SECTION 13 – Table of Contents

13 Pend Oreille Subbasin Overview

13.1 Regional Context for Pend Oreille Subbasin

The Pend Oreille Subbasin (Figure 13.1) is located in northern Idaho and northeastern Washington and represents the northeastern-most corner of the Intermountain Province (IMP). It is bordered by the Upper Columbia Subbasin to the west, the Coeur d' Alene and Spokane subbasins to the south, Montana to the east, and Canada to the north. The Pend Oreille River is the largest river in the Subbasin and flows west out of Lake Pend Oreille and north across the Idaho Panhandle and the northeastern corner of Washington before draining into the Columbia River in British Columbia.

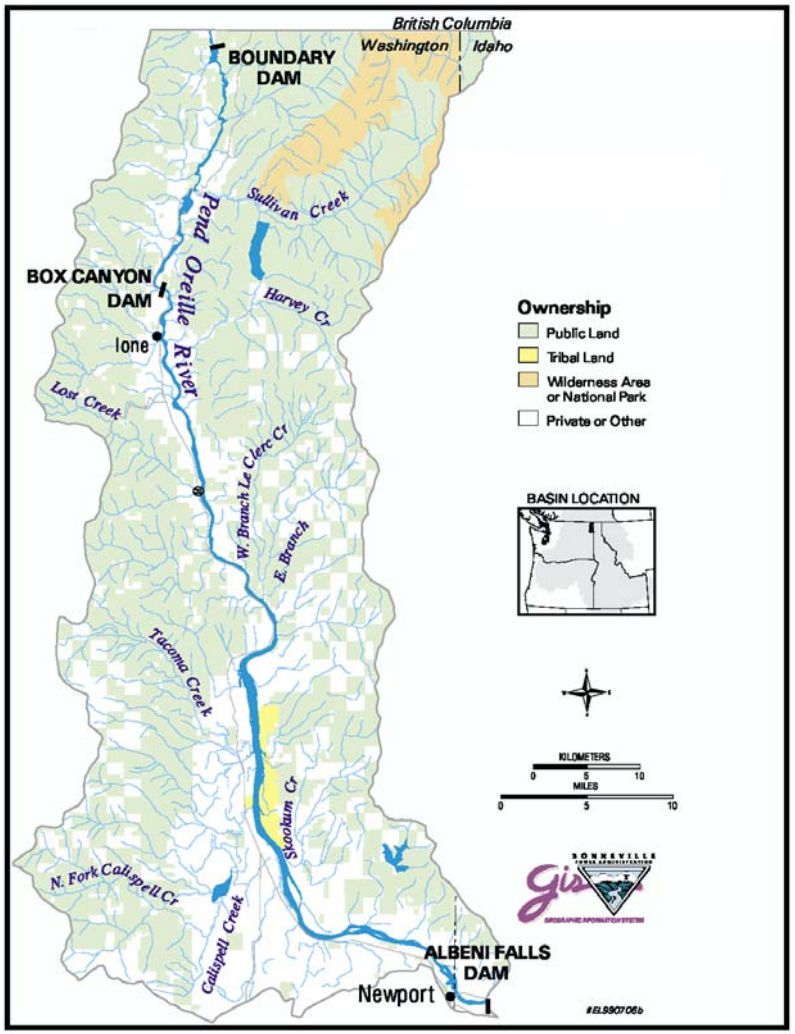
There are five dams on the Pend Oreille River including two in Canada, the Waneta and Seven Mile, plus Boundary, Box Canyon, and Albeni Falls in the United States. The dams have impacted both aquatic and terrestrial resources. None of the dams have fish passage facilities. Dams in the Pend Oreille tributaries further fragment the connectivity of native salmonid population, including Cedar Creek, Sullivan Lake, Mill Pond, Calispell Pumps, and West Branch LeClerc Creek Log Crib dams. Fish passage is blocked upstream of Lake Pend Oreille in the Clark Fork River at the Cabinet Gorge, Noxon Rapids, and Thompson Falls dams. These Clark Fork River dams are conducting experimental fish passage studies and are evaluating structure designs to pass bull trout and cutthroat trout, but the current numbers of fish passed are limited. The operational impacts of the dams have also impacted terrestrial resources by reducing the area of wetland habitats and associated primary productivity, reducing wildlife habitat and wildlife forage, and reducing nutrient input of extirpated salmon and other anadromous species to the ecosystem.

Hungry Horse Dam on the South Fork Flathead River near Kalispell, Montana regulates discharge into the Lower Clark Fork and Pend Oreille rivers. This dam provides nearly three million acre ft of flood control storage (http://www.usbr.gov/dataweb/html/hhorse.html).

13.2 Pend Oreille Subbasin Description[1]

The Pend Oreille Subbasin (Figure 13.1) extends from Cabinet Gorge Dam downstream to the Canadian border. The Subbasin is divided into three functional areas: 1) the Upper Pend Oreille Subbasin, encompassing Cabinet Gorge Dam, all of Lake Pend Oreille and its tributaries located on the Clark Fork River, down to Albeni Falls Dam which is located on the Pend Oreille River; 2) the Lower Pend Oreille Subbasin that includes the Lower Pend Oreille River and its tributaries from Albeni Falls Dam to the Canadian border; and 3) the Priest River Subbasin, which flows into Pend Oreille River just upstream of Albeni Falls Dam, including Upper Priest Lake, Priest Lake, and all tributaries up to the Canadian border. Each of the three geographical areas will be addressed separately in the overview, aquatic assessment, and aquatic inventory sections.

[1] Large portions of Section 13.2 were contributed to by the Pend Oreille Subbasin Summary Report (2001) pp. 3-10, 56-70, 124-129.



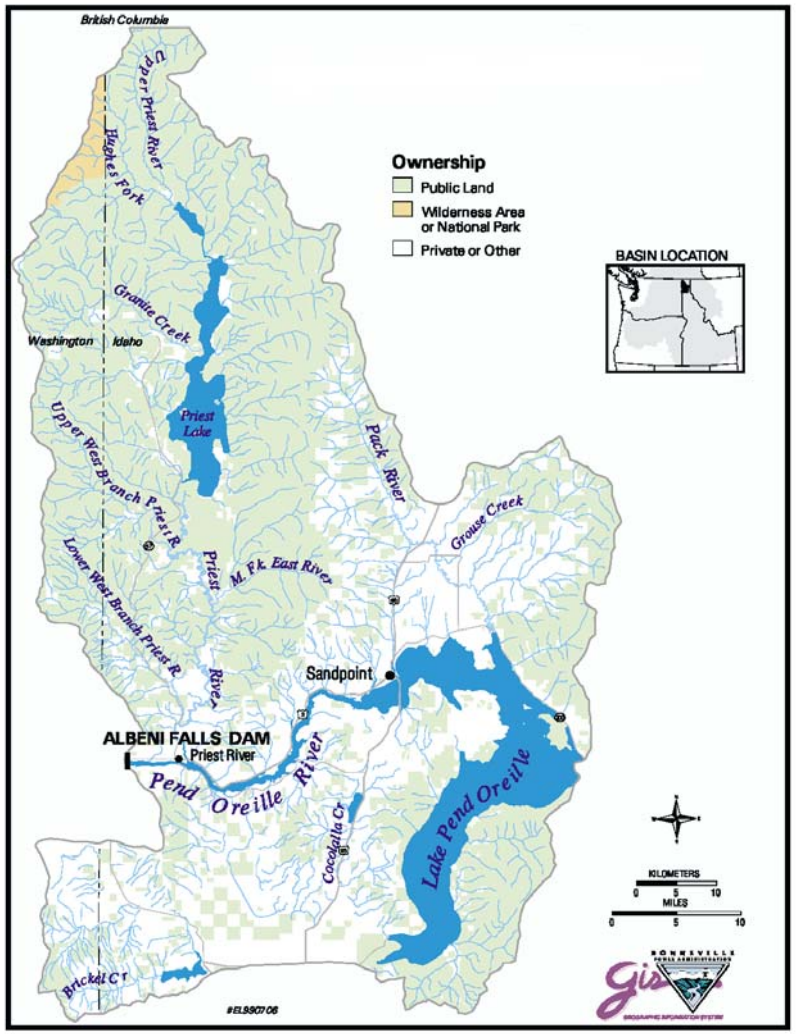


Figure 13.1. Pend Oreille Subbasin, map of Pend Oreille River to left, map of Lake Pend Oreille and Priest River to the right.

Source: (Bonneville Power Administration GIS)

Vegetation

Historic and current vegetation communities are discussed separately for the Upper Pend Oreille, Lower Pend Oreille, and Priest River Subbasins. Figure 13.2 shows the current distribution of wildlife-habitat types in the Pend Oreille Subbasin based on IBIS (2003). A map of the historic vegetation of the IMP, including the Pend Oreille Subbasin, is provided in Section 4, Terrestrial Resources in the Intermountain Province (Figure 4.1).

Road Density

Road density in the Pend Oreille Subbasin is depicted by density class, for each 6th order watershed (Figure 13.3). The majority of Pend Oreille Subbasin is ranked as high road density (1.7 to 4.7 miles of road per square mile). Several areas surrounding Lake Pend Oreille and Priest Lake, a reach of the Pend Oreille River west of Newport, and an area near Metaline Falls, are ranked moderate (0.7 to 1.7 miles of road per square mile). The far northern portion of the Subbasin is ranked as low road density (0.1 to 0.7 miles of road per square mile).

