at the Keating site (Lasar #10724), generally ranging from approximately 0.1 mg/l to a high of approximately 0.6 mg/l **(Figure 4-41 and 4-42)**. Peaks in concentration typically occur in summer. The trend in total phosphorus concentrations at this site is decreasing.

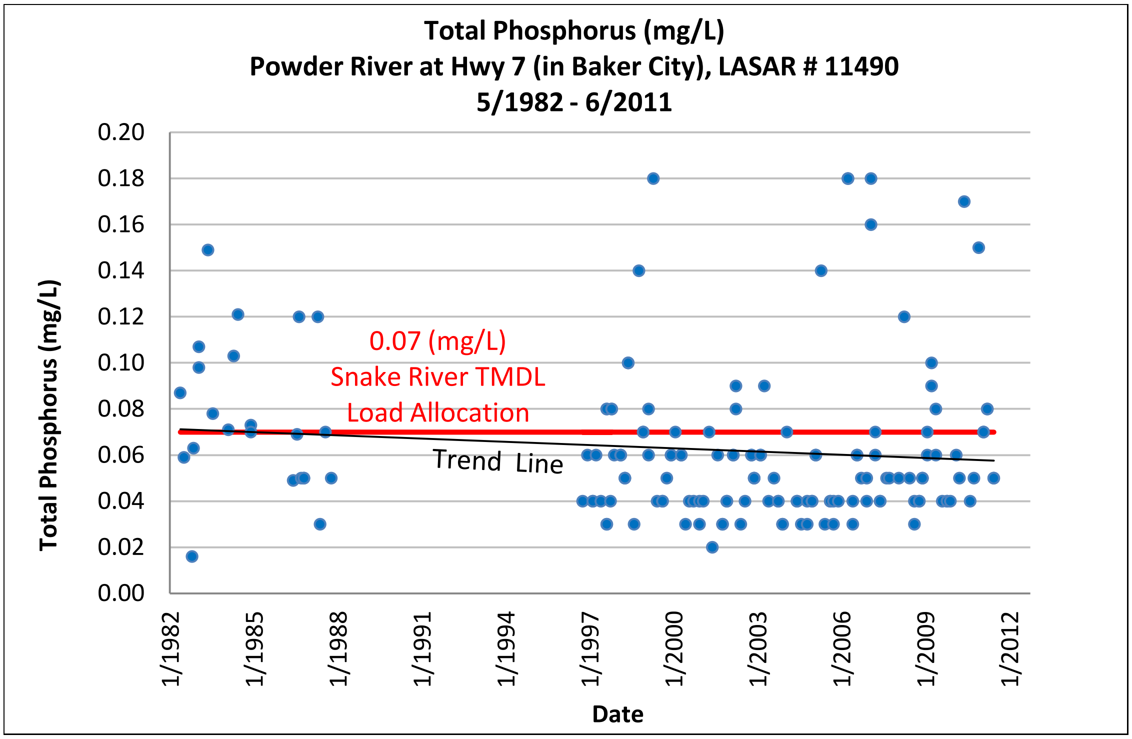


Figure 4-39. Scatter plot of total phosphorus data from Powder River at Hwy. 7 in Baker City, 1982-2011

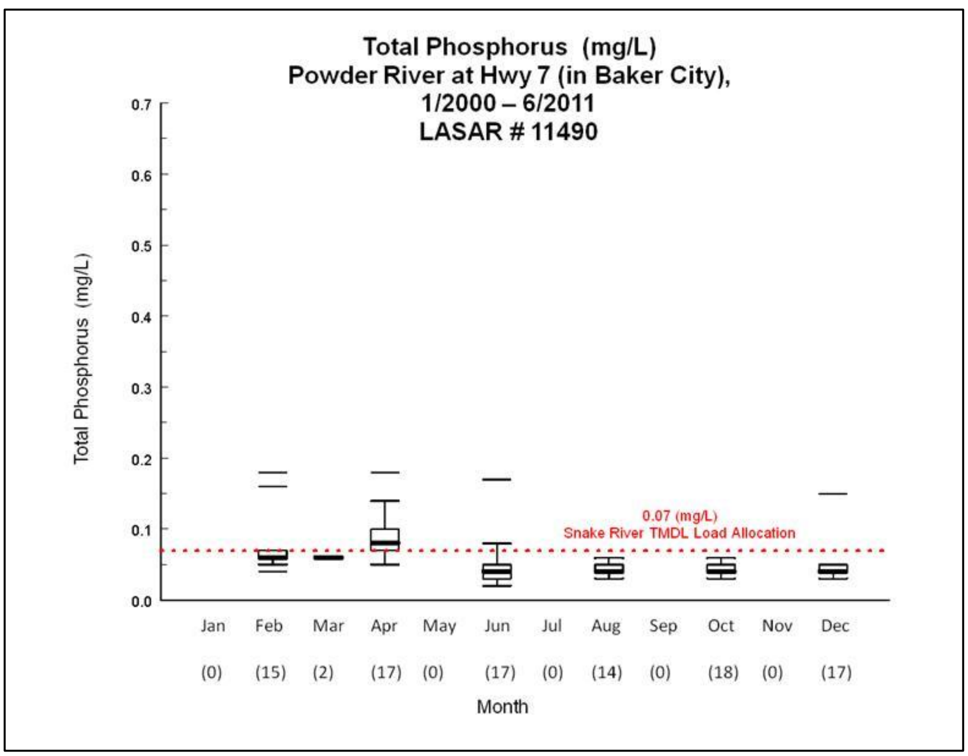


Figure 40. Monthly box and whisker plot of total phosphorus data from Powder River at Hwy. 7 in Baker City, 2000-2011

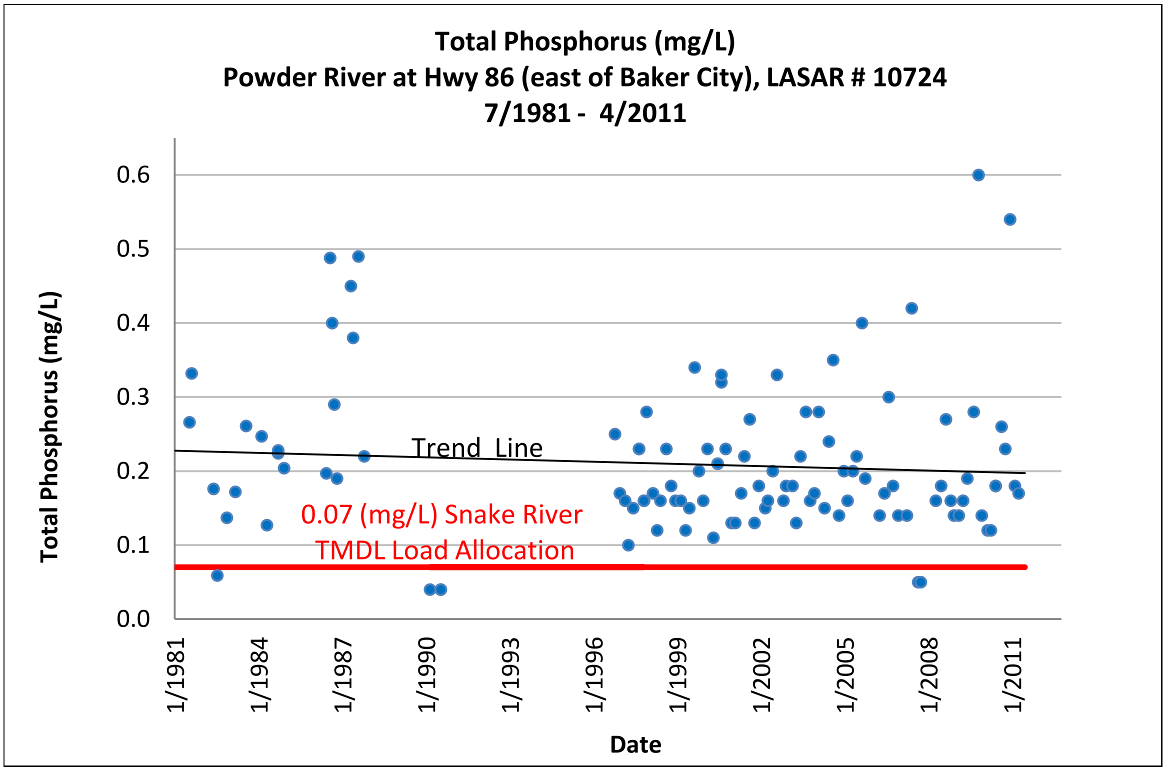


Figure 4-41. Scatter plot of total phosphorus data from Powder River at Hwy. 86 east of Baker City, 1981-2011

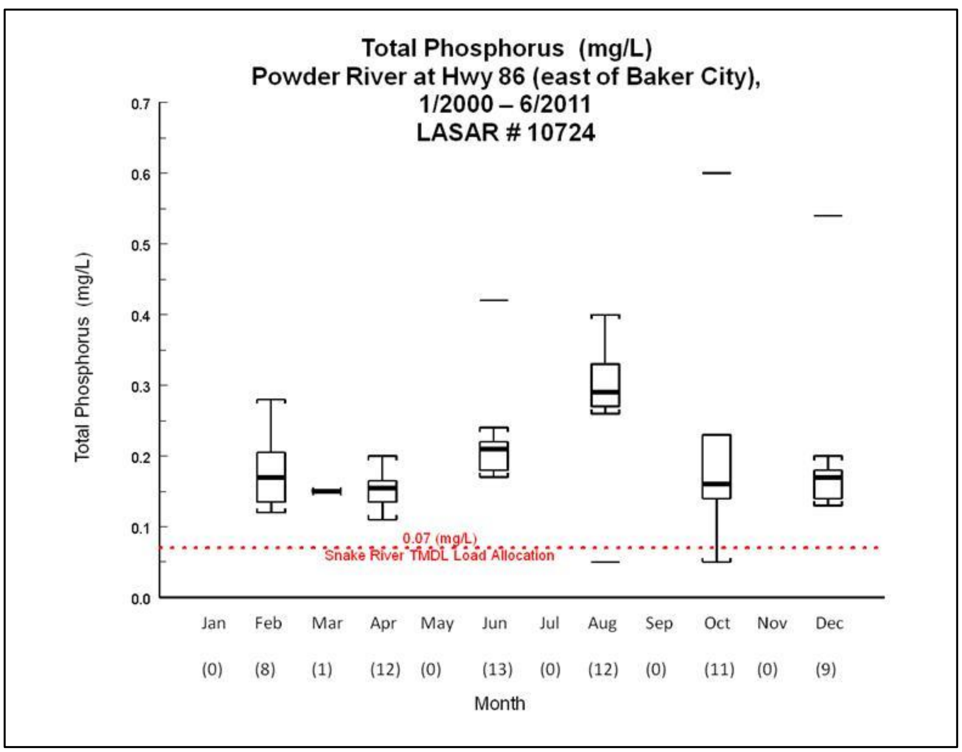


Figure 4-42. Monthly box and whisker plot of total phosphorus data from Powder River at Hwy. 86 east of Baker City, 2000-2011

Total phosphorus concentrations in the lower Burnt River in Huntington are also elevated well above the 0.07 mg/l target concentration. Total phosphorus concentrations generally range from a low of approximately 0.10 mg/l to over 0.50 mg/l with the highest peaks occurring in April through October **(Figures 4-43 and 4-44)**. The trend in total phosphorus concentration is flat **(Figure 4-43)**.

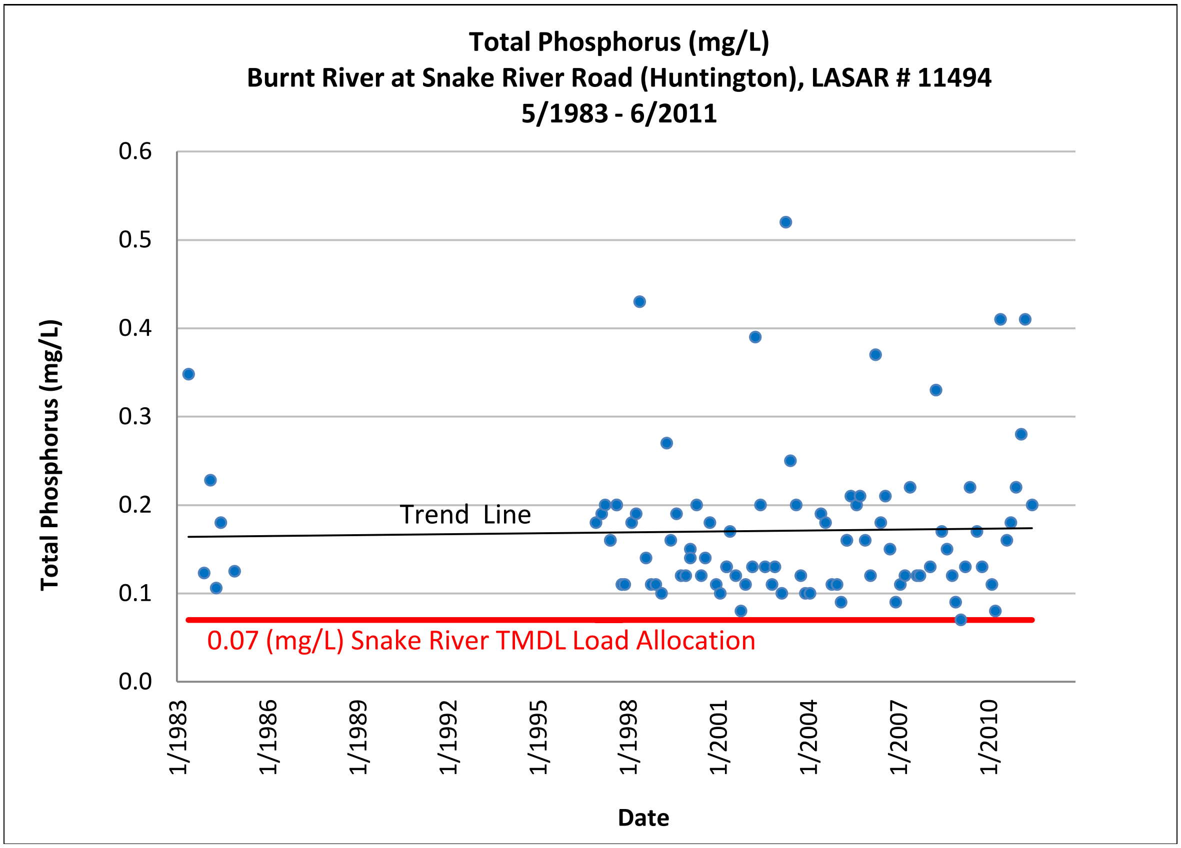


Figure 4-43. Scatter plot of total phosphorus data from Burnt River near Huntington, 1983-2011

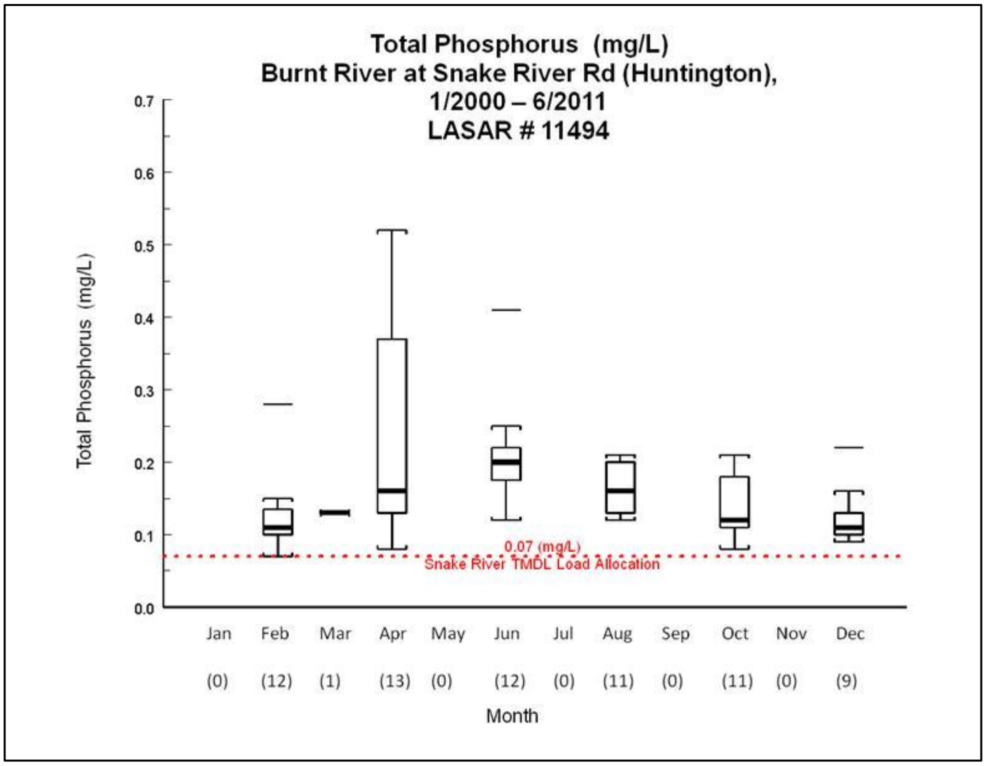


Figure 44. Monthly box and whisker plot of total phosphorus data from Burnt River near Huntington, 2000-2011

4.3.8 Temperature

Numerous stream reaches in all three subbasins, including most of the Powder River, North Fork Powder River, Burnt River, and Pine Creek, are 303(d) listed as water quality limited due to high water temperatures **(Figure 4-45)**. The listings are based on temperature data collected by the BLM, USFS, DEQ, BOR, and Baker Valley SWCD. Some of the listings are based on comparison to the salmonid rearing criterion of 17.8° C (64° F), which no longer applies in the Powder Basin. The Bull Trout Spawning and Rearing criterion has also been changed from 10°C (50°F) to 12°C (53.6°F). Most streams in the basin are designated Redband Trout habitat with a temperature criterion of 20° C (68° F). Some headwater areas designated Bull trout Habitat with a temperature criterion of 12° C (53.6° F) **(Figure 2 -7)**. Compliance with current temperature criteria will be examined during TMDL development.

