Chapter 3

Affected Environment

This chapter discusses the affected environment of the resources potentially affected by Reclamation's proposed action. These resources, in order of discussion, include vegetation, fish, wildlife, threatened, endangered, and special status species, recreation, economics, irrigated agriculture, historic resources, traditional cultural properties, Native American sacred sites, Indian trust assets, environmental justice, surface water quality, groundwater quality, visual quality, air quality, soils, social environment, and public health. Chapter 4 analyzes the environmental impacts of the Action Alternative to these resources, compared to the condition of the resources under the No Action Alternative.

Reclamation recently completed an environmental assessment (EA) and finding of no significant impact for the Banks Lake Resource Management Plan (RMP). The EA includes information on natural resources, such as endangered species, soils, vegetation, cultural resources, recreation use, and Indian trust assets. The information on these resources contained in the EA is incorporated by reference into this EIS.

Vegetation, Fish, and Wildlife

The littoral zone (shore) of Banks Lake extends from the shore just above the influence of waves and spray to a depth where the light is barely sufficient for rooted aquatic plants to grow (Goldman and Horne 1983). This biologically critical zone supports aquatic macrophytes (primarily cattails, bulrush, and sedges) that provide spawning habitat and nursery areas for the majority of Banks Lake's fish species; provides food and cover for waterfowl, mammals, and amphibians; and supports cottonwood trees important for perch sites for bald eagles and other raptors. This zone is the focus of analysis of impacts to vegetation, fish, and wildlife for the proposed August drawdown alternative.

Water levels not only determine the extent of littoral habitat, but affect that habitat when fluctuations occur (Hoyer and Canfield 1997; Ploskey 1986). Several recent studies on littoral zone habitats in lakes have documented decreases in total cover and changes in substrate composition with decreases in water level as small as 0.6 m (2 ft) (Irwin and Noble 1996). Beauchamp et al. (1992) estimated that 20 percent of

rocky substrate, important as cover for small native fishes, was exposed during a drought that lowered Lake Tahoe's water level by 2 m (6.5 feet). Dibble (1993) found that bass populations were adversely affected by water level declines that dewatered shallow water gravel substrates that supported high densities of age-0 largemouth bass (less than 1 yr old).

The surface area and shape of a lake significantly influences the effect wind can have on wave size and current strength. Large lakes tend to have larger fetches (area open to the prevailing wind) and thus have greater wave and current energy than lakes with small surface areas. Wave action and currents erode a terrace along the shoreline, leaving coarse material in shallow water and depositing finer materials in deep water. The direction and strength of the wind, slope, and shape of the lake basin determine where the substrates will move. Generally, points and shallows where wind and wave energy are highest tend to be swept clean. Bays and deep areas in a lake tend to fill with sediment. The variation in the quantity and quality of silt largely controls the distribution of submersed vegetation. Large lakes with many bays or coves may develop an extensive littoral zone, because these areas are protected from strong waves and currents. Thus, basin size, shape, and depth determine, to a large degree, the distribution of sediments in a lake and, therefore, the distribution of aquatic plants. Additionally, a gently sloping littoral zone allows the deposition of fine sediments that promote plant growth. Steeply sloped littoral zones are areas of erosion and sediment transport and are not suitable for plant growth.

Three distinct littoral zone habitat types exist at Banks Lake. The first consists of shallow bays and shoreline areas sheltered from much of the wind and wave action with well developed communities of aquatic macrophyte species such as bulrushes, sedges, and cattails. The second and third types occur in the main lake exposed to wind and wave action. These consist of the extensive shoreline zone composed of sand, gravel, and cobble and the third type is composed of medium to hard-packed clay. Uplands are not affected by changes in water level and will not be addressed.

A vast body of scientific literature is available on the effects of reservoir drawdowns. This analysis draws upon the knowledge gained at many other reservoir projects to develop a better understanding of the present conditions and anticipated impacts resulting from an August drawdown. The analysis of impacts focuses on the littoral zone of the lake, as well as on the productivity of the open water in the form of zooplankton.