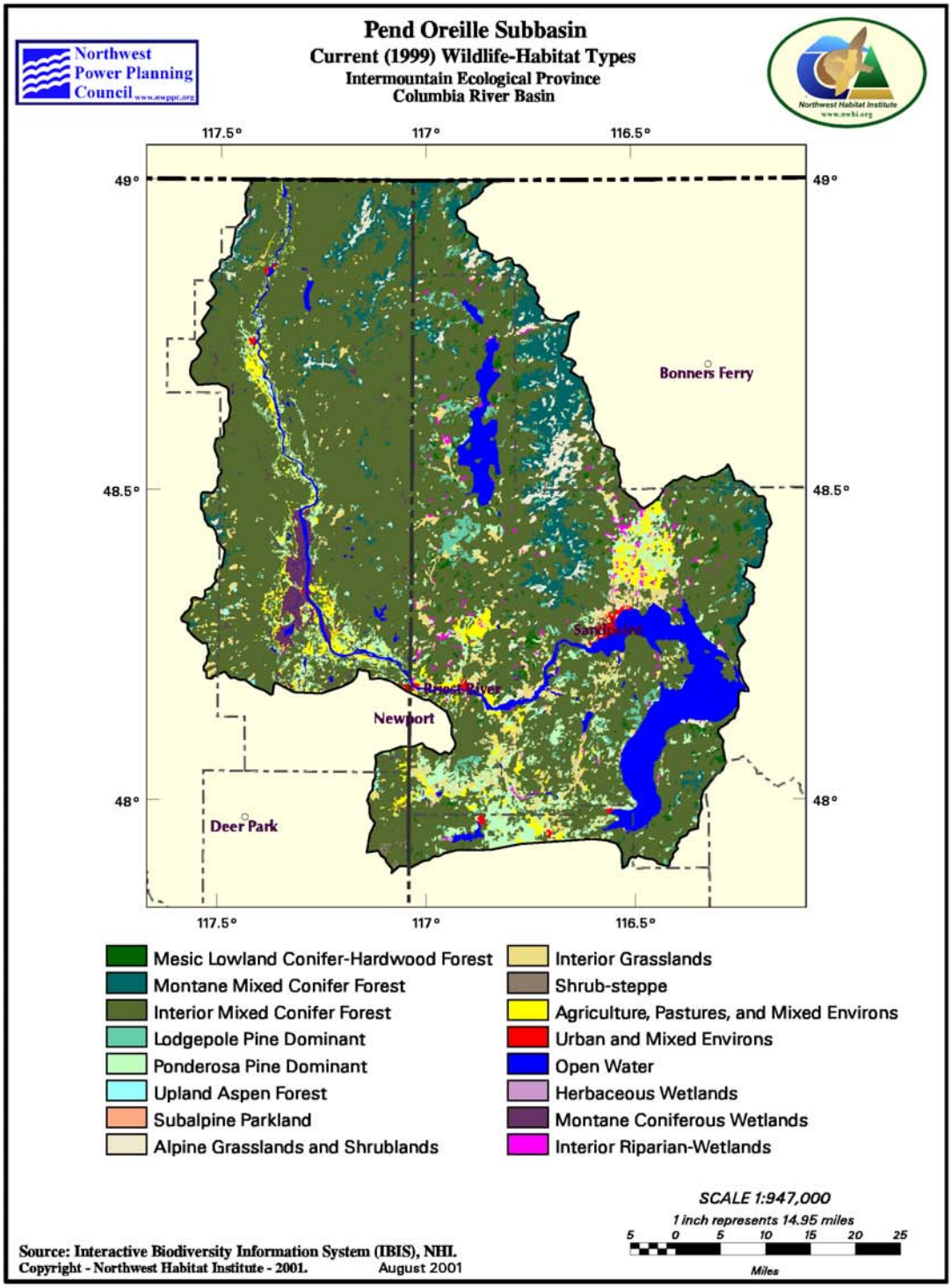


Figure 13.2. Current distribution of habitat-types within the Pend Oreille Subbasin

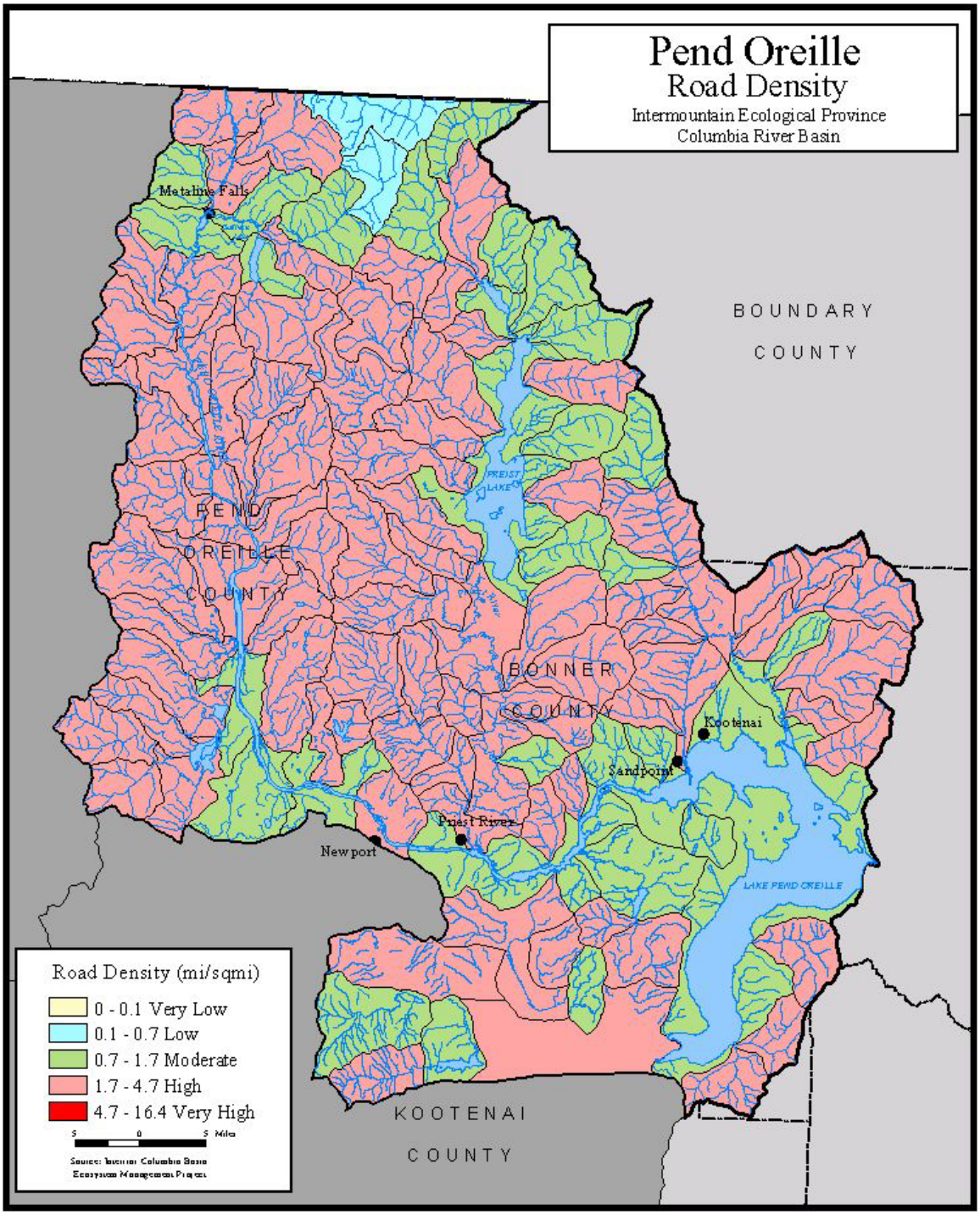


Figure 13.3. Road density within the Pend Oreille Subbasin ranked from very low (0-0.1 mi/square mile) to very high (4.7-16.4 mi/square mile)

13.2.1 Upper Pend Oreille Subbasin Description

13.2.1.1 General Location

The Upper Pend Oreille Subbasin drainage (3173 km^2) encompasses all of Lake Pend Oreille and its tributaries, including 15 km (9.3 mile) of the Clark Fork River upstream to Cabinet Gorge Dam, and the Pend Oreille River and its tributaries down to the lake's control point, Albeni Falls Dam (Figure 13.4). Lake Pend Oreille is located in the Panhandle region of northern Idaho and lies primarily within Bonner County. Lake Pend Oreille elevation is regulated by Albeni Falls Dam. However, elevations are restricted to 625.1 m (2051 ft) minimum in the winter and to 628.6 m (2062.5 ft) maximum in the summer by letter of agreement between U.S. Army Corps of Engineers (USACE) and Idaho Department of Fish and Game (IDFG). Congressional authorization of Albeni Falls Dam, by the 81st Congress, 1st Session, Senate Document No. 9, February 7, 1949, requires that Albeni Falls Dam not contribute to downstream flooding. Inflow comes through Cabinet Gorge (1952) and Noxon Rapids (1959) dams, which "power peaking" facilities owned and operated by Avista Corporation (Avista). During low flow (non-runoff) season, Avista operates them for hourly peaking, but these projects do not affect lake levels. The USACE operates Albeni Falls Dam, which is located on the Pend Oreille River near the Washington border.

13.2.1.2 Drainage Area

Three major tributaries enter Lake Pend Oreille: the Clark Fork River enters the lake approximately 15 km (9.3 miles) west of the Idaho-Montana border; the Pack River drains into the northeastern portion of the lake; and the Priest River drains into the Pend Oreille River about 8 km (5 miles) upstream of Albeni Falls Dam.