The Snake River-Hells Canyon TMDL (2004) established gross nonpoint temperature load allocations of 0.14° C for each major tributary discharging to this reach of the Snake River. This allocation applies to the Powder River during periods when the temperature of the Snake River is greater than 17.8° C (64° F). Compliance with this allocation will be evaluated during development of the Powder Basin TMDL.

As demonstrated in basins throughout Eastern Oregon, it is likely that the natural maximum temperatures of many streams in the Powder Basin exceed the biologically-based criteria. Improvements in riparian vegetation as well as improved flood plain connection and channel form will allow these streams to meet there maximum habitat potential for sensitive aquatic organisms.

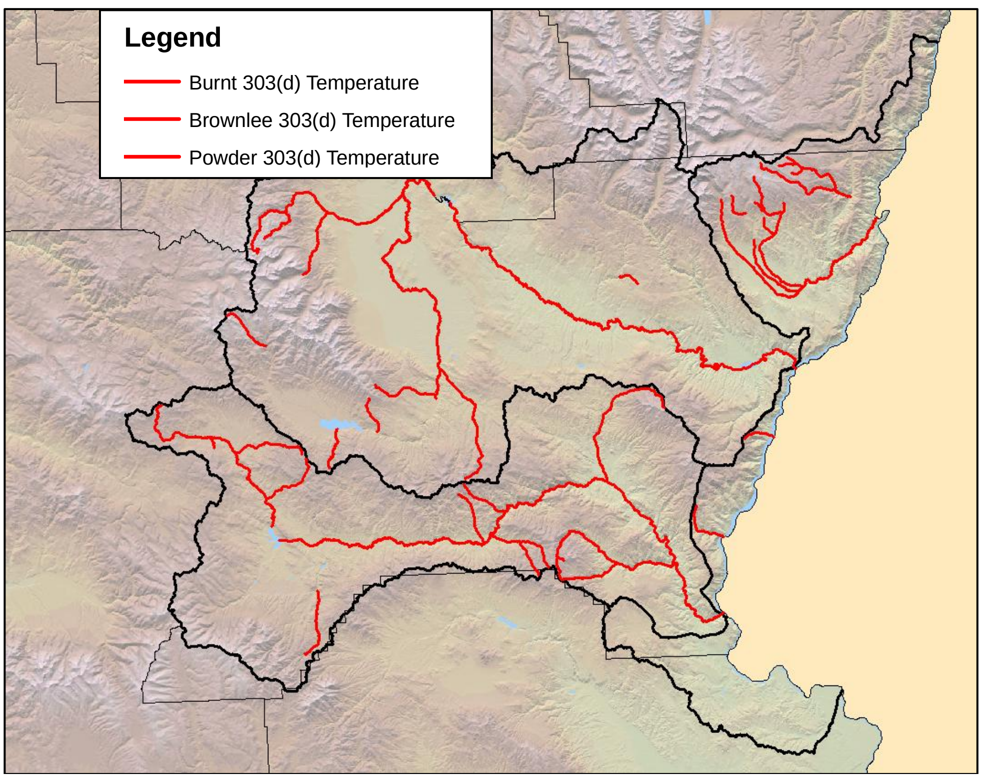


Figure 4-45. Temperature 303(d) Listed Streams in the Powder Basin

Figure 4-46 is a box and whisker plot of the temperature data collected at the three DEQ ambient water quality sites in the Powder Basin. These are one-time "grab" sample data and are not divided by season or month of the year, and may not represent the warmest times of day. Due to these factors, these data should be used for informational comparison purposes and not for determining compliance with water quality standards. Temperatures measured at the Powder River site in Baker City are below the 20^{o} C criterion with very few exceptions. The Powder River at Hwy. 86 and Burnt River at Huntington sites have higher median temperatures and greater exceedances of the criterion.

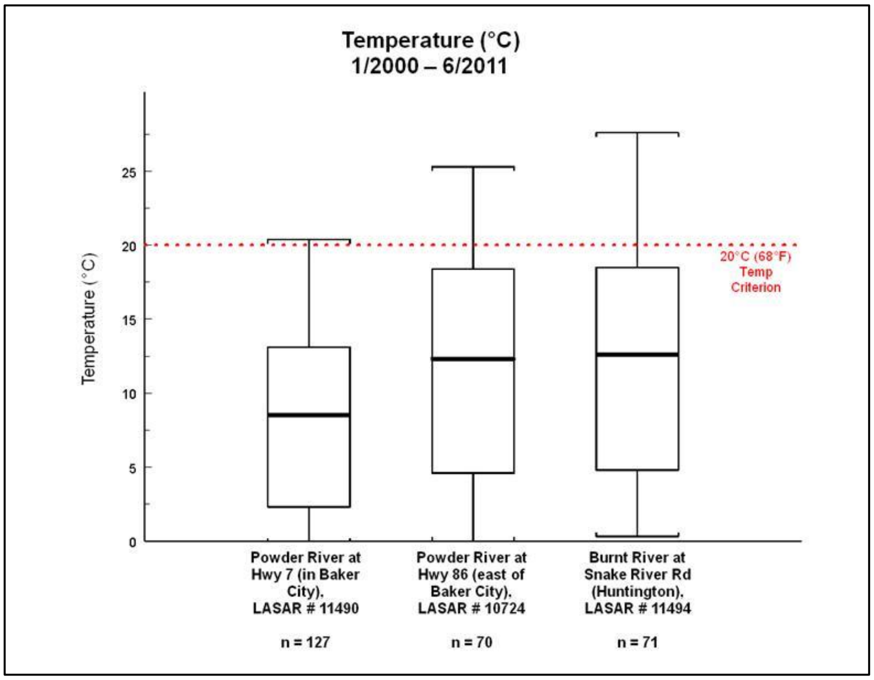


Figure 4-46. Box and whisker plot of temperature data from DEQ Powder Basin ambient water quality monitoring locations, 2000-2011

Temperature data from the Powder River Baker City ambient monitoring site are presented in **Figures 4-47 and 4-48**. The trend in temperature data from 1982 to 2011 is essentially flat, and the few exceedances of the criterion occur in August. It should be noted that there are no July data, the month which would be expected to have the highest water temperatures.

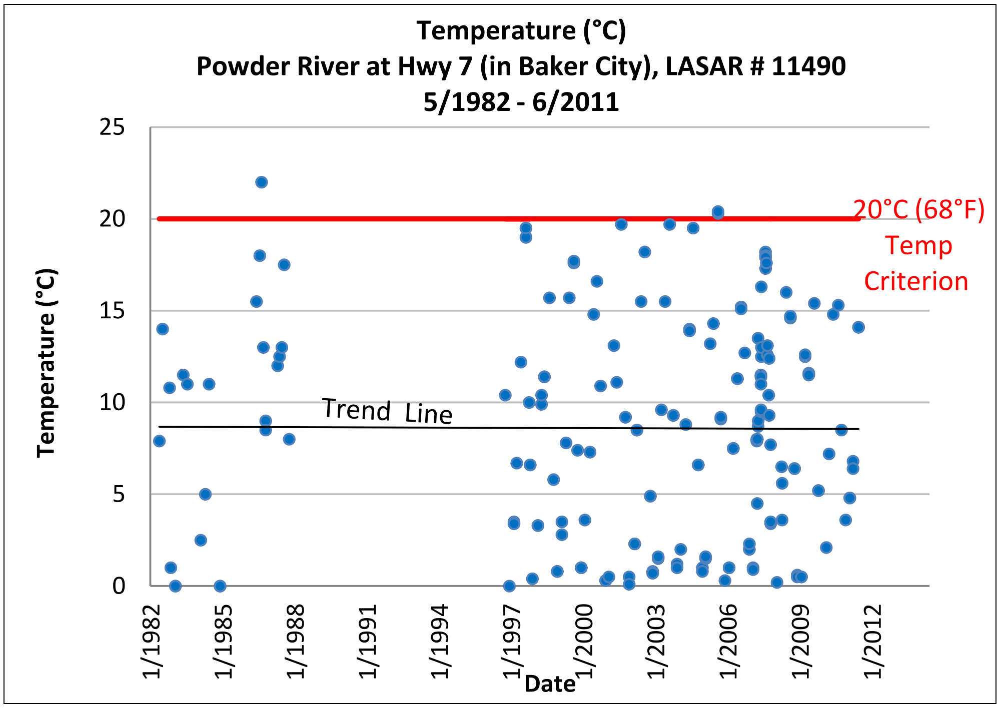


Figure 4-47. Scatter plot of temperature data from DEQ Ambient water quality monitoring location at Hwy. 7 in Baker City, 1982-2011

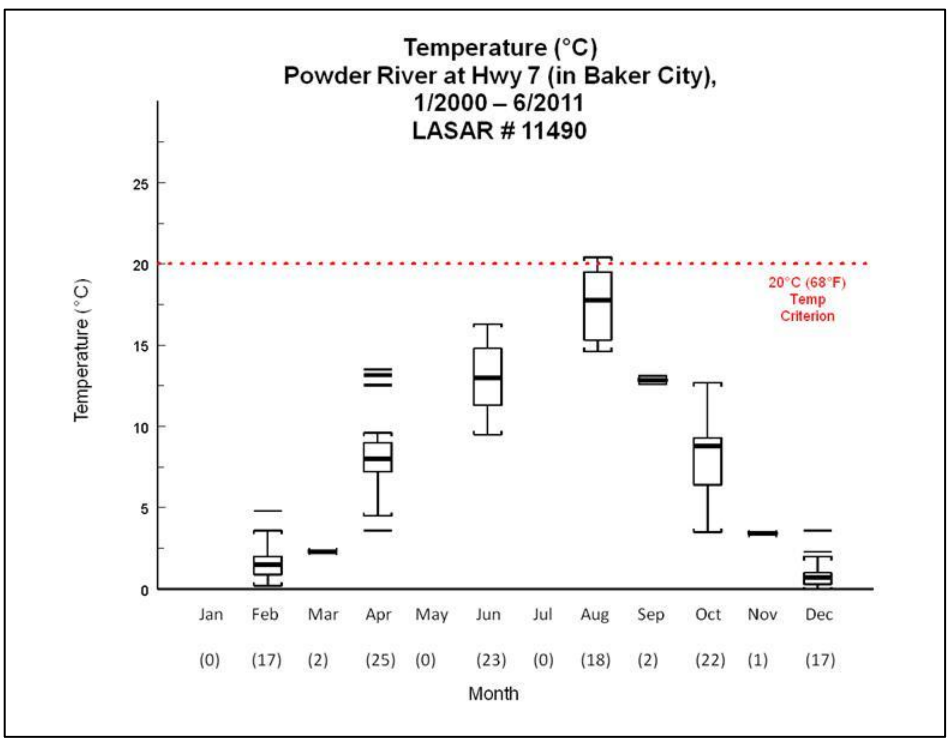


Figure 4-48. Monthly box and whisker plot of temperature data from DEQ ambient water quality monitoring location Powder River at Hwy. 7 in Baker City, 2000-2011

Temperature data from the Powder River Hwy. 86 ambient monitoring site located east of Baker City near Keating, are presented in **Figures 4-49 and 4-50**. The trend in temperature data from

1967 to 2011 is decreasing, and exceedances of the criterion occur in June and August. It should be noted that there are very few July or September data when it is likely that there would be additional exceedances.

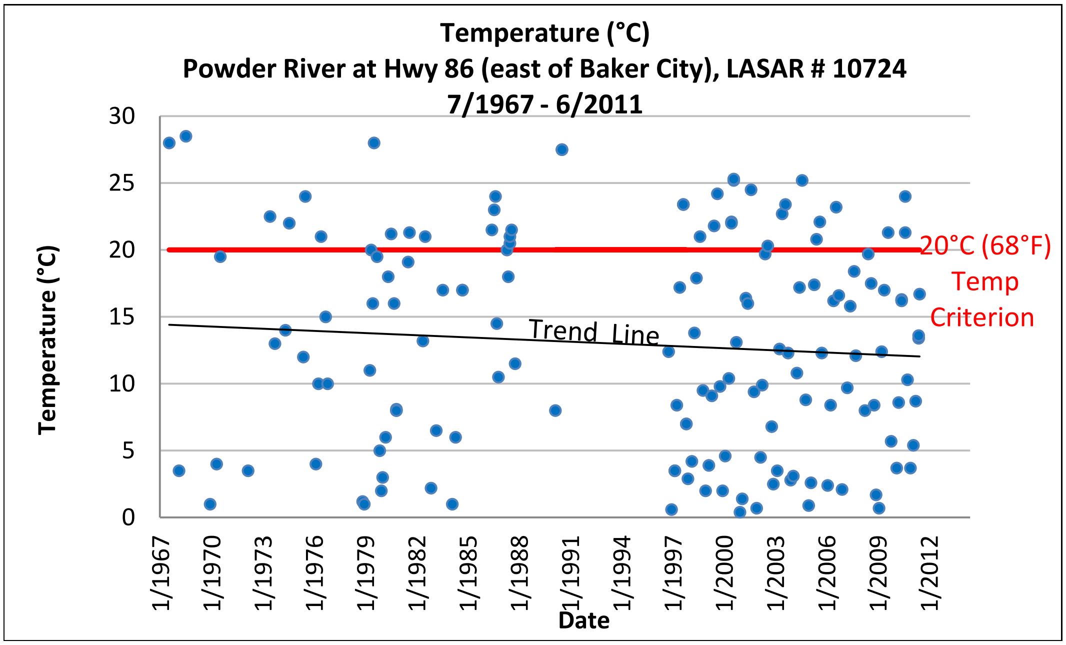


Figure 4-49. Scatter plot of temperature data from DEQ Ambient water quality monitoring location Powder River at Hwy. 86 east of Baker City, 1967-2011

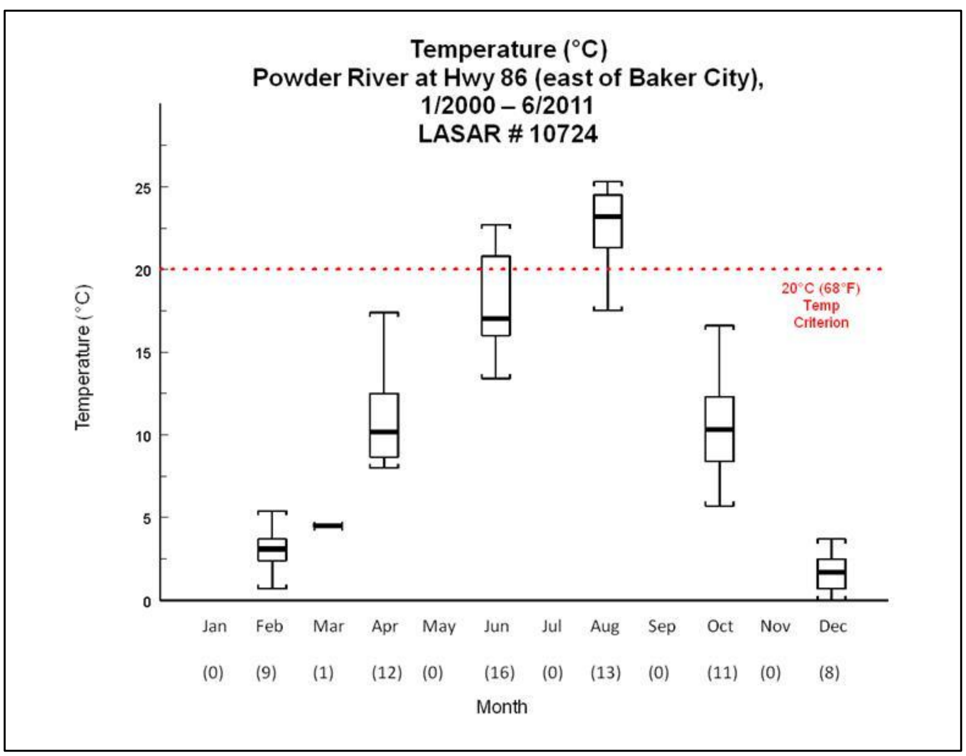


Figure 4-50. Monthly box and whisker plot of temperature data from DEQ Ambient water quality monitoring location Powder River at Hwy. 86 east of Baker City, 2000-2011

Temperature data from the Burnt River ambient monitoring site are presented in **Figures 4-51 and 4-52**. The trend in temperature data from 1983 to 2011 is increasing slightly, and exceedances of the criteria occur in April through August. It is likely that exceedances also occur in September, but there are no data available.