Vegetation

Two major vegetation communities that exist within the littoral zone may be affected by late summer drawdowns: (1) aquatic macrophytes in shallow low gradient bays and shorelines (figure 3-1); and (2) the narrow strip of riparian vegetation that exists just above the high-water line along some portions of Banks Lake. Aquatic macrophytes by definition are the macroscopic (that is large enough to be seen with

Figure 3-1.—Aquatic macrophytes are common in Banks Lake in coves, bays, and shorelines protected from wind and wave action.

the unaided eye) forms of aquatic and wetlands plants found in the shorelines of lakes or slow-moving reaches of rivers.

Four widely-recognized growth forms include emergent, submersed, floating-leaved, and free-floating. Emergent macrophytes are rooted in substrate with the tops of the plant extending into the air. Common emergent macrophytes include plants, such as reeds (*Phragmites*), bulrushes (*Scirpus* spp.); cattails (*Typha* spp.) and spikerushes (*Eleocharis* spp). Submersed macrophytes grow completely submersed under the water and include such diverse species as pondweeds (*Potamogeton* spp) and Eurasian watermilfoil. Floating-leaved macrophytes are rooted to the lake bottom with leaves that float on the surface of the water. They generally occur in areas of a lake that do not periodically dry out. Typical species are waterlilies (*Nymphaea* spp), spatterdock (*Nuphar* spp), and watershield (*Brasenia*). Free-floating macrophytes are plants that float on or just under the water surface with their roots in the water and not in sediment. Duckweed (*Lemna* spp.) typifies this growth form.

In the semi-arid and arid portions of the West, water availability to plants from rain and snowmelt infiltration is limited, sporadic, and unreliable. Riparian and emergent vegetation has adapted to these harsh conditions by drawing much of their seasonal water needs from comparatively reliable groundwater sources (Stromberg 1994; Mahoney and Rood 1991). Any significant change in groundwater elevation

during the growing season has the potential to adversely affect these vegetation communities (Stromberg 1992). Mortality or even stress in these species will lead to changes in vegetation community composition.

Many species of riparian vegetation, especially cottonwood, have very specific soil moisture requirements needed for germination and seedling survival. These requirements typically involve early spring high water levels that recede just prior to seed fall, providing a moist seedbed. Any significant alteration of the timing or magnitude of water levels can adversely affect germination and seedling survival (Bradley and Smith 1986; Stromberg 1992) and can have long term effects on these species.

Aquatic Macrophytes

Banks Lake full pool is water surface elevation 1570 feet. Water levels currently fluctuate approximately 3 to 5 feet annually with the highest water levels typically in June and the lowest levels in August. This relatively stable water regime has allowed the development of aquatic macrophytes in all available protected bays and shorelines. Shallow, marshy areas in bays and along low gradient shorelines occur in only a few areas, but are extremely important to fish and wildlife (figure 3-1). Aquatic macrophytes provide sheltered nutrient-rich spawning and nursery habitat for many of Banks Lake fish species as well as waterfowl nesting and foraging. This habitat type is found primarily in Barker Cove, Osborn Bay, Kruks Bay, Jones Bay, Airport Bay, and Devil's Punch Bowl, and along shorelines in the southwest corner of Banks Lake adjacent to the Dry Falls Dam (figures 3-2 and 3-3).

Stands of aquatic macrophytes occur in shallow (<6.5 feet (2-m) depth), protected bays and shorelines with a gentle slope. A fine-textured substrate is preferred and generally indicates a favorable, low-energy environment. Dominant species include reed canarygrass (*Phalaris arundinare*), and Baltic rush (*Juncus balticus*). Lesser amounts of American bulrush (*Scirpus americanus*), Nebraska sedge (*Carex nebrascensis*), spike rush (*Eleocharius palustrius*), common cattail (*Typha angustifolia*), curly dock, foxtail barley, buttercup, western water hemloc, cocklebur, horsetail, inland saltgrass, noxious knapweeds, marsh sow thistle, and red top bentgrass (*Argostis alba*) also occur in these stands of aquatic macrophytes.

Unfavorable abiotic conditions include excessive water-level fluctuations, high turbidities, and shifting sediments. Small, young plants are especially vulnerable to changing water levels that may place them in water too deep or muddy to allow for adequate light penetration or so shallow as to expose them to turbulence or desiccation or cover them with sediment (Smart and Dick 1999). The ability to tolerate periodic drawdown and drying will determine which aquatic macrophyte species would be able to survive. Fourteen representative aquatic macrophyte species that occur or potentially occur at Banks Lake have been selected for detailed analysis. Table 3-1 summarizes the drought tolerance and the species value for fish and wildlife for these species.