13.2.1.3 Topography/Geomorphology

The Selkirk Mountains to the west, the Cabinet Mountains to the north, and the Bitterroot Mountains to the east shape the Upper Pend Oreille Subbasin. During the ancient Precambrian period over 600 million years ago, shallow seas inundated northern Idaho. Sediments of clay, silt and sand settled out of brackish waters as seas retreated, subsequently metamorphosed, and began to fold and fault. In the last few million years, the Subbasin was substantially altered by major glacial events in the late Pleistocene period. Glacial advances resulted in highly dissected watersheds with high stream density, shallow soils, and subsoil compaction of glacial tills. Groundwater seeps and springs are prevalent in tributaries draining the Cabinet and Bitterroot mountains to the north and east of Lake Pend Oreille reflecting the more recent geology.

Figure 13.4. Location of the Upper Pend Oreille Subbasin in Idaho

The parent rocks of soils developed from the Precambrian Belt Supergroup weather to a preponderance of coarse fragments 60-70 percent, fine silts 20 percent plus, and a small amount of gravel and sand fraction. When these soils are eroded by natural or human caused agents into high gradient mountain streams (Rosgen B or steeper; Rosgen 1994), the fine silts are transported rapidly downstream out of the system while the coarse fragments remain as bedload. This bedload is transported locally within the channel during channel forming events (two-year discharge events). If erosion has been accelerated, the excess bedload fills pools and triggers additional bank cutting.

Generally, streams on the northern and eastern sides of Lake Pend Oreille tend to be more productive and have much less fine sediment than streams draining the granitic soils of the Selkirk Mountains. Streams flowing from the Cabinet and Bitterroot mountains are more likely to have bedload as a limiting habitat factor, whereas streams flowing from the granitic watersheds of the Selkirk Mountains may have fine sediment limiting habitat condition. Migratory fish are precluded from several tributaries, or portions of tributaries, due to natural waterfalls found throughout the basin.

13.2.1.4 Climate

Continental and marine weather patterns influence climatic conditions in the Upper Pend Oreille Subbasin. Winter storms pass over the area from November through March causing a noticeably wet climate. Mid-winter storms periodically bring warm air masses resulting in rain-on-snow events at middle elevations of 762 meters (m) above mean sea level (msl) to 1,372 m above msl. Summer storms, however, generally pass farther north resulting in relatively dry seasonal conditions. Winds typically prevail from the southwest across Lake Pend Oreille.

Average monthly temperatures in the area range from -3° to 18°C. Annual precipitation averages 84 centimeters (cm) in Sandpoint and exceeds 125 cm in the surrounding mountains (Weisel 1982). Precipitation falls mainly as snow in the winter months, averaging 224 cm per year.

The main body of Lake Pend Oreille seldom freezes in winter; however, shallow areas in the northern end of the lake form an ice cover in some years.

13.2.1.5 Hydrology

Lake Pend Oreille is the largest and deepest natural lake in Idaho, covering approximately 33,696 hectares (ha) prior to impoundment by Albeni Falls Dam in 1952. At full pool the lake now covers 38,362 ha (USFWS 1953; Hoelscher 1993). The lake has more than 282 km of shoreline and has a mean and maximum depth of 164 m and 351 m, respectively (Rieman and Falter 1976). An estimated 95 percent of the lake's volume is held in the large, southern-most basin, a glacially influenced portion of the Purcell Trench (Savage 1965) with a mean depth of 218 m.

The USACE regulates the lake's elevation via operations at Albeni Falls Dam about 3.5 m (11 ft) between a winter time low of 625.1m (2051 ft) msl and a summer time high of 628.6 m (2062 ft) above msl. Winter drawdown generally begins after Labor Day. Minimum pool is normally reached between 15 November and 1 December, with a target

date of 15 November to facilitate kokanee salmon spawning (Fredericks et al. 1995). The operation of Albeni Falls Dam is not to contribute to flooding downstream in the lowland Cusick Flats region downstream of the dam (U.S. Senate 1949).

The Clark Fork River is the largest tributary to Lake Pend Oreille. It drains the Clark Fork River watershed, an area of approximately 59,324 km^2 (Lee and Lunetta 1990). The river contributes approximately 92 percent of the annual inflow to the lake (Frenzel 1991) and most of the annual suspended sediment load. Tributaries to the Clark Fork below Cabinet Gorge Dam include Lightning Creek, Twin Creek, Mosquito Creek, and Johnson Creek. Pack River is the second largest tributary to the lake and is fed by a number of significant tributary watersheds, including Grouse Creek.

Melting snow produces annual runoff in the Clark Fork River with peak flows typically of 30-60 thousand cfs occurring in May or June. Tributaries to the lake and Pend Oreille River may experience one or more runoff events. Mid-winter rain-on-snow events can result in rapid snowmelt, and in some years the peak flow from tributary watersheds occurs during these events in winter, that is, the non-runoff season. Lightning Creek and other tributaries draining the Cabinet and Bitterroot Mountains are particularly susceptible to rain-on-snow events due to high precipitation, their location in relation to the lake, prevailing winds, and the tendency for warm winter storms to pick up moisture from the lake. The Pend Oreille River is the only surface outflow from Lake Pend Oreille. Reservoir narrows to what was once the natural river channel, but is now the forebay of Albeni Falls Dam. Velocities in the channel can be “river-like” during high flow conditions. The constricted sections of the lake “flows” for about 44 km from the lake’s northwest corner near Sandpoint into Washington. Lake Pend Oreille is hydrologically connected to the Spokane Valley-Rathdrum Prairie aquifer at the lake’s southern-most end, contributing about 44 million cubic meters (m^3) of water annually to the aquifer via subsurface flow (Hammond 1974; Drost and Seitz 1978).

13.2.1.6 Water Quality

Lake Pend Oreille is an oligotrophic (nutrient poor) lake. The lake’s trophic status was determined in 1989 (Ryding and Rast 1989) using euphotic zone depth, annual mean total phosphorus concentrations, mean and maximum chlorophyll *a* concentrations, and mean and minimum secchi disc water transparency depths. Nutrient concentrations in shoreline areas and in the northern basin of the lake near Sandpoint are considerably higher due to urbanization and suspended sediments in Clark Fork River inflow. Most of the annual phosphorus, and suspended sediment load enters the lake via the Clark Fork River (Hoelscher 1993). Studies of the pelagic zone (open water area) of Lake Pend Oreille indicated no major temporal changes in water quality variables such as secchi-disc readings, pH, alkalinity, dissolved oxygen, percent saturation, nutrients, chlorophyll-a, and trophic state (Woods 1991). Reduction of nutrient loading is one of the priorities to improve water quality in the Clark Fork River according to the Tri-State Water Quality Commission in Sandpoint. Improvements have come primarily from improved treatments facilities in urban areas along the Clark Fork, but non-point runoff is also a concern for the future.

The 1998 303(d) list has been approved by the Environmental Protection Agency (EPA), thus was used rather than the proposed 2002 303(d) that has yet to be EPA approved. A number of stream segments within the Upper Pend Oreille Subbasin are listed as water quality limited (IDEQ 1998). Granite Creek, Pend Oreille River, Pend Oreille Lake, North Fork of Grouse Creek, Caribou Creek, Fish Creek, Schweitzer Creek, Cocolalla Creek, Hoodoo Creek, and the lower Clark Fork River are all listed for not complying with various water quality standards including sediment, flow alteration, metals, total dissolved gas (TDG), bacteria, dissolved oxygen, nutrients, habitat alteration, and thermal modification (IDEQ 1998).

As a result of plunge pool spillways at Cabinet Gorge and Noxon dams, TDGs in Lake Pend Oreille and Pend Oreille River exceed Idaho and Washington standards during runoff in high flow years. The Washington and Idaho state water quality standard for TDG is 110 percent. Regional efforts are being focused on this issue in an effort to more effectively manage TDG levels throughout the Columbia River Basin. Currently Avista is studying the problem at Cabinet Gorge Dam.

13.2.1.7 Vegetation

Historic vegetation patterns in the Upper Pend Oreille Subbasin were largely influenced by wildfire. Early accounts and photographs of the Subbasin indicate that old-growth stands of western red cedar, *Thuja plicates*, and other species were common in riparian zones and floodplains. Large cedar stumps can still be found in many riparian areas along Subbasin streams. Uplands were more typically dominated by seral species in various stages of succession, with age and composition dependent largely on fire cycles, elevation, slope, and aspect.

Low elevation riparian zones near tributary mouths include areas with and without tree canopy cover. Along stream corridors where tree overstory does not exist or is thin, vegetation includes shrubs and small trees such as thin-leaf alder, *Alnus sinuate;* willows, *Salix spp*.; snowberry, *Symphoricarpos albus;* mountain maple, *Acer glabrum;* red-osier dogwood, *Cornus stolonifera;* blue elderberry, *Sambucus cerulea;* and black hawthorn, *Crataegus douglasii.* Where tree canopy is present, tree species include black cottonwood, *Populus trichocarpa;* water birch, *Betula occidentalis;* quaking aspen, *Populus tremuloides;* and a mix of conifer species including western red cedar, *Thuja plicates;* western hemlock, *Tsuga heterophylla*; Douglas fir, *Psuedotsuga menziesi;* grand fir, *Abies grandis;* and western white pine, *Pinus monticola*.

Conifer forests in the Subbasin consist of mixed stands, typified by stands of western red cedar/western hemlock; stands of co-dominant Douglas fir and ponderosa pine, *Pinus ponderosa;* stands of Douglas fir; western larch, *Larix occidentalis;* lodgepole pine, *Pinus contorta;* and western white pine. Dense stands of Douglas fir, larch, and lodgepole are characteristic of slopes with north and east aspects. Relatively open stands of Douglas fir and ponderosa pine are typical on the warmer, dryer south and west aspects.

Representative species of upland shrubs include western serviceberry, *Amelachier alnifolia;* mountain maple; snowberry; mountain balm, *Ceanothus velutinus;* mallow ninebark, *Physocarpus malvaceus;* huckleberry, *Vaccinium spp.;* and others.