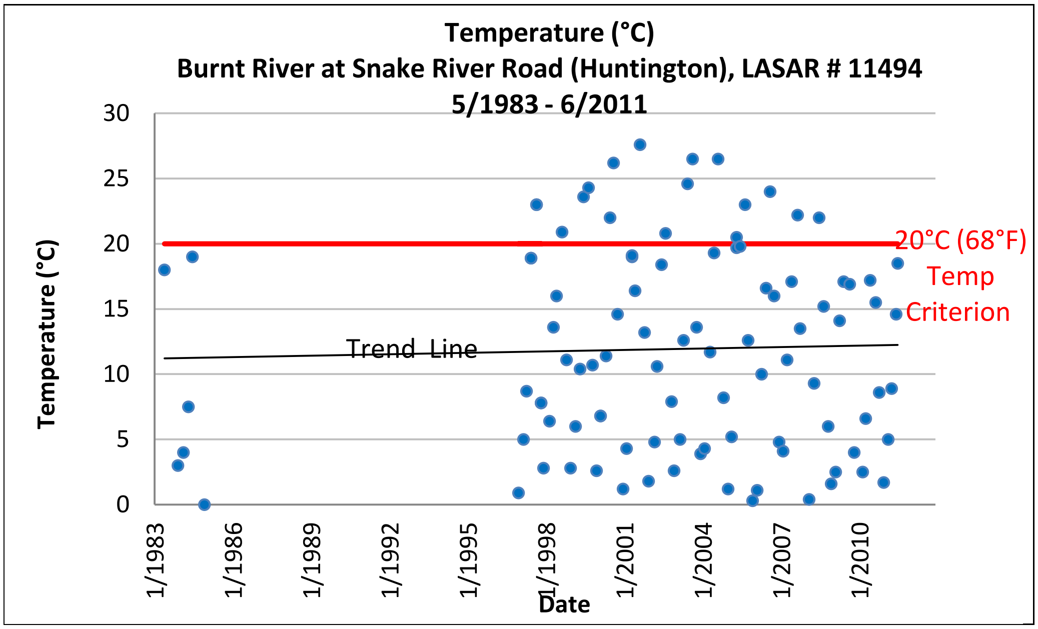


Figure 4-51. Scatter plot of temperature data from DEQ Ambient water quality monitoring location Burnt River near Huntington, 1983-2011

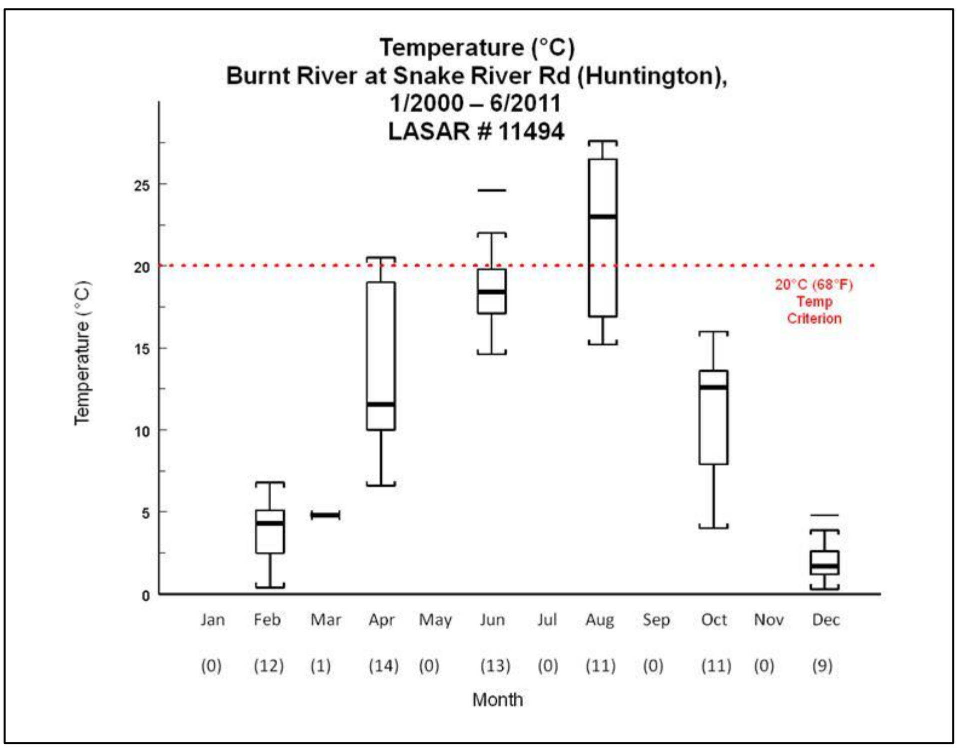


Figure 4-52. Monthly box and whisker plot of temperature data from DEQ Ambient water quality monitoring location Burnt River near Huntington, 2000-2011

Continuous stream temperature data has been collected in the Powder Basin by agencies and groups such as the USFS, BLM, Idaho Power, USBR, Baker Valley SWCD, and Oregon DEQ. Additional continuous temperature data will be collected by some of these groups in the next two years to support temperature modeling as part of TMDL development.

Continuous temperature data collected by DEQ and BLM in Rock Creek, Dixie Creek and the Burnt River, were extracted from the DEQ LASAR database and plotted on **Figures 4-53 through 4-55**. The continuous data plots show that Rock creek and Dixie Creek met the temperature criteria most of the time, but the Burnt River data had significant exceedances in July and August.

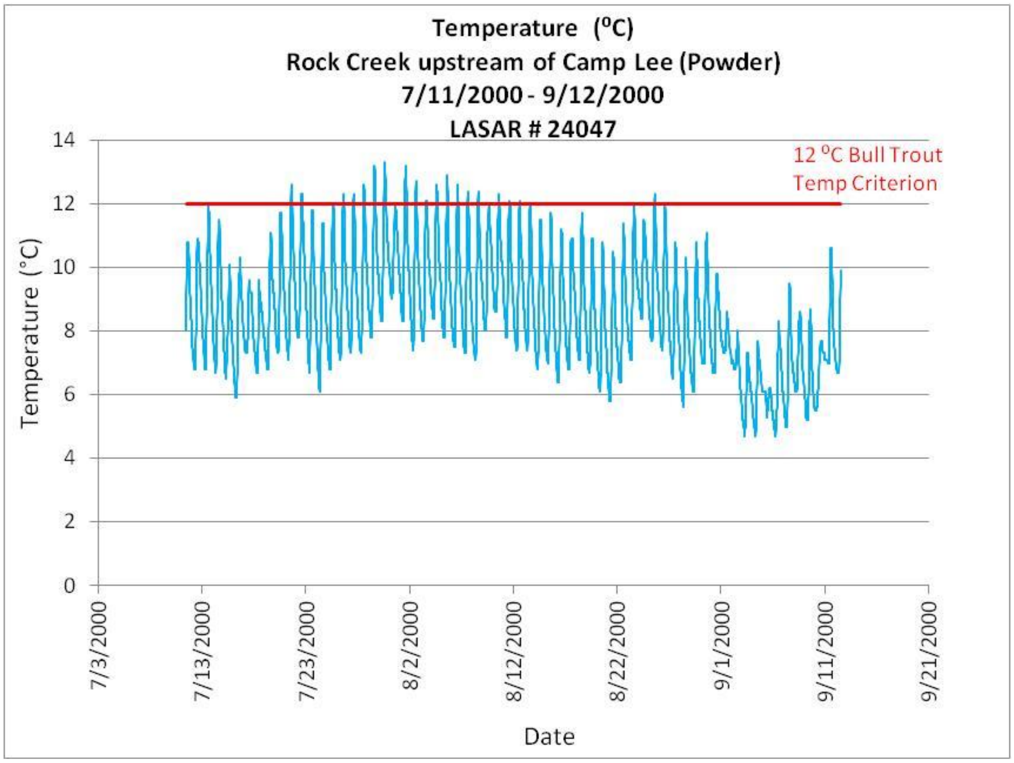


Figure 4-53. Continuous temperature data from Rock Creek (Powder Subbasin) upstream of Camp Lee, DEQ, 7/11/00-9/12/00

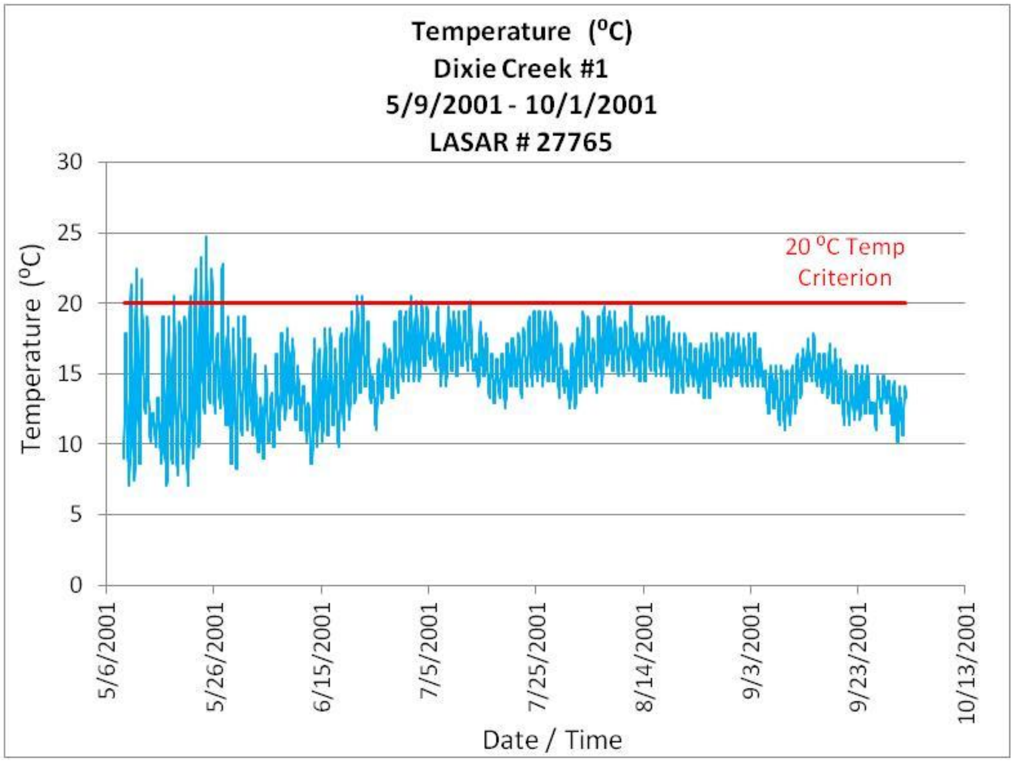


Figure 4-54. Continuous temperature data from Dixie Creek (Burnt Subbasin) approximately 1 mile below north and south forks confluence, BLM, 5/9/01-10/1/01

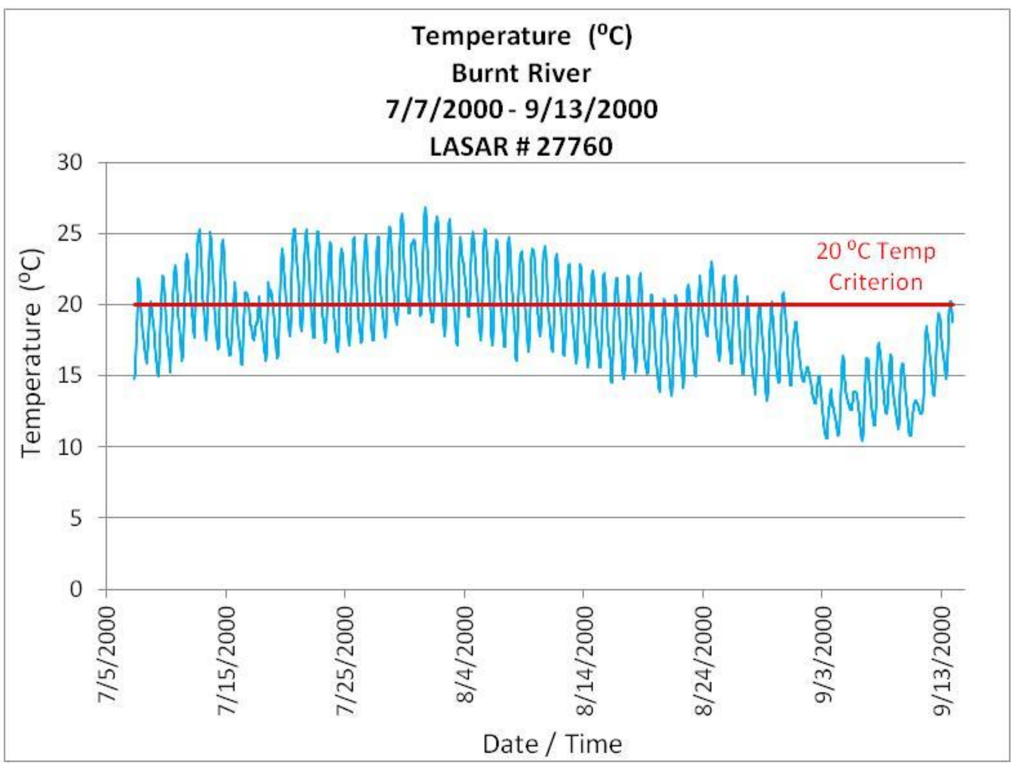


Figure 4-55. Continuous temperature data from the Burnt River approximately 5 miles upstream of Durkee, BLM, 7/7/00-9/13/00.

4.3.9 Toxics

Wastewater Sampling (SB 737)

In 2007, the Oregon Legislature passed SB 737. The purpose of the SB737 effort was to measure the concentrations of approximately 120 chemical pollutants determined to be toxic, bio-accumulative and persistent at 52 of Oregon's largest municipal wastewater treatment facilities. More information regarding SB 737 requirements can be found at: http://www.deq.state.or.us/wq/SB737/index.htm

The statute also required Oregon's 52 largest municipal Wastewater Treatment Plants (WWTPs) and Water Pollution Control Facilities (WPCFs) ("permittees") to develop reduction plans by July 2011 for persistent pollutants detected in effluent above certain levels set by the Environmental Quality Commission (EQC). Baker City is the only municipality in the Powder Basin which is required to develop a Persistent Pollutant Reduction Plan. Final effluent from the Baker City wastewater treatment plant was sampled on two occasions (summer and fall) in 2010 pursuant to the requirements of Senate Bill 737 (SB737).

Summary of Baker City WWTF final effluent July 26th 2010 sampling event (20100673)

Final treated effluent discharged from the Baker City WWTF was sampled on July 26, 2010 and analyzed for the SB737 suite of toxic, persistent and bio-accumulative pollutants and "ancillary" compounds (sampling event 20100673). However, the analyses of semi volatile chemicals were voided due to an extraction failure. On August 23, effluent was re-sampled and analyzed for semi volatile chemicals (sampling event 20100812). Aside from cholesterol and coprostanol **(Table 4-7)**, none of the SB737 chemicals were detected at concentrations above the established "Plan Initiation Levels" in the final effluent. Based on public input, permittees were not required to develop a persistent pollutant reduction plan to address cholesterol or coprostanol which while identified as a pollutant of concern were deemed to be irreducible by-products of the sewage treatment process.

Table 4-7. Concentrations of steroids measured in Baker City WWTF effluent–Spring 2010

Compound	Measured Conc. (ng/L)	Detection Limits (ng/L)	Plan Initiation Levels (ng/L)
Cholesterol	26522	600	60
Coprostanol	29479 (Est)	400	40

Summary of Baker City WWTF final effluent November 1st 2010 sampling event (20101066)

Final treated effluent discharged from the Baker City WWTF into the Powder River was again re-sampled on November 1, 2010 and analyzed for the SB737 suite of toxic, persistent and bio-accumulative pollutants and "ancillary" compounds (sampling event 20101066). Aside from cholesterol and coprostanol (which were resampled November 15th and reported in sampling event 20101127 and noted below in **Table 4-8**), none of the SB737 chemicals were detected at concentrations above the established "Plan Initiation Levels" in the final effluent.

Table 4-8. Concentrations of steroids measured in Baker City WWTF effluent – Winter 2010

Compound	Measured Conc. (ng/L)	Detection Limits (ng/L)	Plan Initiation Levels (ng/L)
Cholesterol	14500	590	60
Coprostanol	5460	390	40

Toxics Monitoring Program Surface Water Sampling

In addition to the SB737 effort in 2010, surface water of the Powder River at two locations was sampled 3 times in 2011 by DEQ's Toxics Monitoring Program. At the time of this summary (December 2011) only results for the Spring 2011 Toxics Monitoring Program were available. The sampling locations **(Table 4-9)** correspond to established DEQ ambient monitoring stations listed in the agency's Laboratory Analytical Storage and Retrieval (LASAR) database. The stations sampled as part of the 2011 Toxics Monitoring program were as follows:

Table 4-9. 2011 Toxics Monitoring Program sampling stations on the Powder River

LASAR #	Site Description	Latitude	Longitude
10724	Powder River at Hwy 86 (east of Baker City)	44.8183	-117.4675
11857	Powder River at Snake River Road (Richland)	44.7463	-117.1718

Of the two Toxics Monitoring Program sampling locations visited in 2011, LASAR station 10724 is the nearest to Baker City and lies approximately 50 miles downstream of the wastewater treatment plant. The second sampling location (LASAR # 11857) was located approximately 18 miles downstream from LASAR station 10724.