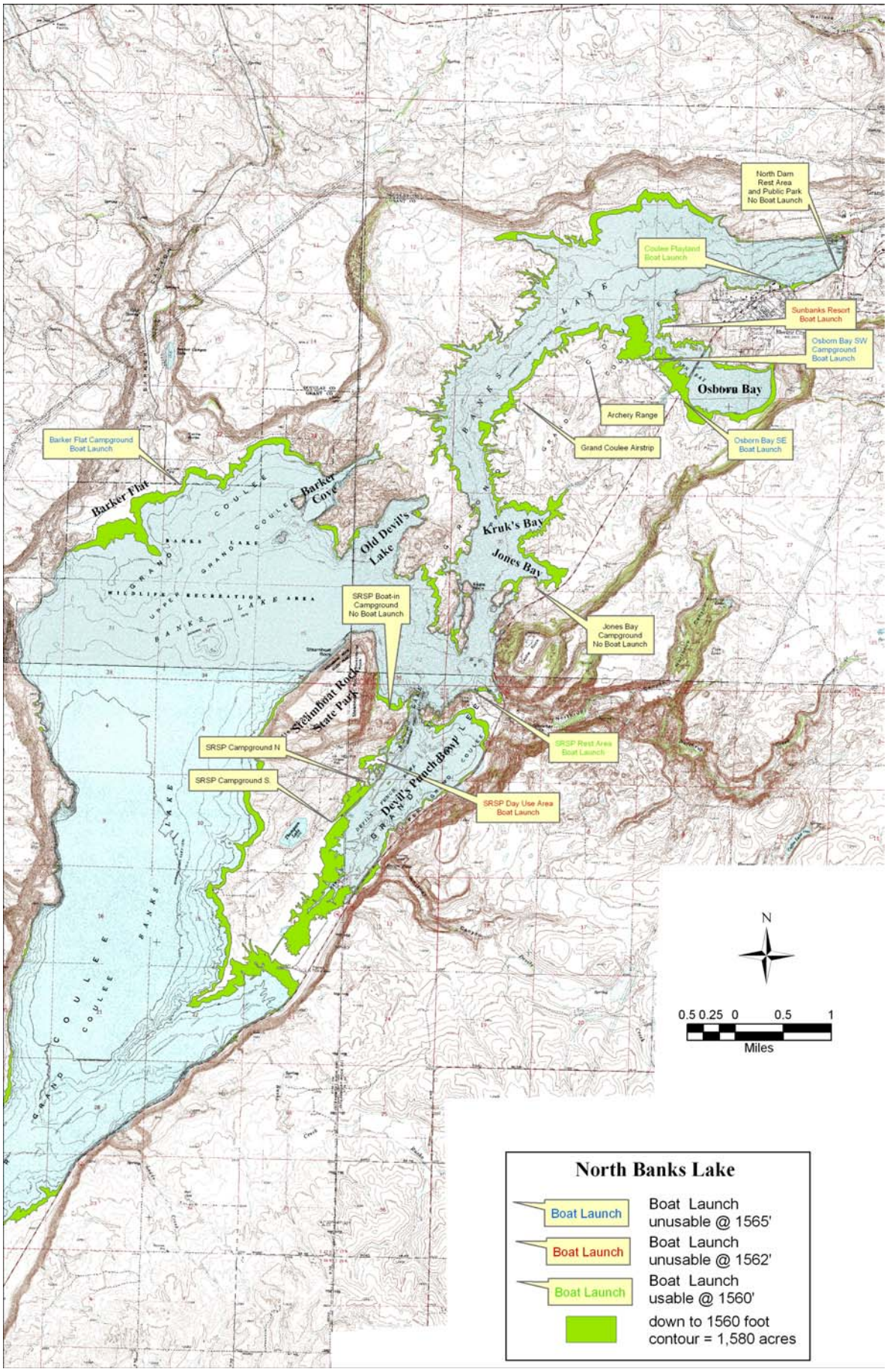

Figure 3-2. North Banks Lake.