13.2.1.8 Major Land Uses

Over half (55 percent) of the Upper Pend Oreille Subbasin is privately owned (Figure 13.5). The remaining land is managed by the U.S. Forest Service (USFS) (25 percent), the state (7 percent), and Bureau of Land Management (BLM) (1.6 percent). Major land uses in the Subbasin include agricultural and timber production and recreational development (Figure 13.6). Only 12 percent of the drainage is open water (Figure 13.5).

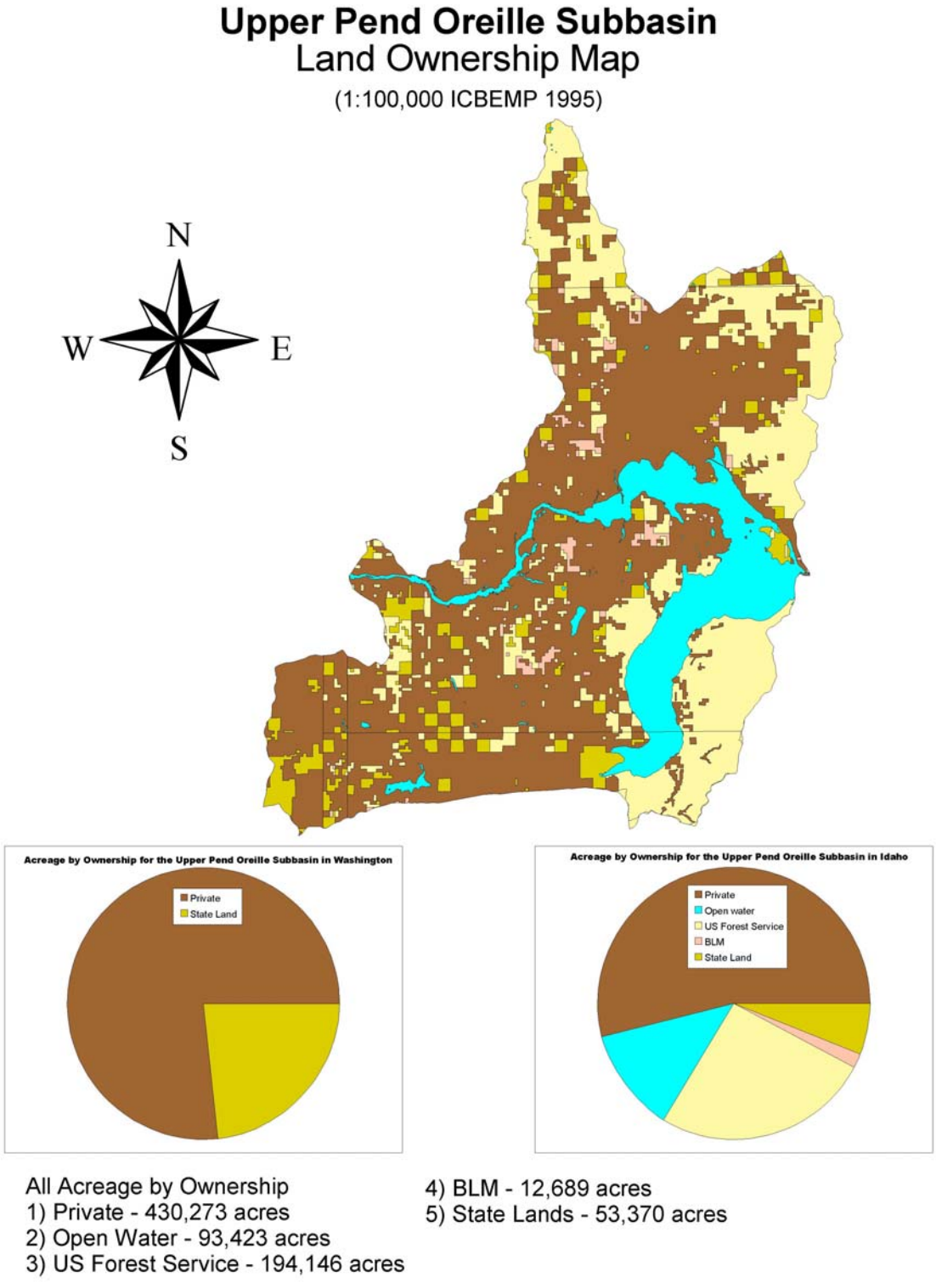


Figure 13.5. Land ownership categories in the Upper Pend Oreille Subbasin

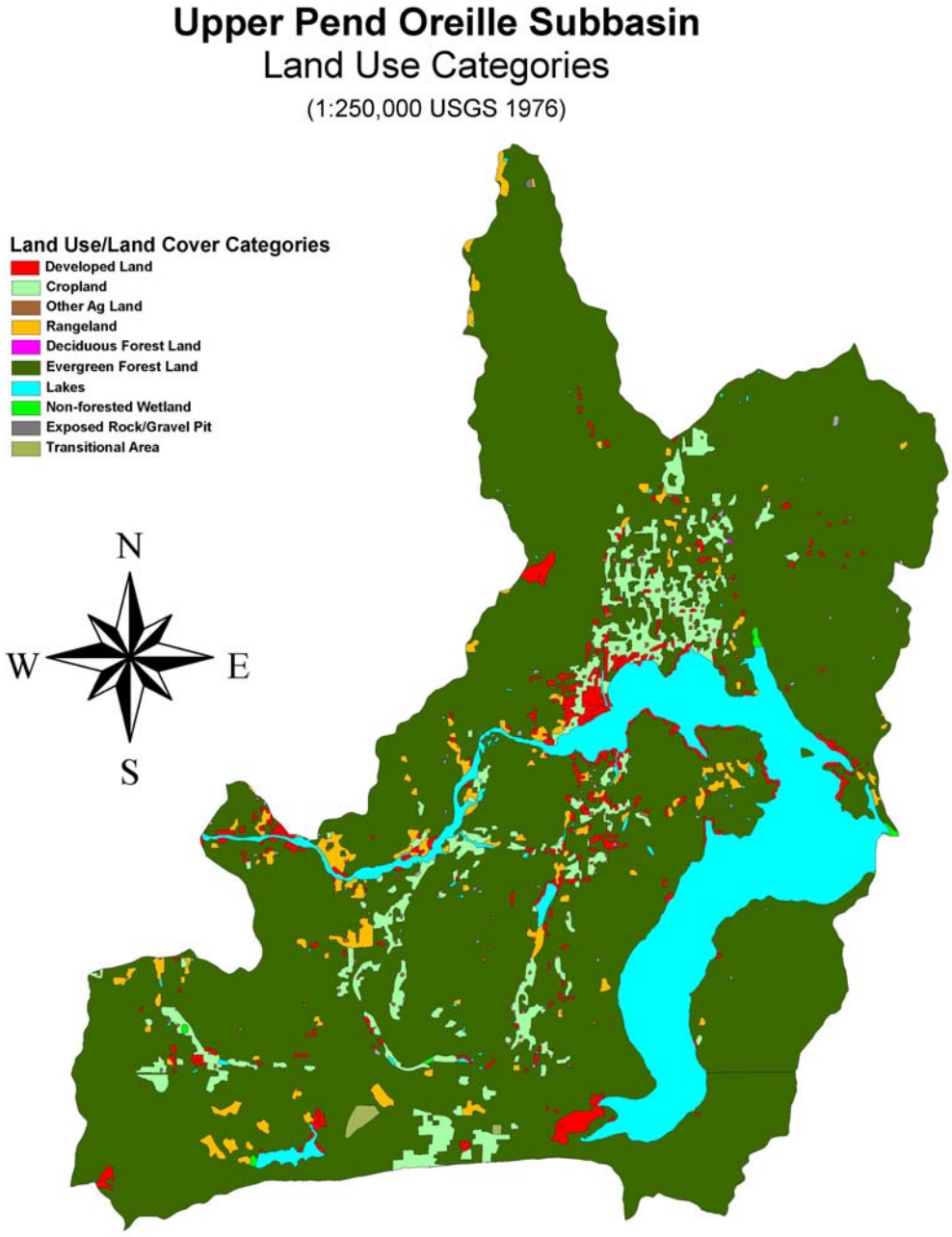


Figure 13.6. Land use categories for the Upper Pend Oreille Subbasin

13.2.2 Lower Pend Oreille Subbasin Description

13.2.2.1 General Location

The Lower Pend Oreille Subbasin (2737 km^2) is located in northeastern Washington approximately 80 km north of Spokane. The Subbasin lies primarily in Pend Oreille County and begins in Idaho at Albeni Falls Dam extending north along the Pend Oreille River corridor to the Canadian border (Figure 13.7). The Lower Pend Oreille Subbasin is bordered by the Selkirk Mountains to the west and the Chewelah Mountains or Calispell Mountains to the east in the upper part of the Colville Valley.

13.2.2.2 Drainage Area

The drainage area of the Pend Oreille River between Albeni Falls Dam and the Canadian border consists of Box Canyon and Boundary reservoirs and two hydroelectric facilities. The largest tributary to the Pend Oreille River in the U.S. is Sullivan Creek, which drains a basin approximately 227 km^2. Other large tributaries in the U.S. include Calispell Creek, Tacoma Creek, Ruby Creek, LeClerc Creek, Lost Creek, Slate Creek, and Skookum Creek. In Canada, the Salmo River is the largest tributary with a watershed draining about 1,300 km^2. The Salmo River flows southerly from its origin about 60 km to the confluence with the Pend Oreille River (Seven Mile Reservoir).