Results for the two ambient surface water sites sampled on June 7, 2011 as part of the Toxics Monitoring Program (Sampling Event: 20110469) revealed several dissolved metals, and except for cholesterol and coprostanol, few organic detections at the Powder River at Hwy 86 site. Analyses of surface water collected at the Powder River at Snake River Road –Richland revealed a similar picture of low dissolved metals and measurable concentrations of cholesterol and coprostanol. These data are currently being evaluated by DEQ LEAD staff.

Mercury

During the spring of 2011, EPA Region 10 proposed to sample fish tissue for mercury in reservoirs in the Powder and Malheur Basins. Five reservoirs were selected for sampling based on their popularity for fishing and their proximity to an area of potential high mercury deposition determined by mercury air deposition modeling. The reservoirs selected were: Brownlee Reservoir, Phillips Reservoir, Thief Valley Reservoir, Balm Creek Reservoir, and Bully Creek Reservoir (Malheur River Basin). Fish samples were collected in June and July of 2011 with the assistance of sampling crews from ODF&W and Idaho Power. Results from the sampling effort were the basis for new fish consumption advisories for Phillips and Brownlee Reservoirs. More information regarding the fish advisories is available at:
http://public.health.oregon.gov/HealthyEnvironments/Recreation/Pages/fishconsumption.aspx#lower

Prior to sampling, EPA compiled fish tissue data from the region of Eastern Oregon and Southwestern Idaho that was collected between 1969 and 2007 by the U.S. Geological Survey, EPA, Idaho DEQ, Oregon DEQ, University of Idaho, the Idaho Fish and Game Department. **Table 4-10** contains a summary of the results with median mercury values for the four sample locations within the Powder Basin. A great majority of the samples were collected in Brownlee Reservoir on the Snake River.

Table 4-10. Mercury Concentrations in Fish Tissue, Powder River Basin/Brownlee Reservoir, 1969-2007

Water Body	Number of Samples	Sample Dates	Species	Median Mercury Conc. (mg/kg)
Sumpter Valley Dredge Ponds	8	2001	Northern Pike Minnow, Bridgelip Sucker	0.25
North Powder River	1	1997	Mountain Sucker	NA
Phillips Reservoir	6	1994	Smallmouth Bass, Black Crappie, Rainbow Trout	0.39
Brownlee Reservoir	238	1969-2007	Smallmouth Bass, White Crappie, Channel Catfish, Carp, Black Crappie, Yellow Perch, Bluegill, Largescale Sucker, Rainbow Trout	0.46

Upper Powder River Heavy Metals Mining Investigation

In August 2001, EPA Region 10, the DEQ Cleanup Program and the Wallow Whitman National Forest conducted fish tissue and stream sediment sampling in Cracker Creek, near Sumpter, Oregon. Cracker Creek is and Upper Powder River tributary located in an historic gold mining district. The fish tissue and sediment samples were analyzed for 23 metals. Most of these metals are commonly associated with gold deposits and associated mining wastes. Samples were collected within three reaches approximately ½ mile in length. The Sumpter Reach is located just upstream and north of Sumpter, the Pole Creek Reach is located upstream at the confluence of Pole Creek and the Silver Creek Reach is located further upstream just below the confluence of with Silver Creek **(Figure 4-56)**. Fish species collected were Redband Trout and Mountain Whitefish. Results are reported in **Table 4-11** and **Table 4-12**.

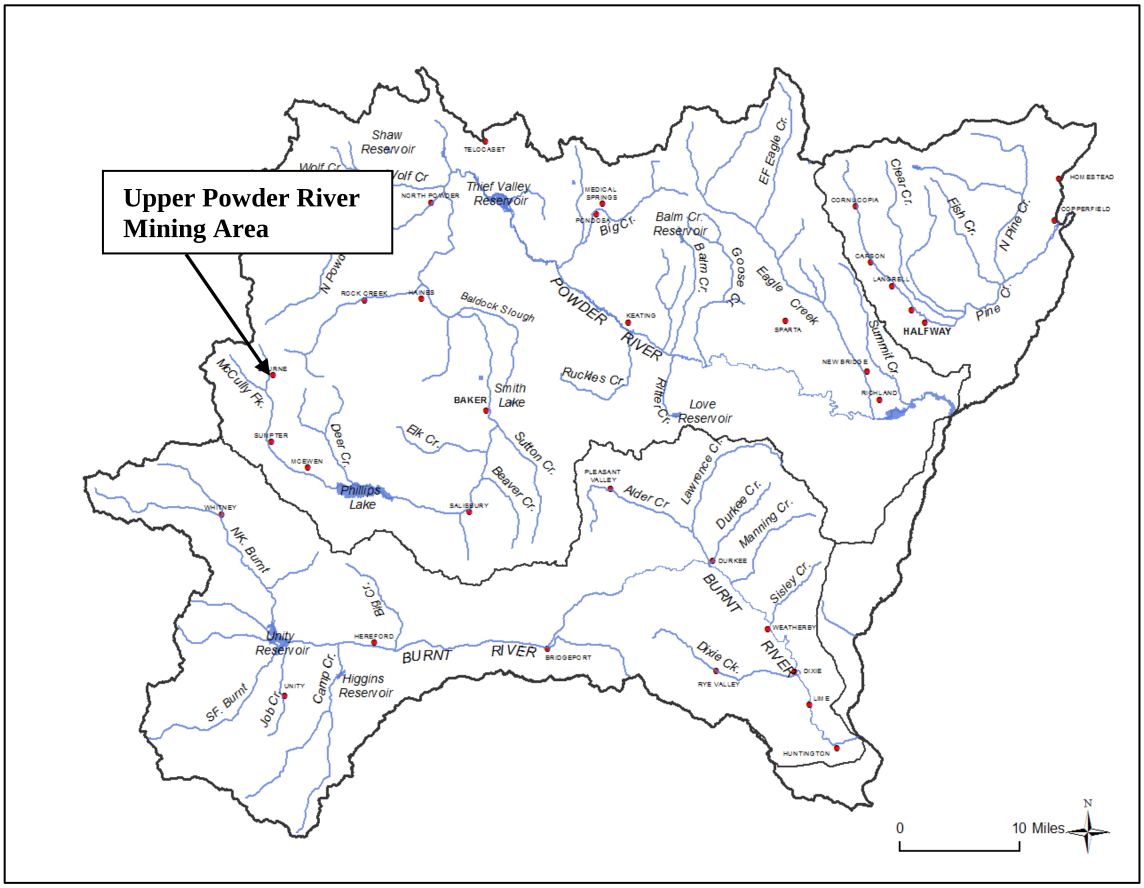


Figure 4-56: Upper Powder River Heavy Metals Mining Investigation Study Area, DEQ, 2001.

A comparison of fish tissue results to dietary screening concentrations that were available in 2001, shows that none of the tissue concentrations exceeded the criteria. However, sediment concentrations of antimony, arsenic, cadmium, copper, lead, mercury, nickel, and zinc exceeded DEQ ecological risk screening criteria. Sediment concentrations of antimony, arsenic and cadmium exceeded screening values in all three reaches, and arsenic concentrations exceeded the screening values by 1-2 orders of magnitude. Arsenic has been found at high concentrations in water discharges, waste rock, and mill tailings at several of the historic mine sites located upstream of the sample locations, and it is likely that this is the source of the metals contamination. More information regarding historic mine sites in the Upper Powder River basin can be found in DEQ's Cleanup Program Environmental Cleanup Site Information (ECSI)

database:
http://www.deq.state.or.us/lq/ECSI/ecsiquery.asp?listtype=lis&listtitle=Environmental+Cleanup+Site%20Information+Database

A toxicological review of the fish tissue and sediment data in 2002 resulted in the conclusion that all fish tissue concentrations were below the NOAEL dietary criteria, and mercury concentrations were also well below the FDA level of 0.3 mg/kg, making them safe for human consumption. The fish tissue results also suggested that metals concentrations were unlikely to be a threat to fish-eating species. However, metals concentrations in sediment, particularly for arsenic and cadmium, may pose a risk to benthic invertebrates.

Table 4-11. Metals Concentrations in Fish Tissue, Cracker Creek, 2001

Upper Powder River Basin Site	Silver Creek Reach		Pole Creek Reach		Sumpter Reach		NOAEL dietary concentration
Metals	**mg/kg-wet**		**mg/kg-wet**		**mg/kg-wet**		**mg/kg**
Aluminum	1.1		2.01		1.3		10.7
Antimony	0.05	U	0.05	U	0.05	U	1.6
Arsenic	0.26		0.36		0.783		2.9
Barium	0.039		0.066		0.07		63.7
Beryllium	0.02	U	0.02	U	0.02	U	8.3
Cadmium	0.052		0.046		0.032		12.5
Calcium	178		236		285		
Chromium	0.519		0.36		0.36		41.0
Cobalt	0.1	U	0.1	U	0.12		15.0
Copper	0.534		0.762		0.73		38.0
Iron	8.23		8.46		8.3		
Lead	0.01	U	0.01	U	0.0099	U	400.0
Magnesium	247		230		252		
Manganese	0.487		0.333		0.569		1100.0
Mercury	0.0716		0.0866		0.108		0.4
Nickel	0.2	U	0.2	U	0.2	U	62.5
Potassium	3840		3310		3740		
Selenium	0.979		1.05		1.25		2.5
Silver	0.08	U	0.08	U	0.079	U	
Sodium	625		581		611		
Thallium	0.05	U	0.05	U	0.05	U	0.1
Vanadium	0.06	U	0.06	U	0.059	U	2.6
Zinc	8.3		8.46		8.15		2000.0

Note: U indicates undetected at the given detection limit

Figure 4-12. Metals Concentrations in Sediment, Cracker Creek, 2001

Upper Powder River Basin Site		Silver Creek Reach		Pole Creek Reach		Sumpter Reach		Ecological Risk Sediment Screening Level Value
Metals		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**
Aluminum		8660		5860		7800		
Antimony		**4.5**	UJ	**4.5**	UJ	**4.5**	UJ	3
Arsenic		**205**		**139**		**72.2**		6
Barium		146		101		106		
Beryllium		0.21		0.19		0.19		
Cadmium		**1.15**		**0.75**		**1.13**		0.6
Calcium		1710		1230		1400		
Chromium		14.1		12.5		22.7		37
Cobalt		7.44	J	5.95	J	9.73	J	
Copper		**42.2**		32.8		**39.4**		36
Iron		19400		15400		19900		
Lead		**40.8**		27.6		15.9		35
Magnesium		5120		3310		4160		
Manganese		358		411		654		1100
Mercury		0.125		**0.251**		0.074		0.2
Nickel		16.6		16		**25.2**		18
Potassium		2280		1490		1210		
Selenium		0.34		0.24	U	0.65		
Silver		1.5		1.78		1		4.5
Sodium		68.3	J	63.9	J	68	J	
Thallium		1	UJ	1	UJ	1.1	UJ	
Vanadium		39.2		27.7		31.4		
Zinc		**187**		106		121		123

Note: U indicates undetected at the given detection limit, J indicates estimated value

Bolded results exceeded screening value

4.3.10 Altered Hydrology

Altered hydrology refers to decreased summer flows due to diversions, changes in flow magnitude and timing from dam operations, flashier flow regimes due to altered uplands conditions, returning excess flow to a different reach or watershed, and groundwater withdrawal impacts. Flow alterations can directly impact instream water quality and fish and aquatic life habitat.

There are 39 303(d) listings of impairment for flow modification (altered hydrology) in the Powder Basin. These impairments were originally identified in the 1994/1996 Water Quality Assessment, with much of the source information for the listings coming from a Nonpoint Source Assessment done by DEQ in 1988 (DEQ 1988). In 2002 EPA determined that flow modification was not a pollutant. Although the water bodies are considered water quality limited, TMDLs are not required to address the problem.

The Oregon Water Resources Department (WRD) and Oregon Fish and Wildlife Department (ODF&W) jointly identified priority areas for stream flow restoration throughout Oregon. The watersheds were ranked based on flow restoration need, flow restoration opportunity, and a combination of the first two criteria which resulted in the designation of state flow restoration priority watersheds which will be addressed by WRD. **Figure 4-57** shows the flow restoration priorities for the Powder Basin. The watersheds are based on the Water Availability Basins (WAB) used for WRD's water availability calculations.

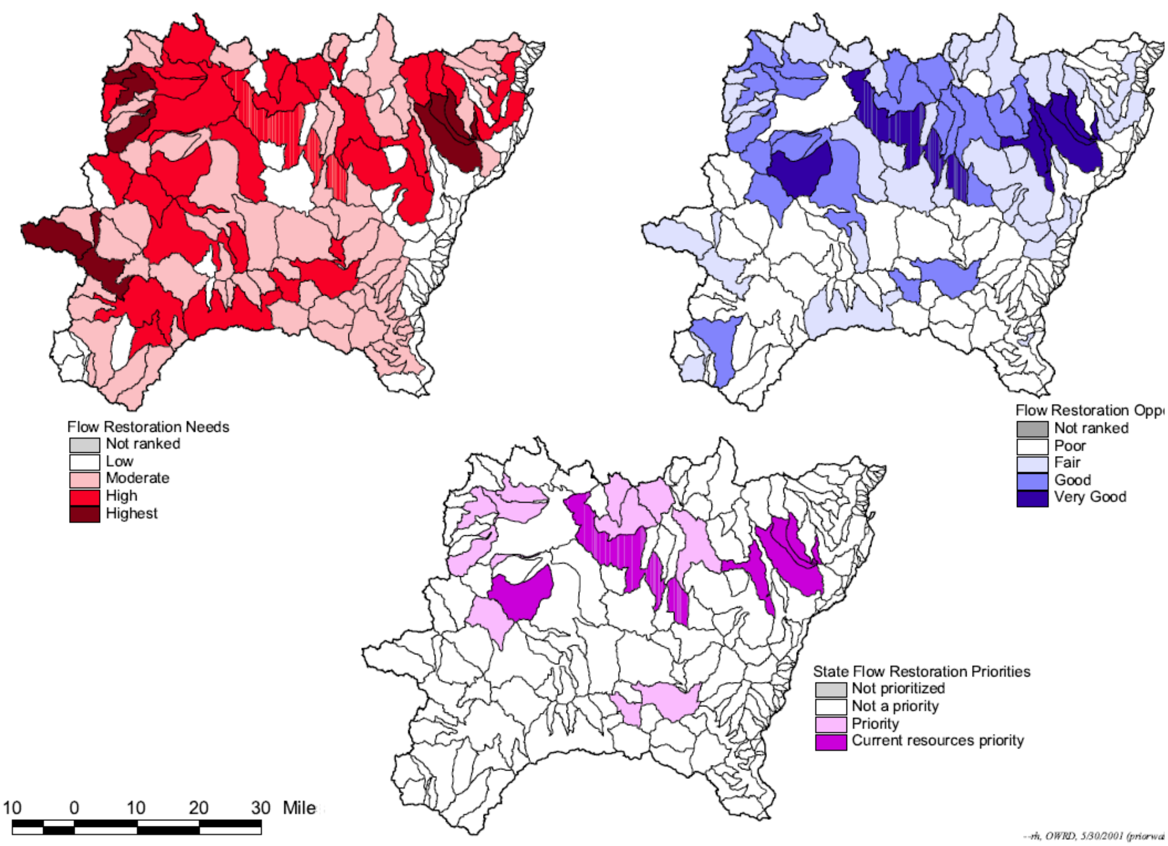


Figure 4-57: Summer (July-September) Flow Restoration Priorities for Recovery of Salmonids, Powder Basin, Oregon, OWRD, 2001:
http://www.wrd.state.or.us/OWRD/mgmt_opsw.shtml

In the Powder Basin, ODF&W ranked the following watersheds as its highest priorities for flow restoration: North Fork Burnt River, Dry Creek (tributary of NF Burnt), upper North Powder River, North Fork Anthony Creek, Anthony Creek, Pine Creek, Clear Creek (tributary of Pine Creek), and East Pine Creek **(Figure 4-57)**. During the prioritization process, ODF&W district biologists used information regarding the presence of fish, habitat integrity, risks to fish survival, and restoration potential for each WAB **(OWRD, 2001)**. These watersheds can be seen in more detail in ODF&W's Flow Restoration Priorities Map **(ODF&W, 2001)** http://rainbow.dfw.state.or.us/nrimp/information/streamflow/09Powder.pdf

Based on a combination of the flow restoration need from ODF&W and the flow restoration opportunity, WRD chose the following watersheds as flow restoration priorities: Salmon Creek, Powder River Below Thief Valley Reservoir, Eagle Creek, Summit Creek (tributary to Eagle Creek), Pine Creek, Clear Creek (tributary to Pine Creek), and East Pine Creek **(Figure 4-57)**. The plan calls for ODF&W and WRD to work with local watershed councils to provide information and input on flow restoration priorities. The assistance of the councils is needed to help in the pursuit of voluntary actions for restoring stream flow. Watermasters are also annually identifying activities in where they can work to restore stream flow **(OWRD, 2001)**.