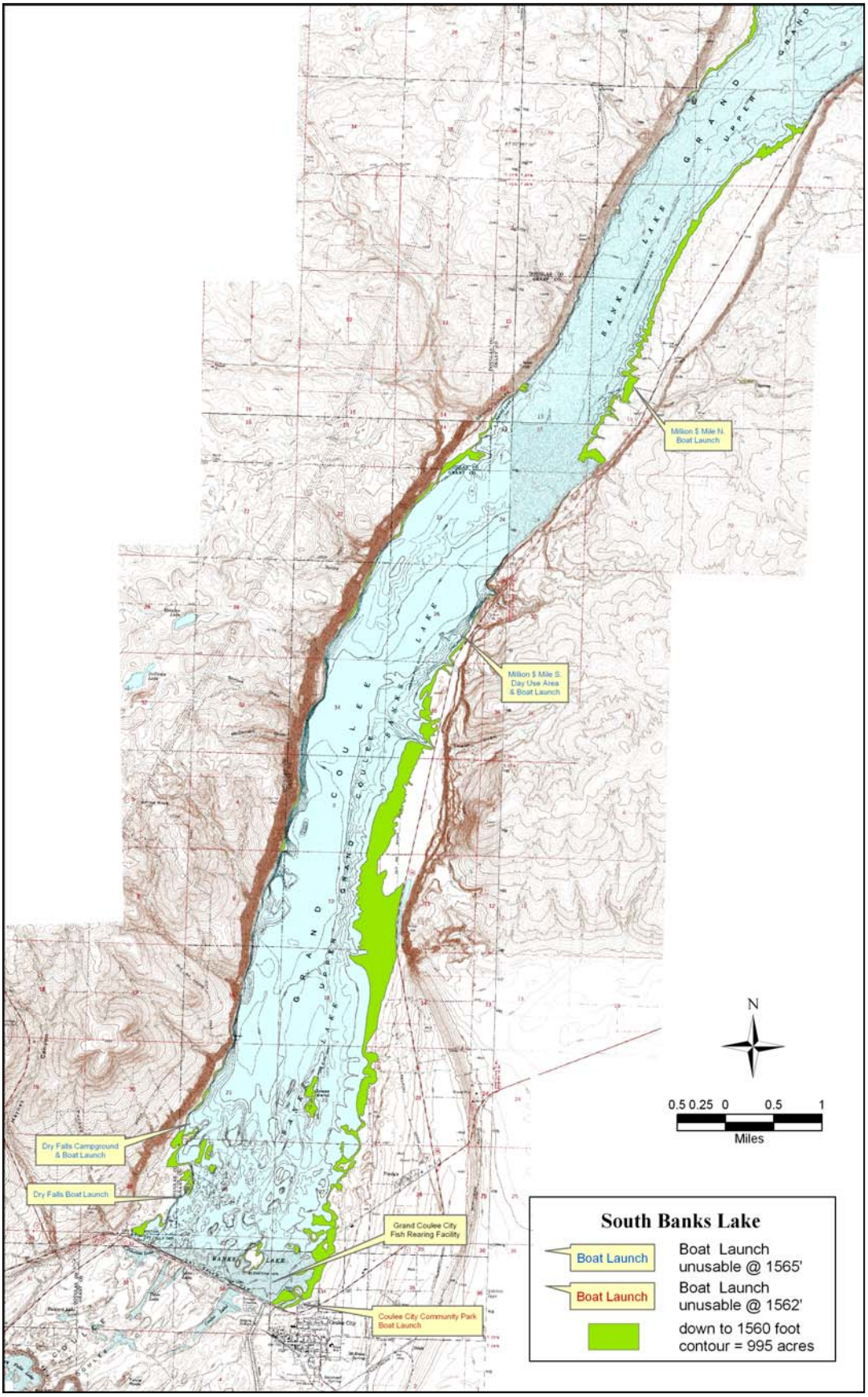

Figure 3-3. South Banks Lake.