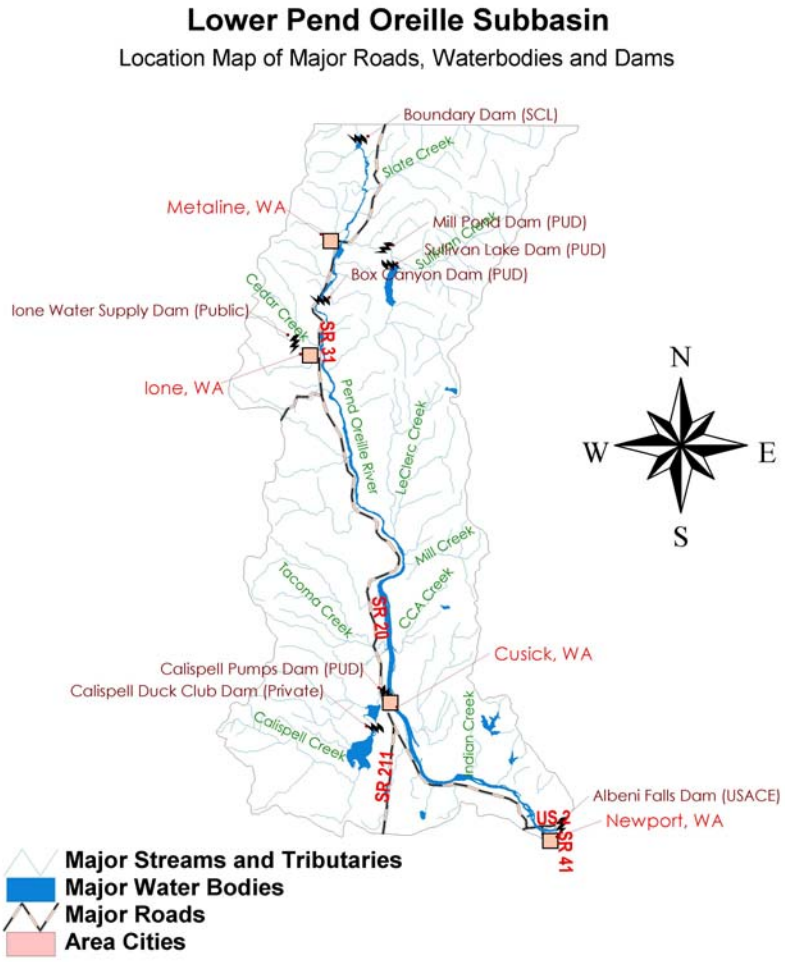


Figure 13.7. Location of Lower Pend Oreille Subbasin

13.2.2.3 Topography/Geomorphology

The Lower Pend Oreille Subbasin lies between the Selkirk Mountains to the east and the Calispell Mountains to the west. The highest peak within the lower Pend Oreille Subbasin is 2230 m (7316 ft) above msl. The southern portion of the Subbasin is mostly rural with large areas of forested mountains and valleys of open pasture. The surrounding topography of the northern portion of the Subbasin is relatively abrupt, and the mountains are steep and rugged.

Most of the Subbasin is underlain by metamorphic or igneous bedrock. The geologic basement rocks, or bedrock, found within the Lower Pend Oreille Subbasin are comprised of metamorphosed sedimentary rocks, quartzite, in the southern portion of the Subbasin. Highly metamorphosed volcanics and marine sediments including carbonates,

conglomerates and quartzite in the northern portion of the Subbasin, and intrusive igneous granite and granodiorites are in the central portion of the Subbasin. The bedrock outcrops at the surface in the high mountain ranges and is encountered at depths greater than 30 m in the valleys.

13.2.2.4 Climate

The climate of the Lower Pend Oreille Subbasin combines characteristics of a typical mountain/continental climate, which predominates in the Rocky Mountains, and a maritime climate. Average annual precipitation at lower elevations near Newport, Washington is 63.5 cm. At higher elevations, the average annual precipitation ranges from 89 to 140 cm. Monthly precipitation patterns show that the majority of precipitation falls in the winter and spring, with the highest totals occurring from November through January. Peak rainfall also occurs in May and June, particularly in the northern portions of the Lower Pend Oreille Subbasin. Total annual snowfall averages 127 to 152 cm in the Pend Oreille River valley.

13.2.2.5 Hydrology

The Pend Oreille River flows for 249 km in a northwesterly direction from its headwaters at Lake Pend Oreille to the Columbia River in British Columbia, Canada. The Pend Oreille River is impounded by several hydroelectric projects. Waneta and Seven Mile dams are located furthest downstream in Canada and are owned and operated by Tek Cominco and B.C. Hydro, respectively. Boundary Dam, owned and operated by Seattle City Light, is also located on the Pend Oreille River about 1.6 km upstream from the U.S.-Canadian border. The reservoir is 28.1 km long and has a surface area of about 664 ha at full pool. Boundary Dam is operated for load-following generation (Entz and Maroney 2001). Load-following generation means it does vary on a daily basis, but the variation changes based on load and on other resources in the system. Box Canyon Dam is a run-of-the river project, owned and operated by Pend Oreille County Public Utility District (PUD) Number 1, is located on the Pend Oreille River and forms a 2,983 ha reservoir. Box Canyon Reservoir extends upstream from Box Canyon Dam 89.8 km to the tailwaters of Albeni Falls Dam. Albeni Falls Dam is located in Idaho approximately 3.5 km upstream from Newport, Washington, with a storage capacity of 1.56 million-acre feet and is operated for hydropower generation, flood control, and recreation. Major lakes within the Subbasin include Sullivan Lake, Bead Lake, Marshall Lake, and Calispell Lake. The Sullivan Lake Project is also a FERC-licensed facility and currently operates only as a storage reservoir (no generation).

Peak flows in the Pend Oreille River below Albeni Falls occur in May and June and are the result of annual runoff above Albeni Falls Dam. Peak flows typically range from 50 to 90 thousand cubic feet per second (cfs). All gates at Albeni Falls Dam are removed during high flow periods exceeding 90 thousand cfs. Flooding along the Pend Oreille River begins at a flow of 100 thousand cfs.

The Calispell Creek is the main tributary to the Pend Oreille River between Albeni Falls Dam and Box Canyon Dam. The Calispell Creek empties into the Pend Oreille River in a diked section of the Pend Oreille River near the town of Cusick. Under normal operation, the Calispell Creek is pumped into the Pend Oreille River at a pumping station consisting

of six pumps. The peak flow in the Calispell Creek occurs in March to April and is the result of snow melts in the Calispell watershed. In years when the pumps are not capable of pumping the Calispell during the peak flow period, Box Canyon is required to lower the river by removing gates thus allowing the Calispell to free-flow into the Pend Oreille. This drawdown of the Pend Oreille River at Box Canyon Dam is only possible when the flow out of Albeni Falls Dam is less than 40 thousand cfs.

Pat McGrane (1999) reports,

> Problems can occur at Cusick if flows in excess of 43,000 cfs are passed through Lake Pend Oreille and into the Pend Oreille River during the spring when Lake Pend Oreille is held essentially level. Runoff (or dam releases) from upstream can at times coincide with normal spring runoff from Calispell and Trimble creeks, two lowland streams that border the Cusick Flats agricultural area. When the Pend Oreille River is high, gates in dikes across the mouths of the Calispell and Trimble creeks must be closed to keep the river from backing up into those smaller tributaries. The dikes hold back water from the Pend Oreille River, but can cause interior flooding on the tributary side of the dikes as the local creeks back up. Pumps designed to lift water from Calispell Creek and Trimble Creek through the dikes sometimes cannot handle the volume. When Lake Pend Oreille was held at an elevation of 2055 ft (626.4 m), Albeni Falls Dam has the hydraulic capacity to release more water than at elevation 2051 ft (625.1 m) due to an increase in head.

Between 1996 and 1999, winter elevations at Albeni Falls Dam were at 2055 ft (4 ft higher than previous winter lake elevations) to evaluate the benefits to kokanee in Lake Pend Oreille. During this same time frame, impacts to the watershed downstream were also investigated by the USACE (McGrane 1999). The study concluded there were "many factors that influenced the water levels in Cusick area over the past four years [1996-1999]. An uncommon series of wet winters [wettest period in over 20 years], the inadequacy of the Trimble Creek pumping facility, failure of Pend Oreille PUD to follow their agreement with the Calispell Creek drainage district (in 1997), the higher releases from Albeni Falls Dam as a result of the kokanee experiment, and the unusual evacuation of Hungry Horse Reservoir (in 1996) all played a role in producing high water levels during the early spring months in the Cusick area."

In Canada, the Salmo River, a fifth-order stream, is the main tributary to the Pend Oreille River. Between 1949 and 1976 the mean annual discharge in the Salmo River was 32.5 cubic meters per second (cms, 1148 cfs), with a mean monthly minimum and maximum discharge of 7.5 cms (265 cfs) and 128.5 cms (4538 cfs) (Baxter et al. 2004). Annual peak runoff occurs in May, with the highest flows between April and July (Baxter et al. 2004).

In the U.S., hydrologic records are maintained by the USGS with data published yearly. Gaging stations in Box Canyon Reservoir are located at the town of Newport (station no. 12395500) downstream of Box Canyon Dam (station no. 12396500), and the Pend

Oreille River at the international boundary (station no. 12398600). There are also USGS gages on Calispell Creek (station no. 12396000) and Sullivan Creek (stations no. 12396900, 12398000). The Sullivan Creek stations were discontinued as of 2004. Information sources on water rights, claims, and water use are available from the Washington Department of Ecology (WDOE) (WDOE 1994, 1995a, 1995b). Geiger et al. (1993) provides an annotated bibliography describing data and studies of surface and groundwater quantity on the Kalispel Indian Reservation.