4.3.11 Habitat Modification (i.e. Sumpter Valley and other channelized and dredged streams)

There are 86 303(d) listings of impairment for habitat modification in the Powder Basin. These impairments were originally identified in the 1994/1996 Water Quality Assessment, with much of the source information for the listings coming from a Nonpoint Source Assessment done by DEQ in 1988 (DEQ 1988). In 2002 EPA determined that habitat modification was not a pollutant. Although the water bodies are considered water quality limited, TMDLs are not required to address the problem.

The Powder Subbasin Report and supplement prepared with support from the Northwest Power and Conservation Council **(NPCC, 2004)**, identified habitat loss and degradation as a common limiting factor for terrestrial and aquatic systems. Channel stability, riparian condition, flow, and habitat diversity, were identified as important aquatic habitat attributes. The Supplement to the Powder and Burnt Subbasin Plans **(NPCC, November 2004)** included a prioritized list of limiting factors. Objectives which address habitat condition limiting factors are listed below:

Objective 1. Improve riparian, floodplain and wetland habitats

Strategies:

A. Maintain/protect existing riparian, floodplain and wetland habitats.
Addresses the limiting factors of riparian condition, channel stability, habitat diversity, low flow, fine sediment and high temperature by preventing further degradation.

B. Implement proper grazing management.
Addresses the limiting factors of riparian condition, channel stability, habitat diversity and fine sediment by managing livestock for minimum stream access to reduce loss of riparian vegetation and degradation of stream banks with its attendant loss of channel stability and increased introduction of fine sediment. Improvements in riparian condition aid in improvements to habitat diversity.

C. Establish buffers to improve riparian areas through conservation easements, riparian fencing and implementation of setbacks.
Addresses the limiting factors of riparian condition, habitat diversity, channel stability and fine sediment. A healthy, functioning riparian zone contributes to habitat diversity through the addition of large wood and root structures, aids in stabilizing channels and captures and holds fine sediment from surface runoff.

D. Reestablish wetlands through easements, restoration and enhancement.
Addresses the limiting factor of low flow. Properly functioning wetlands hold water that becomes available during precipitation and high flow events and release it into the system gradually to maintain flow longer into the summer season. As flows improve, other habitat attributes will follow.

E. Plant native vegetation (seed, rootstock or cuttings).
Addresses the limiting factors of riparian condition, habitat diversity, channel stability, fine sediment and low flow. Native vegetation will contribute to a properly functioning riparian zone which will stabilize stream banks, moderate sediment inputs, increase habitat diversity and store water for gradual release to maintain flow into the summer season.

F. Restore and maintain connection of stream channels to their floodplains to restore floodplain function.
Addresses the limiting factors of channel stability and fine sediment. As with wetlands and riparian areas, a properly connected and functioning floodplain dampens the effects of high flow events by capturing and holding some of the water which reduces erosion and sediment input.

Objective 2. Improve stream channel processes.

Strategies:

A. Allow stream flow processes to maintain channels through restoration of natural flow regimes and floodplain connection.
Addresses the limiting factors of low flow, habitat diversity, channel stability, high temperature, fine sediment, dissolved oxygen and pollutants by restoring more natural function. This may require reductions in irrigation and storage and maintenance of minimal flows to recreate natural flow regimes.

B. Improve in-stream channel habitat through placement of large woody debris and boulders, bank stabilization efforts and flow augmentation/improvement.

Addresses the limiting factors of channel stability, habitat diversity, low flow, high temperature, dissolved oxygen and pollutants. In additions to physically creating habitats and stabilizing channels, these measures will contribute to the potential for aquatic organisms to survive periods of high temperature or low flow by creating habitat features that serve as refugia.

C. Develop off-channel habitat.
Addresses the limiting factors of low flow, high flow and habitat diversity by re-introducing historic habitats.

D. Remove or modify levies, berms, roads or dikes where appropriate.
Addresses the limiting factors of obstructions, habitat diversity, channel stability, fine sediment, low flow and water quality. Removal or improvement of such structures will eliminate some

passage barriers, reduce erosion of sediment into the stream and improve flows by cutting down on water seepage out of the system. Whenever flows are improved, other water quality attributes generally improve as well.

E. Re-configure modified channels through active restoration.
Addresses all the limiting factors by restoring a stream to its natural function.

4.3.12 Biocriteria

DEQ LEAD staff reviewed the limited macroinvertebrate monitoring data (15 sites) that are available for the Powder Basin and reported the following:

Biological Condition: Using DEQ's predictive models to assess biological condition, nine sites were classified as good (least disturbed) condition, four sites were in moderately disturbed condition, and two sites were in most disturbed condition **(Figure 4-58)**. For more information on DEQ's biological condition models, see:
http://www.deq.state.or.us/lab/techrpts/docs/10-lab-004.pdf

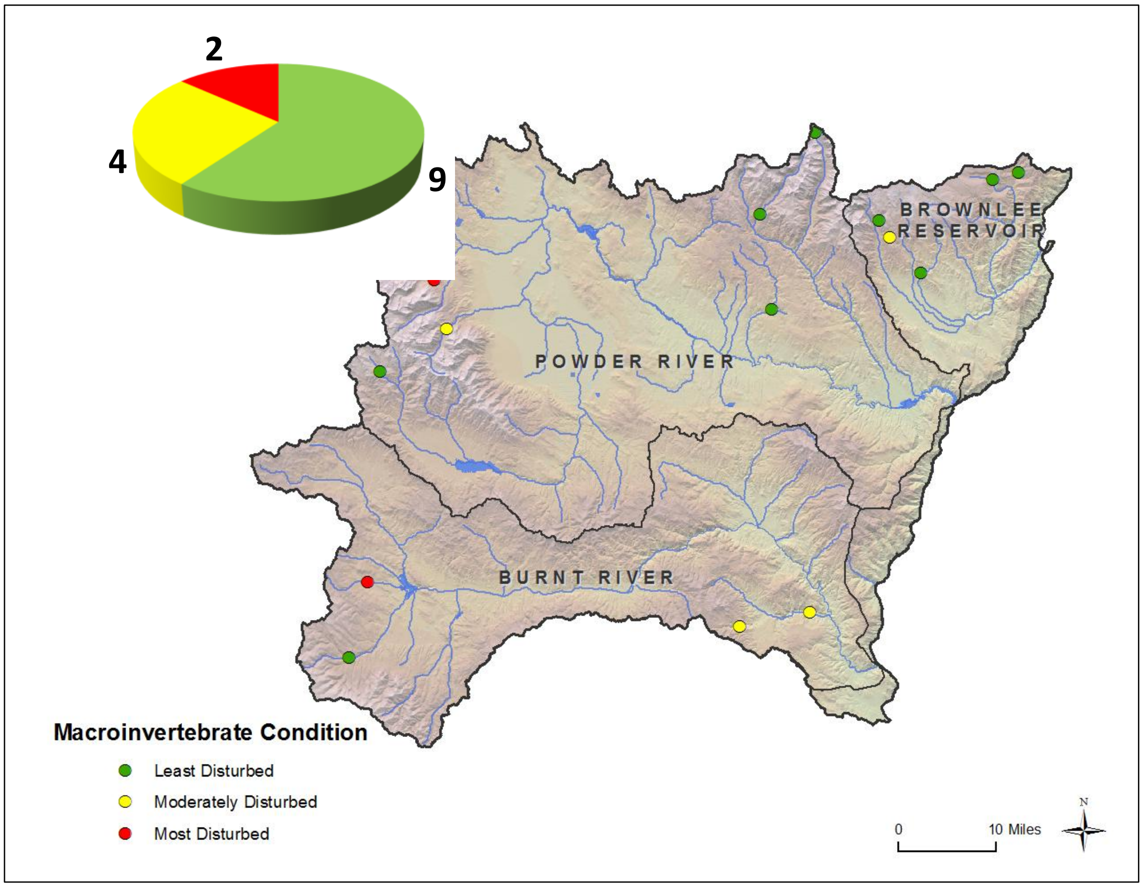


Figure 4-58: DEQ Macroinvertebrate Condition in the Powder Basin 2000-2002

Available information on optimal conditions for macroinvertebrate taxa were used to model potential causes of stress to macroinvertebrate assemblages. Using macroinvertebrates alone, seasonal maximum temperature and percent fine sediments were inferred at each site. Comparisons of inferred conditions at each site were compared to conditions at reference sites in the same ecoregion. The results for temperature stress and fine sediment stress are described below:

Temperature stress: Eight sites in the Powder Basin showed good condition for temperature stress, with two sites in fair condition. Five sites in the Powder Basin showed poor conditions for temperature stress, meaning the macroinvertebrates at these sites showed higher temperature preferences than the macroinvertebrates at most reference sites.

Fine sediment stress: Eight sites were in good condition for fine sediment stress. Three sites were in fair condition and four sites were in poor condition for fine sediment stress.

For more information on DEQ's Stressor ID models, see:
http://www.deq.state.or.us/lab/techrpts/docs/10-LAB-005.pdf

The biological data used for this summary was "found data", pulled together from various projects over the years. Results presented here should be considered as inadequate to accurately represent conditions of the macroinvertebrate aquatic life beneficial use. Support for these monitoring programs has disappeared at DEQ, meaning that future assessments will not be possible without adequate funding. At a minimum, a random survey of macroinvertebrates should be planned prior to the next assessment in order to gain a better understanding of conditions for this beneficial use. At least 30 sites should be surveyed, with 50 sites being the preferred sample size. This should be repeated once every five years to gain an understanding of trends (improving or declining conditions) in the aquatic life use.

Additional sources of data for this beneficial use should be incorporated in future assessments, as well as exploring the development of partnerships to expand on macroinvertebrate monitoring. At a minimum, the USFS has long-term monitoring programs in place that collect macroinvertebrates (as well as other stream health indicators). DEQ needs to pull this data in for assessments within the Watershed Approach. We could potentially maximize efficiencies in our monitoring by using USFS data to assess conditions on federally owned lands, while DEQ monitors macroinvertebrates on non-federally owned lands. This could significantly reduce the amount of resources (i.e., funding) required to do random monitoring across the state. It would require a significant investment in coordination with other agencies to ensure compatible monitoring plans, however the benefits vastly outweigh the costs.

4.3.13 Hamful Algae Blooms

Some species of algae, such as cyanobacteria or blue-green algae, can produce toxins or poisons that can cause serious illness or death in pets, livestock, wildlife and humans. There are multiple beneficial uses affected by harmful algal blooms. These include: aesthetics, livestock watering, fishing, water contact recreation, and drinking water supply.

The Oregon Department of Health Services (DHS) runs the Harmful Algae Bloom Surveillance (HABS) program which tracks blue-green algae health advisories: http://www.oregon.gov/DHS/ph/hab/. Health advisories are generally posted if the cell density of blue-green algae equals or exceeds 100,000 cells/ml (DHS, 2009 http://www.oregon.gov/DHS/ph/hab/docs/DHS_GUIDANCE_on_HAB.pdf; Stone and Bress, 2007). At this time, cell density limits adopted by Oregon are based on recommendations by the World Health Organization (WHO): http://www.who.int/water_sanitation_health/bathing/srwe1execsum/en/index7.html. To protect people from irritation and allergies related to cyanobacteria, WHO also suggests a guideline level of 20,000 cells/ml. DEQ adopted this intermediate guidance level as one of the triggers to indicate a potential concern.

Historically, algae data have been collected on numerous lakes around the state. Data collected prior to 1985 is summarized in two reports (Sweet 1985; Johnson et.al., 1985). In June 2011, DEQ completed a statewide HAB strategy report **(DEQ, 2011)** http://www.deq.state.or.us/wq/algae/algae.htm, which identified HAB concerns in the Powder Basin **(Figure 4-59)**.

- Brownlee Reservoir – *Category 3B (potential concern, data needed)* for HAB (not in the Integrated Report); reports/articles on dog deaths due to HABs but no Oregon Advisories were issued.
- Phillips Reservoir – *Category 3B (potential concern, data needed)* for HAB (not in the Integrated Report); (*Aphanizomenon flos-aquae* was a dominant species in a 1982 algal sample collected from the lake (Sweet, 1985, Atlas of Oregon Lakes (Johnson et al, 1985)).
- Thief Valley Reservoir – *Category 3B (potential concern, data needed)* for HAB (not in the Integrated Report); (*Aphanizomenon flos-aquae* was a dominant species in a 1969 and 1982 algal sample collected from the lake (Sweet, 1985, Atlas of Oregon Lakes (Johnson et al, 1985)).
- Unity Reservoir – *Category 3B (potential concern, data needed)* for HAB (not in the Integrated Report); (*Aphanizomenon flos-aquae* was a dominant species in a 1970 algal sample collected from the lake (Sweet, 1985, Atlas of Oregon Lakes (Johnson et al, 1985)).

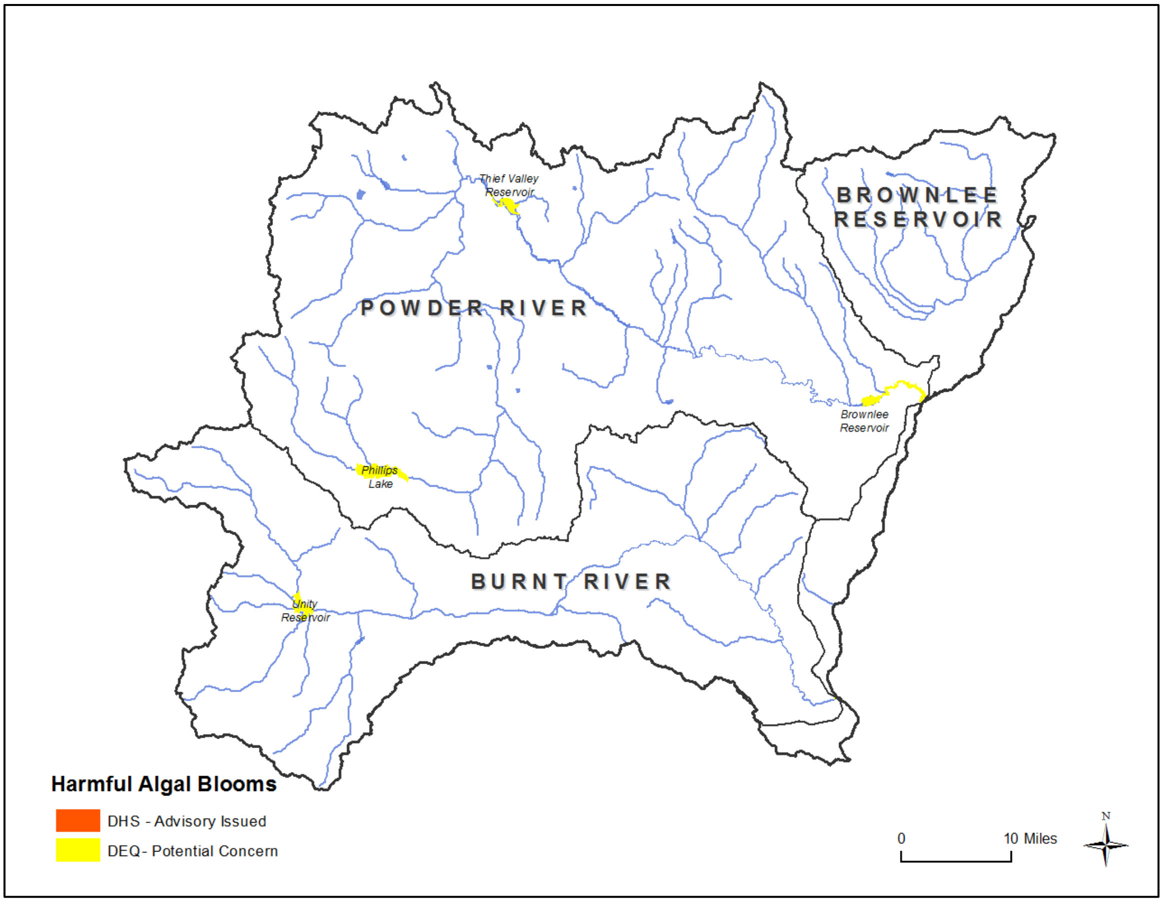


Figure 4-59: Harmful Algal Blooms in the Powder Basin

References

Bailey, Timothy, 2011. Oregon Department of Fish and Wildlife, NE District Biologist, LaGrande, OR.

Johnson, Daniel, R. Petersen, D. Lycan, J. Swett, M. Newhaus, and A. Schaedel, 1985. Atlas of Oregon lakes. OSU Press.

Northwest Power and Conservation Council, 2004a, Powder Subbasin Report, in Columbia River Basin Fish and Wildlife Program, Portland, OR. http://www.nwcouncil.org/fw/subbasinplanning/Default.htm

Oregon Department of Environmental Quality, *1988 Oregon Statewide Assessment of Nonpoint Sources of Water Pollution*, Portland, OR.

Oregon Department of Environment Quality, 2011. Hazardous Algae Bloom status Report. http://www.deq.state.or.us/wq/algae/algae.htm

Sweet, James W. 1985. An Analysis of Phytoplankton of Oregon Lakes. Aquatic analysts. Portland, OR.