13.2.2.6 Water Quality

The lower Pend Oreille River is listed on Washington State's 1998 303(d) list for temperature, pH, and exotic aquatic plants (WDOE 1998). In addition to the Pend Oreille River, other streams are listed on the 303d list including: Skookum Creek for fecal coliform, and Lost and Cedar creeks for temperature exceedences.

Box Canyon Dam construction resulted in the river changing from a free-flowing system to a slow long and narrow flowing, run-of-river reservoir (Bennett and Liter 1991). Velocities in Box Canyon Reservoir range from 0.03 meters per second (mps, 0.1 feet per second, fps) during the summer up to .6 mps (2.0 fps) during the spring (Falter et al. 1991). A short flushing time and shallow depth do not allow vertical temperature stratification. Temperatures can reach 25 °C in the summer months and total dissolved gases exceed 110 percent during certain times of the year (Geist et al. 2004). Aquatic plants, particularly the proliferation and control of Eurasian watermilfoil, *Myriophyllum spicatum,* have been identified as water quality concerns (EPA 1993).

Sloughs along the Pend Oreille River have moderate to high nutrient levels (Falter et al. 1991) in the lower Pend Oreille River below Albeni Falls Dam (Box Canyon Reservoir). The sloughs and the river are homeothermous November through mid-April. The major sloughs weakly stratify in the spring; however, only Tiger Slough and Big Muddy Slough are known to remain strongly stratified throughout the summer. Water quality among the sloughs is similar with the exception of Calispell Slough and Trimble Slough, which have soft water (low conductivity and low total alkalinity). High fecal coliform levels have been identified as a concern in selected tributaries and sloughs (Pelletier and Coots 1990; Coots and Williams 1991).

13.2.2.7 Vegetation

The majority of the Lower Pend Oreille Subbasin is located in the Okanogan Highlands Physiographic Province, which is characterized by conifer forest communities except on wet sites. The northern portion of the river corridor is within the western hemlock vegetation zone (Franklin and Dyrness 1973). Western red cedar is a major climax species in this zone, and grand fir is an important and persistent seral species. Sitka alder is characteristic at moist sites in this zone including riparian areas. Timbering has reduced the ecological function of the uplands by eliminating mature forests. This change is reflected in the number of plant and animal species present in the Subbasin that are listed as threatened or endangered under the Endangered Species Act (ESA).

The southern portion of the Lower Pend Oreille Subbasin near Albeni Falls Dam is within the ponderosa pine vegetation zone, broadly defined to include areas where

persistent, fire-maintained ponderosa pine forests predominate. Within this zone, groves of black cottonwood and quaking aspen typically occur on riparian or poorly drained sites. Other representative conifer tree species in this zone are Douglas fir, western larch, and grand fir. Lodgepole pine is a common seral species on burned sites. Representative shrub species in this zone include snowberry, shiny-leaf spiraea, and rose. On more mesic sites in the zone, ninebark, western serviceberry, and black hawthorn are typical.

Nearly all of the original forests between the major roads east and west of the Pend Oreille River were logged or burned at least once, or permanently cleared for agriculture or residential development (Entz and Maroney 2001). A large part of this area is in pasture, hayfields, and fallow land. Seasonally flooded wetlands are extensive. Wetland types include seasonally flooded fields, scrub-shrub, and forests; persistently flooded, emergent wetlands; persistently flooded, shallow riverine sloughs; old sloughs that are presently connected to the river only during flood conditions; and ponds not connected hydrologically to the river. Riparian cottonwood galleries are in decline as managed hydrology and land use practices have limited regeneration and replacement. The reduction in peak flooding has removed a critical process for the natural development of the floodplains.

Noxious weeds dominate disturbed areas of the Subbasin. The Pend Oreille County Weed Board has identified several noxious weed species, which receive most of the attention within the Subbasin.

Rare plants, whether listed under ESA or not, are a significant reflection of land disturbance in the Lower Pend Oreille Subbasin. The U.S. Forest Service (USFS) and U.S. Fish and Wildlife Service (USFWS) provide the majority of support for rare plant issues. Other entities such as the Kalispel Tribe and the Pend Oreille County PUD are active in identifying and managing botanical resources.

Known information about existing botanical resources in the Lower Pend Oreille Subbasin includes a plant species list of Pend Oreille County (Layser 1980) and a number of documented rare plant occurrences (Washington Natural Heritage Program [WNHP] 1996), a database for which is housed at the WNHP and the Idaho Conservation Data Center. The Pend Oreille PUD has conducted botanical fieldwork as part of its re-licensing efforts and has additional knowledge of rare plants and other plant species of special interest along Box Canyon Reservoir.

13.2.2.8 Major Land Uses

Much of the land within the Lower Pend Oreille Subbasin lies within the Colville National Forest (refer to Figure 13.1). State, Tribal, and private land holdings make up the majority of the remaining ownership within the Subbasin. Rangeland and agricultural land are located adjacent to the Pend Oreille River corridor. Agricultural uses include cultivated crops, grazing, and animal husbandry. The city of Newport is located on the Washington-Idaho border and is the largest urban area in the Subbasin. Other developed areas include Cusick, Metaline, Metaline Falls, Ione, and Usk. Past and current land use practices have not changed significantly; timber production continues to be the predominant land use (Figure 13.8).

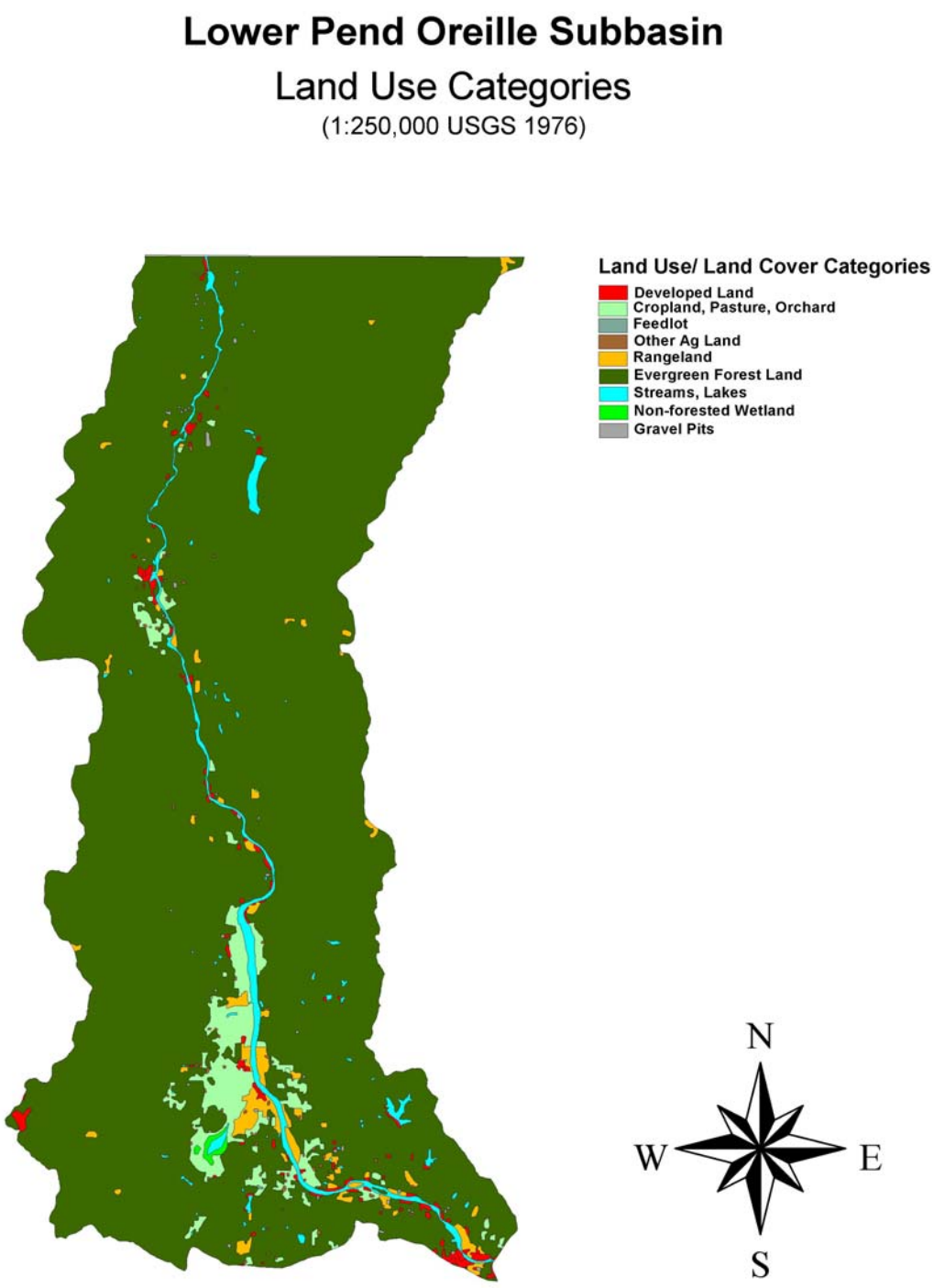


Figure 13.8. Land use categories for the Lower Pend Oreille Subbasin

13.2.3 Priest River Subbasin Description

13.2.3.1 General Location

The 2,538 km^2 Priest River Subbasin is located primarily within the northwest corner of the Idaho Panhandle within Bonner and Boundary counties (Figure 13.9). The Subbasin includes Upper Priest Lake, the Thorofare, Priest Lake, and the Priest River below Outlet Dam (also known as Priest Lake Dam) at Priest Lake. The Thorofare is a body of water connecting Upper Priest Lake with Priest Lake. The headwaters of Upper Priest River originate in the Selkirk mountain range in British Columbia, Canada. Headwaters of major tributaries on the western side of the Subbasin are located in northeast Washington. The Subbasin is bordered on the west by the mountain crest separating the Panhandle and Colville National Forests.