5. Groundwater Quality Status and Trends

5.1 Groundwater Monitoring

Groundwater information is limited in the Powder Basin and DEQ does not have an established basin groundwater monitoring plan. The DEQ LASAR database includes groundwater data from the Haines Groundwater Investigation (1989), monitoring data collected by the permittee of the Baker Landfill (1994-2011), and groundwater data from the northern portion of the Northern Malheur County Groundwater Management Area (1990-2011). These study areas are shown in **Figure 5-1**. Groundwater monitoring data from the Real Estate Transaction database were also reviewed. These data are from private drinking water wells located throughout the basin. Data from these three sources are discussed in **Section 5.2**.

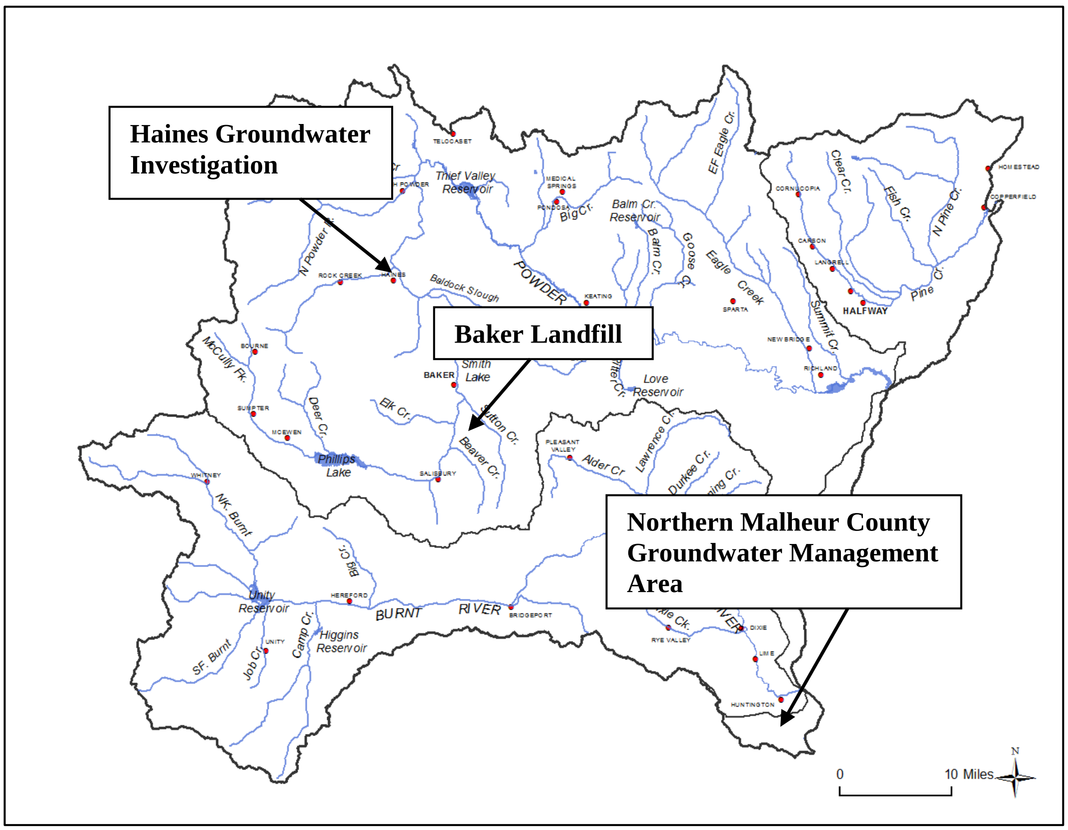


Figure 5-1. Groundwater Sampling Projects in the Powder Basin

5.2 Groundwater Quality and Support of Beneficial Uses

5.2.1 Haines Groundwater Investigation
In 1989, DEQ performed the Haines groundwater investigation in response to a complaint about the potential for pesticides and herbicides in groundwater. A total of 19 wells were sampled in the vicinity of Haines, which is located approximately 10 miles north of Baker City **(Figure 5-1)**. Pesticides and herbicides were not detected with the exception of two detections of the herbicide picloram at 0.00015 and 0.000028 mg/l. The investigation also included analyses for nitrate. Nitrate results are summarized in **Table 5-1**. The Haines area nitrate results were generally low, with all concentrations of nitrate below the nitrate drinking water Maximum Contaminant Limit (MCL) of 10 mg/l and a median value of 0.93 mg/l.

5.2.2 Baker Landfill Groundwater Data
The Baker Landfill **(Figure 5-1)** operates under a Solid Waste permit from DEQ which requires periodic groundwater monitoring. Analyses include a suite of hazardous chemicals along with standard water quality parameters such as nitrate. Monitoring results from groundwater samples collected from monitoring wells at the landfill between 1994 and 2007, indicate that no hazardous chemicals from the landfill are impacting down-gradient groundwater. Nitrate concentrations are low, with a maximum concentration of 2.17 mg/l **(Table 5-1)**.

5.2.3 Northern Malheur County Groundwater Management Area
The Northern Malheur County Groundwater Management Area (NMC GWMA) was declared in 1989 after widespread groundwater nitrate contamination primarily from agricultural-related nonpoint source activities. DEQ, a citizen's advisory committee, and a local interagency advisory committee created an Action Plan for reducing the groundwater nitrate concentrations to acceptable levels. The advisory committee also expressed concerns about the pesticide dacthal which had been detected in local wells. Dacthal was added to the monitoring program and has declined in concentration over time. However, some recent data has not been of suitable quality for use in calculating trends. Qualitative assessments of dacthal data have been performed instead.

The Northern Malheur County GWMA covers an 115,000-acre area in the northeastern portion of the Malheur County where land use is dominated by irrigated agriculture. The GWMA boundary starts at the mouths of the Malheur and Owyhee Rivers where they converge with the Snake River and extend to the uppermost irrigation canals. The northern tip of the NMC GWMA is located within the southeast corner of the Powder Basin **(Figure 5-1)**. This brief summary of nitrate data from the GWMA is meant to only apply to this limited portion of the GWMA and its relation to other groundwater data from the Powder Basin. More information regarding the NMC GWMA can be found at: http://www.deq.state.or.us/wq/groundwater/nmcgwma.htm.

Nitrate concentrations in groundwater from the five monitored wells in the GWMA that are located in the Powder Basin are significantly higher than concentrations from the other groundwater data sets in the basin that have been developed from sampling over a period of over 20 years **(Table 5-1)**. Nitrate concentrations from samples collected in the Powder Basin portion of the NMC GWMA range between 9.62 and 250 mg/l with a median value of 19.7 mg/l, well above the nitrate drinking water MCL of 10 mg/l, and consistent with nitrate levels found throughout the NMC GWMA. These concentrations of nitrate indicate that the drinking water beneficial use of groundwater in the GWMA is not supported. Many groundwater users in the area use treatment systems to reduce nitrate concentrations to acceptable levels.

5.2.4 Real Estate Transaction Database

The Oregon Health Authority requires monitoring of nitrate and bacteria concentrations in drinking water from private wells at the time of property transfer. Results from the Oregon Real Estate Transaction Database for transactions in the Powder Basin from 1991-2003 were reviewed. The data mainly included results for bacteria and nitrate, and a few measurements of pH, hardness, and arsenic. Bacteria results were presence/absence only and were all non-detect. Nitrate results are summarized in **Table 5-1**. With a few exceptions, most results were below the nitrate MCL of 10 mg/l.

Table 5-1. Powder Basin Nitrate Concentrations in Groundwater (mg/l)

Data Set	Number of Samples	Maximum	Minimum	Median
Haines GW Study (1989)	19	9.2	0.03	0.93
Baker Landfill (1994-2007)	29	2.17	0.16	0.24
NMC GWMA (1990-2011)	281	250	9.62	19.7
Real Estate Transaction Database (1991-2003)	32	32.2	0.10	1

6. General Water Quality Priorities in the Powder Basin

The following general water quality-related priorities for the Powder Basin were derived from a review of water quality data, report recommendations, and grant proposals from groups such as the USFS, U.S. BLM, NRCS, Powder Basin SWCDs, Powder Basin Watershed Council, and Northwest Power and Conservation Council. This report section is intended to give a general view of significant watershed issues as defined by partner agencies with appropriate planning responsibilities and is not intended as an exhaustive list.

- **Forestry -** manage for a more natural frequent, low-intensity fire cycle to reduce damage from insects and disease, overstocking, and fuel buildup. Thinning and improved management is needed to increase productivity and reduce the risk of catastrophic fire and improve riparian vegetation.

- **Agriculture**

  Rangeland **-** manage juniper stands for better watershed health, reduced water use, reduced invasive weeds, and better riparian habitat.

  Pasture/Hay – improve water management, improve grazing management, reduce streambank erosion and improve riparian vegetation.

  Grain and Row Crops – improve water management, reduce irrigation induced erosion, improve riparian vegetation.

- **Dam/Water Management** – alter flow management to improve riparian vegetation, establish minimum stream flows where possible.

- **Flood Plain and Stream Channel Restoration** – re-establish stream/flood plain connections, and natural stream channel shape and sinuosity where possible.

- **Roads** – manage road systems for improved riparian condition, flood plain connection, reduced erosion, and fish passage (culverts).

- **Invasive Plants** – manage the high levels of invasive plant communities which are affecting intensity and frequency of wild fires and increasing the levels of erosion and sedimentation of streams (especially in areas adjacent to the Snake River).

7. Status of Current DEQ Water Quality-Related Actions

7.1 TMDL Program

Streams in the Powder Basin are included on the 303(d) list of water quality limited waterbodies with Total Maximum Daily Loads (TMDL) needed for dissolved oxygen, chlorophyll, bacteria, temperature, turbidity, sedimentation, and arsenic. Monitoring is being conducted to support TMDL development for these parameters, as well as the total phosphorus load allocations developed in the Snake River-Hells Canyon TMDL **(DEQ, 2004)**.

Actions: DEQ will continue the monitoring program for nutrients and bacteria currently underway, and will also implement a temperature monitoring program. These data will be used to model water quality conditions and to develop load allocations for nonpoint sources as well as waste load allocations for point sources such as discharging wastewater treatment plants.

DEQ has started to engage stakeholders in the basin as part of its monitoring efforts along with outreach conducted as part of the Watershed Approach process. These efforts will continue throughout TMDL development.

7.2 Waste Water Control – Point Source Program

7.2.1 Domestic Waste Water Permitting

As discussed in **Section 3.1.1**, there are four discharging WWTPs in the Powder Basin that are regulated by NPDES permits. These four WWTPs are the most significant point sources of water pollutants in the Powder Basin. All four permits are due for renewal, and all four plants are in need of upgrades to meet current and future needs.

Actions: The DEQ Water Quality Permitting Section will continue to work with the cities of North Powder, Halfway, Huntington and Baker City to renew the discharge permits for their wastewater treatment plants and upgrade their facilities to meet current water quality standards, and position them to meet future TMDL requirements.

7.2.2 Pre-Treatment Program

There is currently no active pre-treatment program in the Powder Basin. In accordance with its NPDES permit, Baker City has updated its industrial waste survey for 2012 and found no industrial discharges which require pre-treatment.

Actions: The DEQ Wastewater Permitting Program will continue to work with Baker City and to assess the need for industrial pre-treatment. The need for similar measures in the other smaller cities in the basin will be determined on a case by case basis.

7.2.3 Stormwater Program

Stormwater runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snow events often contain pollutants that could adversely affect water quality. NPDES permits are required for storm water discharges to surface waters from construction and industrial activities and municipalities if stormwater from rain or snow melt leaves your site through a "point source" and reaches surface waters either directly or through storm drainage. A point source is a natural or human-made conveyance of water through such things as pipes, culverts, ditches, catch basins, or any other type of channel.

A municipal separate storm sewer system (MS4) is a conveyance or system of conveyances (e.g., roads with drainage systems, municipal streets, catch basins, curbs, gutters, manmade channels or storm drains) owned or operated by a governmental entity that discharges to waters of the State. Sources that need to obtain an MS4 permit are classified as either "Phase I" or "Phase II". Phase I MS4s are those with populations greater than 100,000, while regulated Phase II (or "small") MS4s serve populations less than 100,000 located within Census Bureau-defined Urbanized Areas. Federal regulations also provide EPA and the states the discretion to require other MS4s outside of Urbanized Areas to apply for a permit. There are currently no MS4 municipal stormwater permits in the Powder Basin.

Actions: DEQ will continue to work with communities to address stormwater issues and coordinate with the UIC program to achieve compliance with UIC rules and also meet surface water quality goals such as possible TMDL load allocations.

7.2.4 Biosolids Program

Biosolids are the nutrient-rich organic solids that are derived from the treatment of domestic wastewater at municipal wastewater facilities. The organic matter, nitrogen, and phosphorus as well as numerous micronutrients present in biosolids enhance intensively-managed agricultural soils as well as degraded soils. Biosolids act as a slow-release fertilizer, which improves plant growth, while reducing the use of conventional fertilizers in agricultural operations. The high organic matter content in biosolids enhances soil water holding capacity and improves microbial activity. Overall, biosolids improve soil quality by enhancing soil functions, such as cycling nutrients, regulating water, and filtering potential pollutants. The results of biosolids land applications include healthier crops with better drought resistance, fewer pollutants leaching to groundwater and surface water, and less erosion and sediment runoff to surface waters.

The DEQ Biosolids program regulates wastewater solids and domestic septage that has undergone sufficient treatment to allow its beneficial use as a soil amendment or fertilizer through land application. Biosolids are regulated through NPDES or WPCF water quality permits issued by DEQ. Prior to land application, the concentrations of ten pollutants must fall below federal and state limits, pathogens must be reduced, and the biosolids stabilized (i.e., vector attraction reduction or VAR) to reduce odors. Biosolids contain significant concentrations of nitrogen and may not be applied at rates that exceed the agronomic requirements for crops cultivated onsite.

Ten municipal wastewater treatment facilities operate in the Powder Basin. All of these facilities currently operate some type of lagoon wastewater treatment system and do not have routine biosolids land application programs. Facilities operating wastewater lagoons typically land apply biosolids only when the lagoons are dredged for maintenance or cleaning, which often occurs at frequencies between 10 and 20 years.

Wastewater treatment facilities in the Powder-Basin operating lagoons that require periodic dredging and land application of accumulated wastewater solids include:

- Baker City
- Baker County
- Haines
- Halfway
- Huntington

- North Powder
- Richland
- Sumpter
- Unity
- USDOI, BLM – Oregon Trail Interpretive Center

Actions: Continue to work with wastewater treatment facilities to identify beneficial reuse opportunities as needed for periodic lagoon maintenance and ensure appropriate application through NPDES and WPCF permit requirements.

Alignment Opportunity: Work with wastewater facilities, communities, and land owners to recognize environmental benefits of biosolids programs. Identify potential reuse locations in the geographic area of the wastewater treatment facilities.

7.2.5 Water Re-Use Program

DEQ encourages water reuse as a strategy for protecting Oregon's water resources. Water reuse means using water again that has been previously used for another purpose. Reusing water reduces the demand to use potable water for uses, such as irrigation, that don't require highly treated water. Water reuse can effectively improve water quality by reducing the discharge of pollutants to water bodies and reducing withdrawals from surface water sources. Water reuse for non-potable purposes allows individuals, municipalities, and industrial facilities to use lower quality water sources for beneficial purposes. DEQ encourages three general categories of water reuse: graywater, recycled water, and industrial wastewater.

Graywater refers to water from showers, baths, bathroom sinks, kitchen sinks and laundries. Graywater can be reused for limited activities, such as subsurface irrigation with minimal treatment. In August 2011, the Oregon Environmental Quality Commission adopted new administrative rules (OAR 340-053) for graywater reuse and disposal system. Under the new rules, most individual homeowners and small businesses can reuse graywater by obtaining an inexpensive WPCF general permit from DEQ.

Recycled water refers to treated effluent from a municipal wastewater treatment facility. Oregon's administrative rules (OAR 340-055) identify four classes of recycled water (Class A, B, C, and D), based on various levels of treatment, that can be reused for specific beneficial purposes. Class A water is the most highly treated and disinfected; Class D recycled water is the least treated and disinfected. DEQ regulates recycled water use through a wastewater treatment facility's WPCF or NPDES permit. DEQ works with the Oregon Health Authority and Oregon Water Resources Department on the permitting of this practice. DEQ staff also work with municipal facilities to ensure proper operation and management of wastewater treatment facilities that pursue water reuse. Facility permits require management plans for water reuse and must submit an annual report on recycled water use to DEQ. Over 120 (or greater than one-third) of Oregon's municipal wastewater treatment facilities are permitted to operate a recycled water use program. Most recycled water is used for irrigation of crops and golf courses. In response to growing interest in sustainable water management, DEQ has issued three permits for three urban facilities (i.e., building-scale) to treat and reuse water onsite, including uses such as toilet and urinal flushing, evaporative cooling, and landscape irrigation.