The Outlet Dam is owned by the state of Idaho and managed by Avista. The dam was first installed in 1950. Prior to 1950, the lake had annual log drives down the mainstem of the Priest River. Originally, the dam was installed because of concerns that the Lake would run dry. Prior to the impoundment, the water height was 1.5 to 1.8 m (5 or 6 feet) with the spring freshet. The lake height at this point in the summer was about 0.3 m (1 foot). Washington Water Power (WWP) built the original log-crib and they paid $15,000 for the water rights. In 1961, the Idaho Legislature passed H.B. 273 authorizing the state engineer to operate the dam. The law says that the water level at the dam would be maintained at 0.9 m (3 feet) until the end of each recreational season.

13.2.3.2 Drainage Area

Upper Priest Lake has two major tributaries: Upper Priest River and Trapper Creek. The Hughes Fork flows into the Upper Priest River above Upper Priest Lake. Caribou Creek and Beaver Creek flow into the Thorofare. The Thorofare contributes about 40 percent of the annual inflow to Priest Lake. Major streams draining the Selkirk range on the east side of Priest Lake are Lion Creek, Two Mouth Creek, Indian Creek, Hunt Creek, and Soldier Creek. Seven minor flow streams are interspersed between the major east side tributaries. The west side of the Priest Lake drainage extends from Beaver Creek, discharging into the lowest reach of the Thorofare just above Priest Lake, to the southern end of the lake. The west side of Priest Lake has one major stream, Granite Creek, and one moderate flow stream, Kalispell Creek and several smaller though significant streams, Lamb Creek and Reeder Creek. The remaining tributaries are of much lower volume. The Priest River originates at Outlet Dam on the southwest corner of Priest Lake 72.4 km to its confluence with the Pend Oreille River near the town of Priest River. Major tributaries include Binarch Creek, Upper West Branch, Lower West Branch, Quartz Creek and East River.

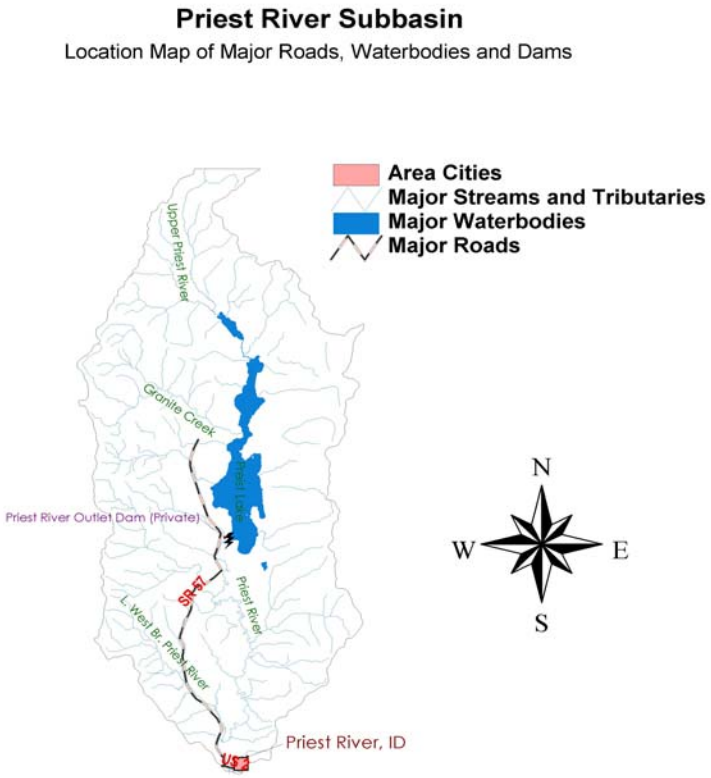


Figure 13.9. Location of Priest River Subbasin, Idaho, Washington and British Columbia, Canada

13.2.3.3 Topography/Geomorphology

Savage (1965, 1967) and Miller (1982) conducted geological investigations and mapping of the Priest River Subbasin. Summaries, maps, and updates of this work are provided by Bonner County (1989), Buck (1983), McHale (1995), Idaho Water Resource Board (1995), and Rothrock and Mosier (1997). Geology of the Priest River Subbasin is shown in Rothrock (2000). The entire Priest River Subbasin lies within the Northern Rocky Mountain Geomorphic Province (USFS 1997). Faulting is the major structural factor affecting the geology and drainage patterns. During the Pleistocene Era, a series of glaciers scoured the area after which time the glaciers receded and the river downcut in places through the glacial debris. Continental glaciation left extensive fluvial, lacustrine, and morainal deposits overlying bedrock in the Priest River Subbasin. The deposits include mixes of gravels, sands, silts, and clays. Elevation within the Subbasin ranges from 742 m, where Priest River enters the Pend Oreille River, to more than 2,134 m within the Selkirk Mountains.

13.2.3.4 Climate

The climate in the Priest River Subbasin is transitional between a northern Pacific coastal type and a continental type (Finklin 1983). July and August are the only distinct summer months and temperatures are relatively mild due to influence from Pacific maritime conditions. The average daily summer maximums are around 28 °C. Winter temperatures also are relatively mild compared to areas east of the Rocky Mountains. The annual precipitation averages 81 cm. At elevations above 1,463 m, snowfall accounts for more than 50 percent of total precipitation (Finklin 1983). The wettest months normally are November, December, and January. The elevation zone between 610 m and 1,067 m is subject to rapid snowmelt from winter storms. The lower half of the western side of the Subbasin is particularly vulnerable to high discharge rain-on-snow events.

13.2.3.5 Hydrology

Upper Priest Lake has a surface area of 541 ha, a maximum depth of 31.4 m, a mean depth of 18.3 m, and a volume of 0.1 km^3 (Fredenberg 2000). The lake has a short hydraulic residence time, about three months on average. The lake level on the larger main lake is controlled by the dam on Priest Lake. Priest Lake has a surface area of 9,430 ha, a maximum depth of 112 m, a mean depth of 39 m, and a volume of 3.7 km^3. Average hydraulic residence time is about three years.

13.2.3.6 Water Quality

In the Priest River Subbasin a study conducted by Idaho Department of Environmental Quality (IDEQ) in 1993 through 1995 examined several components of the lake system. These components included trophic status indicators of the open waters (limnetic zone), bathymetry, plant growth in near-shore (littoral) zones, quantity and quality of inflow waters, characteristics of selected groundwater aquifers, and watershed characterization utilizing a geographical information system (GIS). The study concluded: 1) open waters of Upper Priest Lake and Priest Lake can be classified as oligotrophic; 2) lake waters of shallow, near-shore sampling sites showed no indication of nutrient enrichment linked to onshore human development; 3) both lakes exhibit a marked decline in water clarity during tributary spring runoff; 4) phytoplankton growth in Priest Lake may be co-limited by phosphorus and nitrogen at least during summer months; 5) attached algae growth in the littoral zone of many Priest Lake shoreline areas appears excessive given the low nutrient content of ambient near-shore waters; 6) the primary nutrient fueling sources relating to attached algae biomass were not determined; 7) phosphorus, nitrogen, and sediment loading from various sources into Priest Lake was determined to be low to moderate, except that loading per area of runoff from some residential areas can be high; 8) some isolated areas of groundwater sampling indicate an altering of background water quality by sewage effluent plumes; and 9) project consultants consider human induced nutrients and sediments represent a potential threat to existing Priest Lake good water quality (Rothrock and Mosier 1997).

As of 1998, the State of Idaho had listed portions of the Priest River and the following tributaries as water quality impaired: Binarch Creek, Kalispell Creek, Lower West Branch of the Priest River, and Reeder Creek. These reaches did not meet clean water standards for dissolved oxygen, flow, sediment, and/or temperature. The beneficial uses

of Priest River include: domestic water supplies, agricultural water supply, coldwater biota, and recreation.

Studies by the State of Idaho and the University of Idaho suggest that the aquifer underlying the Kalispell Basin likely extends far beyond the Subbasin boundaries (USFS 1997). Preliminary data suggests that as much as 61 m of unconsolidated material underlies the basin and that the aquifer is one of the major water sources for Priest Lake.

13.2.3.7 Vegetation

Vegetation within the Subbasin varies in association with soil moisture conditions, slope aspect, elevation, precipitation, temperature, wildfire history, and land use patterns. The area is predominately coniferous forest. In the higher elevations of the Selkirk range, subalpine fir and Engelmann spruce are the dominant species. A large area on both the east and west sides of the Subbasin is occupied by western red cedar and western hemlock in moist soils, and Douglas fir, grand fir, western larch, white pine, lodgepole pine, and ponderosa pine in semi-dry soils. There are some spectacular stands of western red cedar, for example, at the Roosevelt Grove of Ancient Cedars on Granite Creek and above Upper Priest Lake. The make-up of coniferous species has changed through time because of timber harvesting and replanting, fire, and plant diseases (Fredenberg 2000).

13.2.3.8 Major Land Uses

The majority of land within the Priest River Subbasin is publicly owned and managed by the USFS or Idaho Department of Lands (IDL) (figures 13.10 and 13.11). The British Columbia Ministry of Forests manages the headwaters of the Upper Priest River. Private property comprises approximately 10 percent of the total land area on the west side of the Subbasin. There are some blocks of commercial timberlands owned by Burlington Northern Inc./Plum Creek Timber and a few large, private agricultural holdings in the Nordman, Lamb Creek, Reeder, Granite, Kalispell, Coolin, Cavanaugh and Huckleberry Bay areas (Fredenberg 2000). Most of the Priest Lake shoreline is managed by either the USFS or the IDL.