Permitted sources that recycle treated effluent in Powder Basin are listed below:

- City of Haines
- City of Halfway
- City of North Powder

- City of Richland
- City of Sumpter
- BLM Oregon Trail Interpretive Center

Industrial wastewater refers to treated effluent from an industrial process, manufacturing or business, or from the development or recovery of any natural resource. An example of industrial wastewater is water derived from the processing of fruit, vegetable, or other food products. DEQ regulates industrial water reuse through both general permits and facility-specific individual permits. DEQ staff also work with industrial facilities to ensure proper operation and management of wastewater treatment facilities that pursue water reuse. Facility permits require management plans for water reuse. In addition to a number of individual permits issued for industrial water reuse, DEQ currently regulates more than 175 food processing facilities through general permits, which allow the reuse of industrial process waters for irrigation purposes.

Action: DEQ will implement the administrative rules for graywater reuse and disposal systems adopted by the EQC in August 2011 and begin accepting graywater permit applications in the spring 2012. DEQ Wastewater Permitting staff will coordinate with wastewater treatment facilities and other interested stakeholders and continue exploring opportunities for improving water quality through recycled water and industrial water reuse. DEQ will coordinate with permittees on improved annual reporting on water reuse activities.

Alignment Opportunity: Nonpoint source staff can assist with local stakeholder outreach as part of the graywater program implementation. Water Reuse staff can work with the groundwater and NPS programs to provide outreach to local communities, building authorities, graywater system designers and graywater users to ensure systems are operated and maintained to protect water quality.

7.2.6 Underground Injection Control Program

An underground injection control (UIC) system is designed to discharge or distribute fluid below the ground surface. The DEQ UIC program goal is to protect aquifers from contamination due to underground injection activity. The UIC began in 1974 under the Safe Drinking Water Act. Oregon DEQ operates this program under the authority of the Underground Injection Control rules (OAR Chapter 340, Division 44). In accordance with these rules, UICs are not allowed to discharge directly into an aquifer. Groundwater is especially sensitive to contamination and in many cases is the sole source of public and private drinking water. Groundwater pollutants can also enter lakes, streams, wetlands and springs.

The most common UIC systems in Oregon are stormwater drywells. Drywells are often used to manage runoff from roads, roofs, and other impervious surfaces. Best management practices are used to eliminate the pollution of stormwater or treat it prior to discharge. Industrial facilities may also seek approval to discharge process wastewater to sumps, drywells, trench drains, septic tanks and drainfields which can be classified as UICs. Approval depends on the type of waste and the level of pre-treatment prior to subsurface discharge.

A total of 206 UICs in the Powder Basin were recorded in the DEQ UIC database as of October 18, 2011. Most of the UICs are stormwater dry wells, including 53 registered to Baker City, 21 registered to Marvin Wood Products in Baker City, and 11 registered to the Baker City School District. Many others are septic systems and greywater sumps at campgrounds and RV parks, including 69 UICs at Farewell Bend State Park. More information can be found on the DEQ UIC website: http://www.deq.state.or.us/wq/uic/uic.asp.

Baker City was concerned about compliance with UIC rules and recently was planning to eliminate all of its stormwater UICs and send the stormwater to the Powder River. The City met with DEQ and discussed the issue in April 2011. DEQ explained that the TMDL for the Powder Basin will likely have goals which are not favorable to stormwater discharge to surface water. The TMDL goals will favor the reduction of rapid rises and fall in flow caused by storm water discharges as well as reduction of pollutants such as sediment, bacteria and nutrients. The DEQ UIC Program staff also worked with Baker City Public Works staff to plan more cost –effective UIC improvements so stormwater was managed without increasing surface water discharge. After the discussions with DEQ Baker City agreed to upgrade its stormwater management plan to include the following goals and practices:

- The use of shallow trenches and improved catch basins where practical.
- Upgrade existing UICs and catch basins to trap sediment and oil/grease, some will be closed and connected to the existing storm sewer.
- Reduce the number of UICs to 49 or less in low traffic areas to avoid monitoring and permit fee requirements.
- Use the OAR 340-71 sand filter specifications to create an acceptable 2-foot separation distance between a UIC and seasonal high groundwater.
- Investigate low interest loan funding for the UIC projects through the State Revolving Loan Funding (SRF) program.

Action: DEQ plans to meet with other cities in eastern Oregon to discuss similar issues regarding stormwater UICs and to develop guidance for UIC management.

7.2.6 On-Site Septic Program

As discussed in **Section 3.2.1**, DEQ regulates the siting, design, installation, and ongoing operation and maintenance of onsite septic systems. DEQ administers the On-Site Program in the Baker County, Union County, and Wallowa County portions of the Powder Basin. Malheur County administers the program in its own borders, including the portion in the Powder Basin.

Action: Onsite program policy disallows the use of general fund money to support the program. Application fees cover the costs of issuing permits, evaluating sites for potential septic approvals, and the costs for enforcement and complaint investigation. During times when DEQ has high volumes of applications, staff resources are often limiting to enforcement work. Applicants with outstanding applications want immediate action and there is little time to follow up on complaints. During recessionary periods when housing construction slows there are few new applications and funding is often limits complaint response. An adequately funded complaint investigation program would allow follow up and correction of systems that are contributing to surface water pollution and creating public health problems in Oregon. DEQ is working with stakeholders to address some of these issues through policy and funding packages in the next budget cycle (2013-2015).

7.3 Compliance and Enforcement

DEQ has a range of compliance and enforcement tools at its disposal including technical assistance, compliance inspections, warning letters, field citations, compliance orders, mutual agreement and orders (MAOs), and formal enforcement actions. DEQ regularly conducts inspections of projects, facilities, permitted entities and reviews monitoring data to determine compliance with DEQ permits and state laws. DEQ also investigates complaints received from the public and other agencies about possible violations.

When an inspector determines a violation exists or occurred, the inspector determines the appropriate level of enforcement by consulting DEQ's "Enforcement Guidance for Field Staff". The Guidance is organized by program and subprogram and directs the inspector how to respond to any given violation depending on the circumstances surrounding the violation (e.g. whether the violation has been repeated in the last 36 months, whether it was beyond the reasonable control of the violator, etc.). The purpose of the Guidance is to ensure that DEQ enforcement is consistent and fair, regardless of the region or office where the violation originates.

As an alternative to paying a civil penalty to the state of Oregon's general fund, state law allows respondents to pay up to 80% of their civil penalty towards a Supplemental Environmental Project (SEP). An SEP is a project that primarily benefits public health or the environment in the geographic region where the violation took place. Examples of projects include on-the-ground stream bank restoration projects, an education pamphlet that informs people of the risks of spreading invasive species, and trash removal. DEQ encourages respondents to perform SEPs and is liberal when reviewing SEP applications. A SEP may be proposed at any time after an FEA is issued. While DEQ encourages Respondents to perform SEPs, DEQ cannot outwardly advocate for one SEP over another. DEQ does however maintain a small list of SEP ideas that includes a list of non-profit groups, watershed councils, and other potential SEP partners that we can share with respondents interested in doing a SEP.

Actions and Alignment Opportunities:

- Assign one ELS to handle all WQ formal enforcement actions within a basin
- Develop basin-specific enforcement guidance that reflects the priorities within a basin, particular threats to beneficial uses within the basin, resource constraints within the basin (e.g. if turbidity is a particular problem within the basin revise the guidance so that water quality violations where there is a potential for turbid water discharge receive a heightened enforcement response).
- Change formal enforcement action case numbers to include a basin identifier so that enforcement efforts within a particular basin are easier to identify and search.
- Include a field for basin identification in the development of the ACES database.
- Develop SEP ideas and SEP partners within a basin in order to facilitate and encourage respondents to perform SEPs.
- Develop SEP ideas and SEP partners that may address basin priorities (e.g. if temperature is a problem, include tree planting SEPs in the SEP idea list).

7.4 Groundwater Program

As stated previously, DEQ does not have an established groundwater monitoring plan for the Powder Basin. However, the DEQ/DHS Drinking Water Protection Program works with communities to identify and protect source water areas for surface and groundwater public drinking water supplies.

In the Powder Basin, there are 39 public water systems (PWS) (summarized in **Table 2-5**) relying on groundwater in whole or in part, serving a total population of almost 15,000 residents. Note that Baker City is served by both ground water and surface water sources and its population of 10,105 is included in the discussion on both sources.

As documented in Source Water Assessment reports for community public water systems in the Powder Basin, the potential sources of contamination identified within drinking water source areas that pose the greatest risk to source water for the three public water systems (PWSs) are:

- Historic mining activities, and
- Forest management activities including roads and harvesting.

Actions: DEQ and DHS will continue to work with the operators of public water supplies in the Powder Basin to identify and protect drinking water supplies. The Drinking Water State Revolving Fund will help to support these goals through financial assistance.

7.5 Water Quality Standards and Assessment

Establishing water quality standards is at the core of DEQ's water quality activities. The Water Quality program establishes standards to protect beneficial uses of water, such as water supply, aquatic life, fishing (consumption) and recreation and then acts to protect and restore water to the standards that support those uses. Water quality standards and assessments program activities include:

- Conduct standards reviews and rule revisions to establish and update scientifically based water quality standards.
- Identify water bodies not meeting water quality standards.
- Develop policy, guidance, and procedures documents for implementing standards.

Action: Improved water quality data management. All programs in water quality would benefit by having any new water quality data regularly and routinely uploaded into an accessible database. By improving data management and accessibility the best available information can be used by DEQ programs and the public. This will allow the identification of data gaps and monitoring to fill data needs to be completed prior to a given DEQ action (e.g. permit issuance). Improved data management will facilitate the use of water quality data to guide the establishment of conditions and/or permit limits that will protect beneficial uses.

DEQs data management tool (LASAR) is currently undergoing upgrades to increase capacity and resolve data upload challenges. In some instances datasets include parameters that LASAR is not capable of housing. DEQ will need to assess this problem and determine if LASAR parameter fields need to be expanded or if alternate databases need to be developed.

Reviews and rule revisions

Turbidity

DEQ has begun the process of revising the water quality standards for turbidity based on the best available science regarding the effects of turbidity on beneficial uses, in particular aquatic life. DEQ also will address a number of issues that have made it challenging to implement the current turbidity standard across all of DEQ's water quality programs, such as better definition of what is allowed for a limited duration exceedance and the duration and frequency of exceedances that would violate the standard. Turbidity issues exist in the Powder Basin but DEQ is unable to successfully identify and implement objectives for water quality due to a lack of turbity assessment tools and clear in-stream targets. Given current resource uncertainties, DEQ does not have a timeline for when the turbidity rule revisions will be completed.

Sedimentation

There is no formal DEQ strategy for assessing, addressing or responding to sediment concerns. Sedimentation issues exist in a number of Powder Basin watersheds but DEQ is unable to successfully identify and implement objectives for water quality due to a lack of sediment assessment tools and clear in-stream targets. Presently a narrative sediment standard exists with no documented implementation method, which has led to a lack of certainty regarding how to apply the standard in the context of beneficial uses. In addition, it is unclear what type of monitoring data can and should be used to inform management decisions regarding sedimentation.

The biocriteria section **(4.3.12)** of this document identifies sediment as a primary biological stressor and the evaluation of biological conditions in relation to sediment impairment has been a useful tool. In addition, methods to evaluate embedded sediment conditions are also being considered in support of the development of a more robust sediment strategy.

The development of either numeric sediment criteria or clear guidance on how the narrative standard should be applied is needed. Progress made in these areas will allow the review of data to determine if sedimentation is limiting beneficial uses and could subsequently trigger the TMDL process. It would also facilitate discussion regarding the development and implementation of consistent assessment protocols for streambank erosion, channel stability and general sedimentation conditions. The Mid-coast sediment TMDL development team is proposing to use biologically derived sediment targets, which supports the need for a sound sediment strategy.

Action: Provide regional input to the standards program identifying standards needs. Continue to provide regional input during the development of an implementation plan or Internal Management Directive for any new or revised standards. This is an opportunity for regional needs to be included and aligned.

Develop and implement more effective sedimentation and turbidity standards:

- Regional support for the initiation of an agency strategy for identifying and responding to sediment impairment concerns, identify funding for support of sediment assessment tools and strategies, and develop, adopt and implement a better way to assess sedimentation and determine impairment.
- Regional staff will work with standards section staff to evaluate data needs related to sedimentation and explore data collection opportunities using proposed methodologies for stream condition assessment as potential models for agency use (e.g. Relative Bed Stability and/or other available methods.
- Regional staff will work with other programs and stakeholders to determine potential causes and treatments of sediment impairments. Interests may include; DEQ (Standards and Assessment, Permitting, Monitoring, TMDLs, Nonpoint source, and 319 programs), ODA, Drainage Districts, OWEB, NRCS, EPA, USFS, ODF, BLM, ODFW and others.

Water bodies not meeting water quality standards

DEQ is required to assess the level at which Oregon's water quality supports beneficial uses. DEQ prepares an integrated report for submission to EPA that meets the requirements of the federal Clean Water Act (CWA) for Section 305(b) and Section 303(d). CWA Section 305(b) requires a report on the overall condition of Oregon's waters. CWA Section 303(d) requires identifying waters that do not meet water quality standards where a TMDL needs to be developed.

Integrated Report Alignment

There is an opportunity to have the assessment described by the Integrated Report database more closely align with basin assessments. These assessments and action plans will be reviewed every five years. In May 5, 2009 EPA memorandum articulates support for "the rotating basin approach as an effective tool for States to make water quality assessment determinations and manage their water quality programs. In this approach, available assessment resources are concentrated or targeted in defined watersheds for a specified period of time, thus allowing for data to be collected and assessed in a spatially and temporally "focused" manner. Over time, every portion of the state is targeted for monitoring and assessment (often over a four or five year period). States using a rotating basin approach may consider explaining in their data solicitation that a special emphasis is being placed on obtaining and considering data and information from the basin of interest, but that data and information from outside of the basin may also be considered for water quality assessments, NPDES permitting decisions, TMDL development, compliance monitoring, etc."

Actions:

- Work with 303(d) coordinator to secure all available quality data for review. The 2010 Assessment reflects current updates for Aquatic weeds and algae (hazardous algal blooms), turbidity (source drinking water), and biocriteria. Other parameters were not included in the in the data reviewed for this report. The EPA additions to the 2010 integrated report should also be reviewed and addressed as appropriate.
- Better define and account for "Insufficient data" versus "Potential concern" listings – Information included in the 1988 NPS Assessment was evaluated in the development of the 1994 303d list. In many instances anecdotal concerns were identified related to a given parameter but no supporting data was available. Where no data exists, it is recommended that these segments be identified as areas of potential concern. Segments identified as those having "insufficient data" could be applied to sites where data is available but Integrated Report minimum data requirements are not met. Segments in this category may represent areas that attain criteria or where available data may indicate the potential for a water quality problem. Where these small datasets indicate water quality problems exist emphasis should be placed on building a dataset of sufficient size to allow the characterization of water quality conditions, at least for priority pollutants.
- Apply assessment benchmarks for parameters with narrative criteria. The water quality assessment can use benchmarks developed to implement the narrative criteria. The effort and priority of agency work to develop and implement these benchmarks could be aligned to the needs and priorities of the Powder Basin. Developing approaches to address sedimentation and nutrient loading are basin priority actions.
- Work to better define and refine the distribution of the beneficial uses of resident trout and other sensitive aquatic species.

7.6 Water Quality Monitoring

7.6.1 Ambient Water Quality Network

As discussed in **Section 4.1.1**, three ambient water quality sites are currently being monitored in the Powder Basin. Two are located on the Powder River, site 11490 in Baker City, and site 10724 at the lower end of the Keating Valley. The third site (11494) is located near the mouth of the Burnt River in Huntington **(Figure 4-1)**. The sites are monitored bi-monthly as part of the state-wide ambient water quality network and have been integrated into the TMDL sampling program for the Powder Basin.

Action: DEQ will continue to monitor the ambient water quality sites in the basin and update trend reports on an annual basis as resources allow. The DEQ Basin Coordinator and LEAD staff should continue to integrate the ambient monitoring data into the Powder Basin TMDL monitoring program and the Powder Basin Monitoring Program managed by the Powder Basin Watershed Council.

7.6.2 Biomonitoring

DEQ biomonitoring sites in the Powder Basin are presented in **Section 4.1.5**, and the available data are presented in **Section 4.3.12**. According to DEQ monitoring staff, the macroinvertebrate sample size for the Powder Basin is quite small, and sites were chosen as parts of various different projects with no real intent to characterize the Powder Basin as a whole. At this point in time, DEQ has little understanding of the level of support for the Fish and Aquatic Life Beneficial Use. The status of this beneficial use should be considered as a “data gap”.

Action: A random survey of macroinvertebrates should be conducted prior to the next assessment in order to gain a better understanding of conditions for the Aquatic Life Beneficial Use. At least 30 sites should be surveyed, with 50 sites being the preferred sample size. This should be repeated once every five years to gain an understanding of trends (improving or declining conditions) in the aquatic life use.

Additional sources of data for this beneficial use should be incorporated in future assessments, as well as exploring the development of partnerships to expand on macroinvertebrate monitoring. At a minimum, the USFS has long-term monitoring programs in place that collect macroinvertebrates (as well as other stream health indicators). DEQ needs to pull this data in for assessments within the Watershed Approach. DEQ could potentially maximize efficiencies in our monitoring by using USFS data to assess conditions on federally owned lands, while DEQ monitors macroinvertebrates on non-federally owned lands. This could significantly reduce the amount of resources (i.e., funding) required to do random monitoring across the state. It would require a significant investment in coordination with other agencies to ensure compatible monitoring plans, however the benefits vastly outweigh the costs.

7.6.3 Hazardous Algae Blooms

Waterbodies in the Powder Basin which have had potential hazardous algae blooms are identified in **Section 4.3.13**. Very little monitoring for HABs has been done in the basin however, conditions which can produce HABs (stagnant water, high water temperatures, high nutrient levels) are fairly common. These factors suggest that additional surveillance for HABs would be prudent.

Action: DEQ can improve its communication with other groups in the Powder Basin regarding the need for concern regarding possible HABs. DEQ has recently improved its preparation for HAB response through the development of generic monitoring plans and increased availability of sampling equipment in region offices. DEQ can support limited sampling efforts when potential HABs are identified.

7.6.4 Volunteer Monitoring

DEQ’s Volunteer Water Quality Monitoring Program provides technical assistance to watershed councils, SWCDs and local non-governmental organizations wishing to collect water quality data. Technical support to partner organizations includes help in designing monitoring plans, providing equipment, supplies and training to conduct monitoring and assistance in analyzing the resulting data. The volunteer program has empowered over 50 organizations across the state of Oregon to collect high quality data. Two organizations in the Powder and Burnt Subbasins have participated in the DEQ volunteer program:

Baker County

The most recent data set is information that has been collected in relation to the 401 Hydropower application to build a hydroelectric project at Mason Dam. This project involved field parameter data collection (dissolved oxygen, pH, conductivity, turbidity and temperature) at the intake in Phillips Reservoir and a few locations below the dam. This monitoring was conducted by Jason

Yencopal, who is a Baker County employee.

SWCDS

The Baker SWCD collected field parameter data (temperature, dissolved oxygen, pH, conductivity and turbidity) during 1999-2000 in order to gather general water quality data. This sampling project included 22 stations in the Powder and Burnt Subbasins with a few summer time samples collected at each site. This data is in LASAR as sampling event 20011383.

Action: The Powder Basin Watershed Council was awarded a 319 grant in 2011 to hire a monitoring coordinator and begin a water quality monitoring program in the Powder Basin. A diverse working group has formed and is working to develop the program and hire the coordinator. DEQ plans to continue to work with this group to develop monitoring plans and priorities and to support the group through technical assistance, loaner equipment and Sampling and Analysis Plan development from the Basin Coordinator and Volunteer Monitoring Program.

7.6.5 Toxics Monitoring

In 2010, Baker City conducted toxics monitoring of their wastewater treatment plant effluent as required by SB737.

In late 2011 DEQ sampled the Powder River for toxic constituents at two locations downstream of Baker City as part of its Toxics Monitoring Program.

DEQ has also consulted with EPA regarding their project which measured mercury concentrations in fish tissue in 5 reservoirs in the Powder and Malheur River Basins. These projects are described in **Section 4.3.9**.

Actions: DEQ LEAD staff should continue to support Baker city's efforts to comply with SB737 requirements.

LEAD staff should also finish evaluating the data gathered during the surface water toxics monitoring project conducted on the Powder River in 2011, and assist the Basin Coordinator with the communication of results.

The DEQ Basin Coordinator should continue to work with EPA, ODF&W and Oregon Health Authority to interpret mercury fish tissue data and plan to fill data gaps and communicate with the public.

7.7 Financial and Technical Assistance

7.7.1 State Revolving Loan Fund Projects

The Clean Water State Revolving Fund (SRF) loan program provides low-cost loans for the planning, design or construction of various projects that prevent or mitigate water pollution. DEQ administers the program. Eligible agencies include Indian tribal governments, cities, counties, sanitary districts, SWCDs, irrigation districts, various special districts and certain intergovernmental entities.

Eligible projects include:

- Wastewater system plans and studies
- Secondary or advanced wastewater treatment facilities

- Irrigation improvements
- Infiltration and inflow correction
- Major sewer replacement and rehabilitation
- Qualified stormwater control
- Onsite wastewater system repairs
- Matching funds for some U.S. Department of Agriculture conservation programs
- Estuary management efforts
- Various nonpoint source projects (stream restorations, animal waste management, and other conservation projects)
- Qualified brownfields projects

According to DEQ records from the last 20 years, the Powder Basin cities of Unity and Haines have received State Revolving Fund Loans through DEQ totaling over $269,944. The loan money was used for pump system and waste water system improvements in Unity, and for reduction of groundwater infiltration into the Haines waste water system.

Action: SRF Program staff in are actively working to make funds from the program available to local governments and organizations such as irrigation districts. Interested parties in the basin can contact the DEQ Pendleton Office for information about the program.

7.7.2 319 Grant Program

DEQ administers the federal Nonpoint Source Implementation 319 Program in Oregon. This program provides federal grant funds under the Clean Water Act's Section 319(h) to address nonpoint water pollution issues. Nonpoint source pollution, unlike end-of-pipe pollution from industrial and sewage treatment plants, comes from many diffuse sources, including runoff from agricultural, forest and ranching activities, construction sites, home landscaping and road surfaces.

Through an annual solicitation, DEQ seeks proposals from government agencies, tribal nations and nonprofit organizations to address nonpoint sources of pollution affecting coastal, river, lake, drinking and groundwater resources in Oregon. DEQ's Water Quality Program has authority under the EPA to oversee 319 project grants in Oregon, including administration of funding and monitoring/review of selected proposals. Recipients of 319 project grants are required to provide a 40% match to the 319 project money. Matching can be in the form of money and/or sevices (in-kind).

In Oregon, about $1 million of federal grant dollars are expected to be available under the 319 program in fiscal year 2012. Proposals were due January 17, 2012. Past 319 grants awarded to organizations in the Powder Basin are summarized in **Table 6-1**.

- The Powder Basin Monitoring Program grant was awarded to the Powder Basin Watershed Council to assist with hiring a monitoring coordinator and to develop a basin-wide water quality monitoring program.

- The Powder River Restoration-Kirkway Reach is a streambank stabilization and riparian vegetation planting project along the Powder River in Baker City.

- The Powder River Water Quality Enhancement Project involved fencing and off-stream water development to keep thousands of cattle from direct access to the

Powder River along a 10 mile reach of the Powder River downstream of Baker City. Grant money from the 319 Program provided match for larger contributions from OWEB. The Baker Valley SWCD administered the project.

- The Burnt river Riprap study funded efforts to develop methods for using logs from juniper thinning projects to stabilize stream banks and allow riparian plantings to establish. The method has been successfully implemented at several more recent projects along the Burnt River.

Table 7-1. 319 Projects in the Powder Basin

Project Year	Project Name	Subbasin	319 Funds	Match Required
2012	Powder Basin Monitoring Program – Phase I	Powder	$25,385	$50,000
2010	Powder River Restoration - Kirkway Reach	Powder	$ 23,400	$15,600
2007	Powder River Water Quality Enhancement	Powder	$52,500	$35,000
2004	Burnt River BMP Juniper Riprap Study	Burnt	$14,200	$21,600

Action: DEQ will continue to review new 319 grant proposals and develop priorities for funding. DEQ will work with stakeholders in the Powder Basin to manage recently funded projects such as the Powder Basin Monitoring Program, and to develop proposals for new grant projects which will implement water quality goals for the basin.

7.8 401 Certification

Section 401 of the federal Clean Water Act requires that any federal license or permit to conduct an activity that may result in a discharge to waters of the United States must first receive a Water Quality Certification from the state in which the activity will occur. DEQ 401 program staff evaluate project proposals for potential impacts to water quality and beneficial uses. Certifications may be: 1) issued for the project as proposed, 2) issued with conditions intended to eliminate or minimize impacts, 3) denied, or 4) waived if DEQ takes no action within one year of receiving the request for a 401 certification. The majority of applications receive 401 certifications with conditions. Most certification requests come to DEQ through either the Federal Energy Regulatory Commission (FERC) process for **hydroelectric projects**, or through US Army Corps of Engineers (USACE) permits for **removal and fill activities.**

7.8.1 Section 401 Removal/Fill Certification

A proposal to conduct work in waterways or wetlands requires a Joint Permit Application submitted to both the USACE and the Department of State Lands (DSL). These agencies process the applications separately. USACE determines if an application may result in a discharge and requires a permit. If a permit is required, USACE will determine which type of permit (Nationwide Permit, Regional General Permit, or Individual Permit) is needed.

Action: DEQ will continue to coordinate with DSL and USACE on removal/fill projects needing 401 certification.

7.8.2 FERC Licensed Hydroelectric Projects

There are no hydroelectric facilities in the Powder Basin with a current license from the Federal Energy Regulatory Commission (FERC). DEQ has provided comment on a pending application for a facility on Rock Creek near Haines, and is working on the 401 Certification for a proposed project at Mason Dam on the Powder River. DEQ has also been contacted about a possible project at Unity Dam on the Burnt River.

Action: DEQ has moved the responsibility of FERC licensed facility 401 to regional Basin Coordinators. The Basin Coordinators are in a better position to integrate individual basin water quality goals into the process. DEQ should support this effort through continued training and support from water quality program staff in headquarters.

7.8.3 Minor Hydroelectric Projects

WRD may issue water rights for minor hydroelectric projects, those with relatively small turbines (generating less than 100 theoretical horsepower). To approve an application, OWRD must first find that the project will meet applicable resource protection standards given in OAR 690 Division 051, including water quality. OWRD consults with state resource agencies, including DEQ, to make this determination. DEQ evaluates proposed minor hydroelectric projects and may place certain conditions in the water right as necessary to ensure compliance with applicable water quality standards.

Currently, DEQ 401 Hydro staff prioritize reviews or site visits to small hydropower projects based on project location, potential to affect water quality, and existing workload. The 401 Hydro program does not maintain a central file of small hydro project reviews; information resides in individual staff electronic and paper files. Water Resources Department on-line information indicates that there are no small hydropower projects in the Powder Basin.

Action: The 401 Hydro program should consider developing a screening tool for small hydro project review, instituting centralized record keeping, and notify or consult with appropriate Basin Coordinators when applications are received. The screening tool would help staff prioritize review and further investigation of small hydropower projects and would consider characteristics of the project such as impoundment, potential flow reduction, cumulative effects, and alteration of hydrologic function or sediment budget. Copies of DEQ’s review or additional investigation should be stored in a regional or central 401 hydro project file.

8. Status of Non-DEQ Water Quality-Related Actions

8.1 OWEB Grants

The Oregon Watershed Enhancement Board (OWEB) provides grants for watershed restoration projects throughout the state. Recipients of OWEB grants are required to provide a 25% match to the OWEB money. Matching can be in the form of money and/or services (in-kind).

The OWEB Oregon Plan for Salmon and Watersheds 2009-2011 Biennial Report summarizes OWEB funded priorities and projects in the Powder Basin. **Table 8-1** lists the OWEB restoration priorities for the Powder Basin.

Table 8-1. OWEB Restoration Priorities for the Powder Basin

Riparian/Wetland	Upland	Instream & Passage	Other
• Loss of Riparian Cover	• Juniper Encroachment • Overstocked Forest Stands	• Water Quality Degradation • Loss of Instream Habitat	• Effects of Historic Dredge Mining

Figure 8-1 shows the total Powder Basin restoration funding reported to OWEB for the period of 1997-2009, and **Figure 8-2** shows sources of reported restoration funding in the Powder Basin for 2008 and 2009.

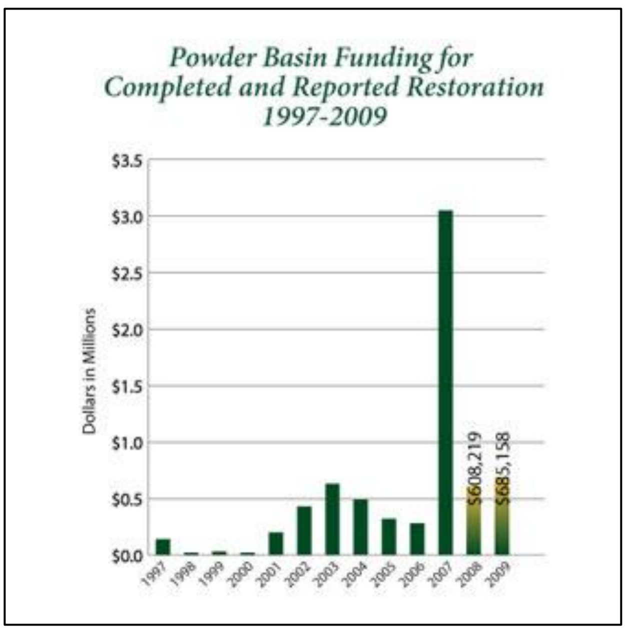


Figure 8-1. Powder Basin Restoration Funding Reported to OWEB 1997-2009.

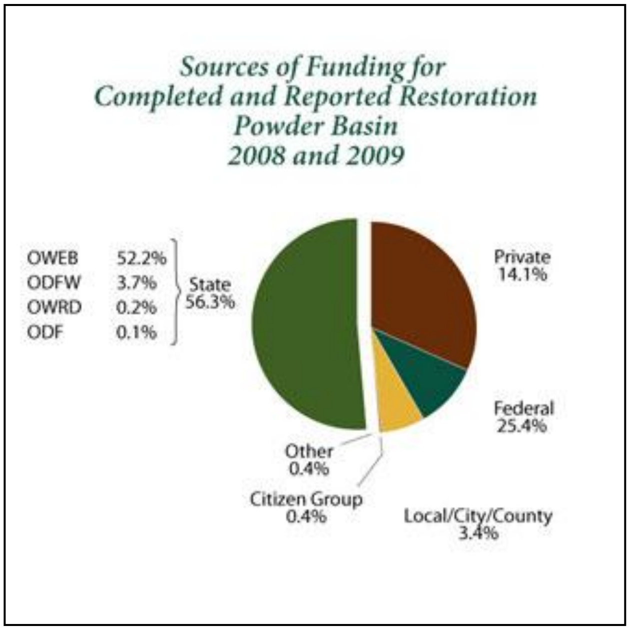


Figure 8-2. Sources of Funding for Powder Basin Restoration Projects in 2008 and 2009.

8.2 NRCS Programs

The Natural Resources Conservation Service (NRCS), a division of the U.S. Department of Agriculture, implements conservation programs to help people reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. The NRCS Snake River Basin Team works in the Powder Basin as well as adjacent Snake River tributary basins.

The NRCS Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition, a purpose of EQIP is to help producers meet Federal, State, Tribal and local environmental regulations.

The NRCS has developed a fiscal year 2012 list of Conservation Implementation strategies for basins in Oregon. Conservation strategies for the Powder Basin consist of the Lower Powder River Watershed Irrigation Improvement and the Catherine Creek and Powder River Forestry projects. NRCS has identified the Baker County SWCDs, ODF&W, and Oregon Department of Forestry as partners in these projects.

Actions: The DEQ Powder Basin Coordinator will work with the NRCS Snake River Basin Team on conservation projects in the basin with the goal of supporting improvements in water quality and sharing resources.

8.3 ODA Programs

8.3.1 CAFOS

As discussed in Section 3.2.3, the Oregon Department of Agriculture (ODA) regulates Confined Animal Feeding Operations (CAFOs) in the State of Oregon, including 16 facilities in the Powder Basin.

Action: The DEQ Basin Coordinator will work with the ODA CAFO inspector for the Powder Basin to integrate this program with DEQ water quality goals including the TMDL that is currently under development.

8.3.2 Area Plans

As also discussed in Section 3.2.3, ODA is responsible for regulating agricultural activities on private lands that affect water quality in Oregon. ODA uses *Agricultural Water Quality Management Area Plans* (AgWQMAPs) and associated rules to protect water quality and implement TMDLs throughout the state.

Action: The DEQ Basin Coordinator and Headquarters Nonpoint Source staff will work with ODA and its partners during plan updates to provide support for the process and to coordinate it with TMDL development and implementation and other watershed actions.

9. Data Needs/Monitoring Plan

Current DEQ monitoring activities in the Powder Basin are described in detail in **Section 4.1** of this report. Future DEQ monitoring priorities are presented below:

- Continue to integrate the ambient water quality monitoring activities in the Powder Basin (3 sites) into the TMDL monitoring program.

- Conduct analysis on the TMDL bacteria/nutrient monitoring data in order support water quality modeling and load/waste load allocation development.

- Develop a water temperature monitoring program in cooperation with stakeholders such as the USFS, BLM, Idaho Power, irrigation districts, and the Powder Basin Monitoring Working Group. Temperature monitoring was conducted in the Burnt River Subbasin in 2012, and the the Powder River Subbasin in 2013. Temperature monitoring in the Brownlee Reservoir Subbasins will follow in 2014.

- Develop and implement a biomonitoring program for the Powder Basin that can support TMDL development and implementation.

- Coordinate with basin stakeholders to develop better monitoring and response to potential Hazardous Algal Blooms (HABs).

- Coordinate with DEQ LEAD staff to interpret and disseminate toxics monitoring data.

- Work with the Powder Basin Monitoring Working Group to develop and implement a long term monitoring program which will support the goals of the wide range of stakeholders working to improve water quality in the basin.