The majority of west side of the Subbasin is in the Idaho Panhandle National Forest (IPNF), Priest Lake Ranger District. The USFS manages the three large islands on Priest Lake, Kalispell, Bartoo, and Eightmile (Fredenberg 2000). There are also two state parks on the east shore of Priest Lake, Indian Creek and Lionshed State Parks.

More than 90 percent of the east side of the Subbasin is owned by the State of Idaho. Most of this land is administered by IDL under the State Endowment Trust. A substantial amount of private and commercial timberlands have been transferred to the state through various property exchange agreements, although some blocks of private forest land still exist (Fredenberg 2000). The Idaho Department of Parks and Recreation (IDPR) manages Priest Lake State Park.

Approximately 26 percent of the Priest Lake shoreline is privately owned (Bonner County 1989). The west shoreline is where the most concentrated residential and business development has occurred (Figure 13.10). Within the federal and state-owned lands, there is considerable waterfront development through lease lot programs (Fredenberg 2000).

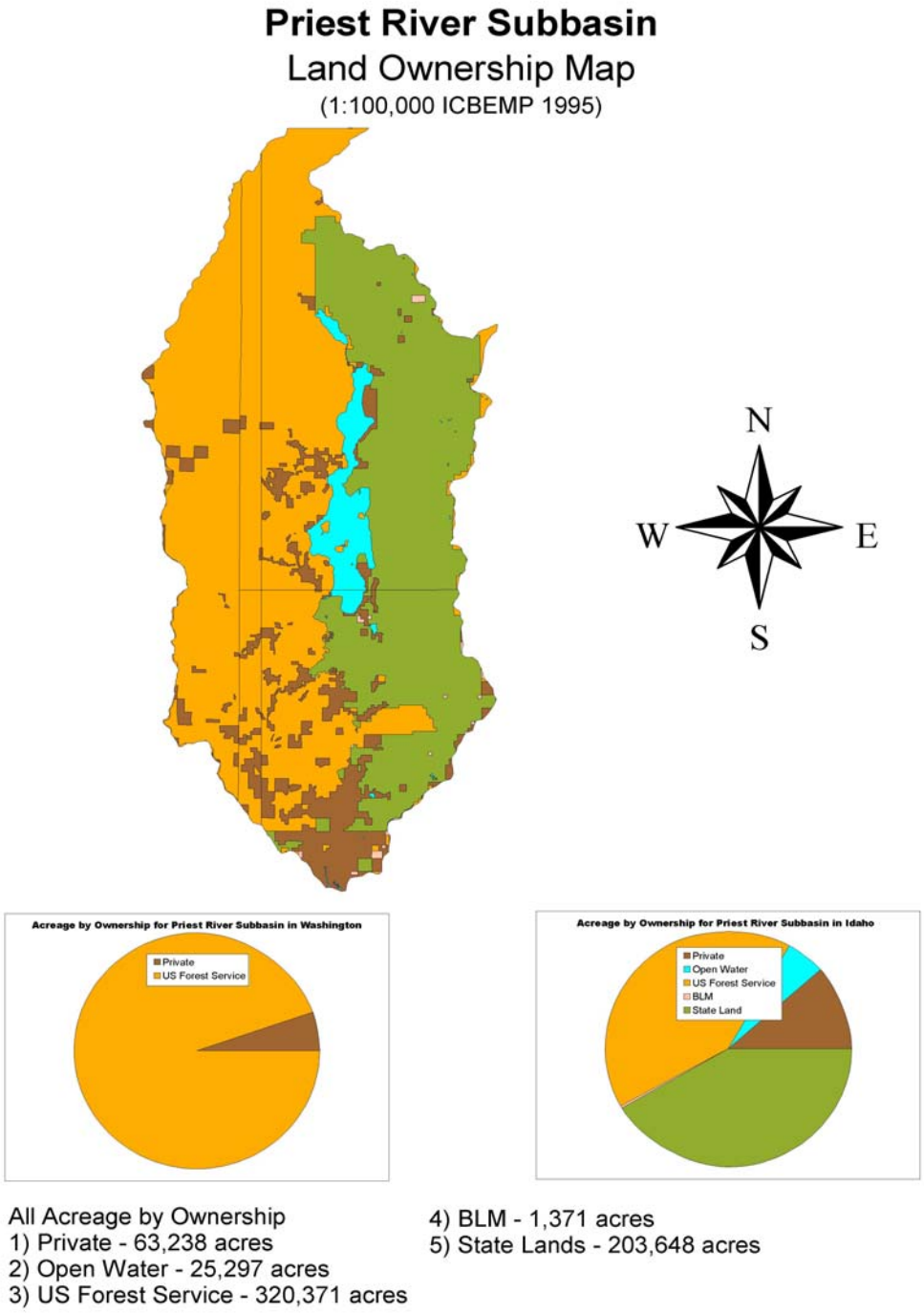


Figure 13.10. Land ownership characterization for the Priest River Subbasin

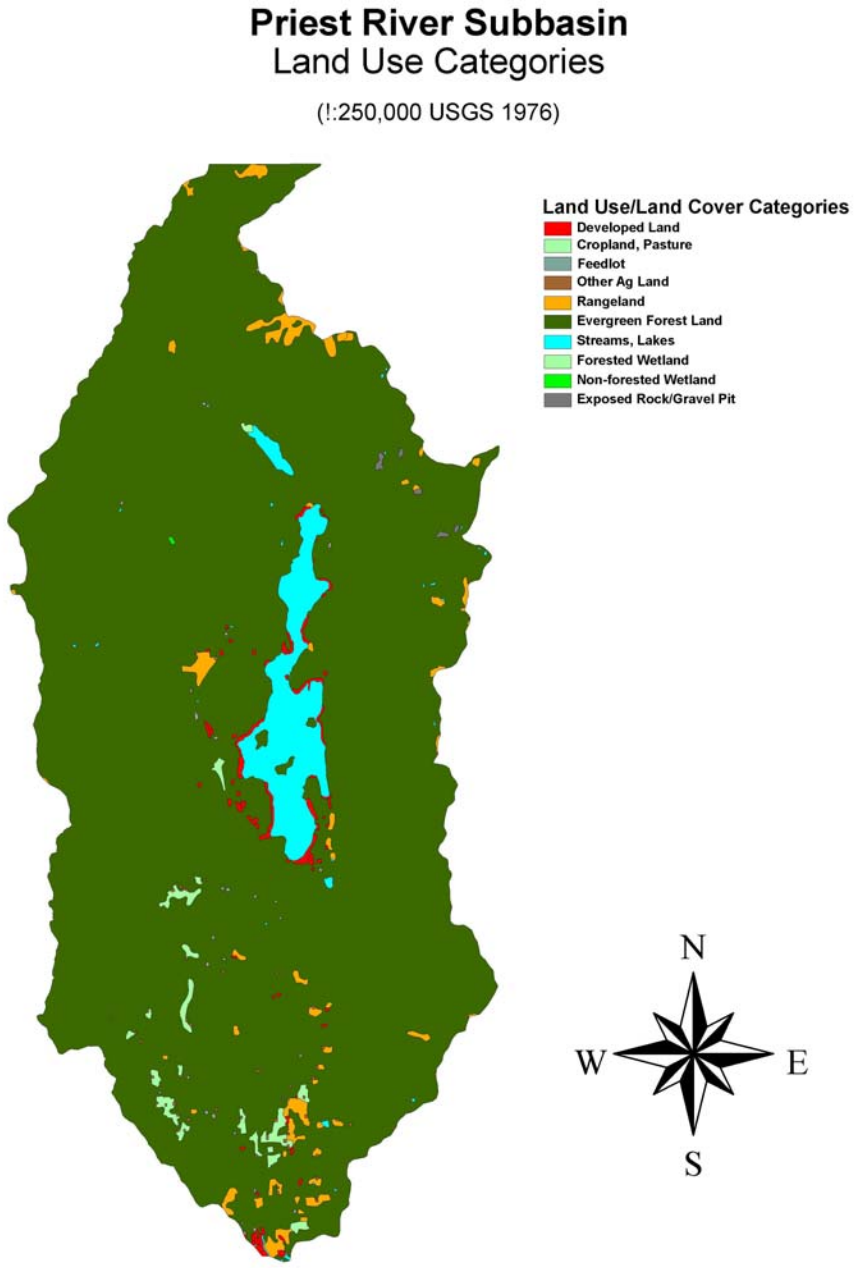


Figure 13.11. Land use categories for the Priest River Subbasin

13.3 Logic Path

The logic path starts with an overall physical description of the Subbasin, followed by an assessment of aquatic and terrestrial resources from which a management plan was created with specific strategies and objectives to address limiting factors and management goals. In the next section, Section 14 Pend Oreille Subbasin Assessment – Aquatic, aquatic resources regarding the historic and current status of selected focal species are described in detail. An analysis based on the QHA technique (described in Section 3) identifies specific habitat attributes that have been altered the most over time relative to the entire Subbasin and which areas in the Subbasin are categorized as having poor or good habitat for the respective focal species. Based on the current status of the focal species, limiting habitat attributes, and management goals recognized in the Subbasin, strategies and objectives were identified and are presented in Section 18 Pend Oreille Subbasin Management Plan. The terrestrial assessment, presented in Section 16, provides a description of the historic and current status of wildlife species and condition of terrestrial habitat types within the Subbasin. Based on the terrestrial assessment and key findings, strategies and objectives were developed and are defined in Section 18 Pend Oreille Subbasin Management Plan.