Table 3-1.—Drawdown tolerance for aquatic macrophytes species characteristic of the habitat at Banks Lake

Species	Drought Tolerance	Fish/Wildlife Value
Nebraska sedge	Drought tolerant. Prefers soils saturated early in the season that later dry out.	Good food for waterfowl, cover for waterfowl and small mammals.
Beaked sedge	Drought tolerant. Tolerates extreme water level fluctuation, but shoot size can be affected.	Provides food for waterfowl and small birds.
Hardstem bulrush	Fairly drought tolerant. Often associated with common cattail. Can persist through several years of dry conditions. Establishes well from seed stored in the seedbank. May be replaced by cattail in continuously flooded marshes following drawdown.	Fair food for small mammals, songbirds, and upland gamebirds. Provides good cover for birds, small mammals, and waterfowl. It buffers wind and wave action that can enhance vegetation establishment along shorelines.
Baltic rush	Drought tolerant. Tolerates dry conditions, as well as a wide range of hydrologic conditions.	Important nesting, hiding, and feeding cover for shorebirds, songbirds, waterfowl, and small mammals.
Common spikerush	Drought tolerant. Thrives in shallow wetlands that are flooded by spring runoff, and then slowly dry up during summer. Seeds are always present in the seedbank and can germinate in standing water.	High protein content makes it an important food for waterfowl. Provides cover for waterfowl, small birds, and small mammals.
Common cattail	Drought tolerant. Tolerant of continuous inundation and seasonal drawdowns.	Poor waterfowl nesting habitat when dense. However, it provides good nesting cover for various small bird species.
Narrow-leaved cattail	Similar to the more robust common cattail.	Similar to the common cattail.
Eurasian water milfoil	Drought tolerant. Obligate wetland species; however, drawdowns must occur during periods of freezing temperatures to kill it.	Little value to wildlife or fish.
Reed canarygrass	Drought tolerant. Tolerant of frequent and prolonged flooding and submergence.	Waterfowl, upland game birds, riparian mammals, and fish use it for cover and food.
American bulrush	Drought intolerant. Best survival and growth occurs where average minimum yearly water levels do not fall below 2 to 4 inches above the soil surface.	Important food for waterfowl and small mammals.
Softstem bulrush	Drought intolerant. Establishes from the seedbank following periodic draining and reflooding though prolonged draining and reflooding can reduce or eliminate stands.	Provides good food and cover for waterfowl.
Redtop bentgrass	Drought intolerant. It is found in wet, poorly drained conditions in shallow shoreline fringes and terraces adjacent to shoreline.	Provides good food and cover for waterfowl and upland gamebirds.
Lesser duckweed	Drought intolerant. Obligate wetland species.	High value for waterfowl and shorebird food.
Sago pondweed	Drought intolerant. Obligate wetland species.	Very high value for waterfowl and shorebird food.
Source: Natural Resources Conservation Service 2000; Forest Service, 2000; Hitchcock and Cronquist 1973; Bentrup and Hoag, 1998; Reclamation, 2001.		

Riparian Vegetation

The riparian vegetation along the shoreline of Banks Lake is dominated by black cottonwood (*Populus balsamifera*), Russian olive (*Elaengnus augustifolia*), willow (*Salix* spp.), and Wood's rose (*Rosa woodsii*), with lesser amounts of red-osier dogwood (*Cornus sericea*). Shoreline erosion is degrading many shoreline riparian areas or is preventing their establishment and development. In some areas, persistent erosion is undercutting the banks and roots of mature riparian cottonwood and willow trees, causing them to fall over (figure 3-4). Land use activities such as livestock grazing, dispersed recreation, and motor vehicle travel have accentuated the erosion problem and contribute to the lack of riparian vegetation and ground cover in many shoreline areas.

There are more than 30 willow species in Washington (Wash. Dept. Transportation 2001); however the willow species present along the littoral zone at Banks Lake have not been keyed to species to our knowledge. Two representative willow species characteristic of the Eastside (Interior) riparian-wetlands of Washington were chosen to analyze the overall drought tolerance and value to wildlife. The peachleaf willow (*Salix amygdaloides*) is a common species of the riparian areas in the sagebrush-steppe habitat type (IBIS 2000). Coyote or sandbar willow (*Salix exigua*) is also a common species in the eastern Washington shrub-steppe zone, but has a wider drought tolerance that ranges from low to medium. Black cottonwood, Russian olive, red-osier dogwood, and Wood's rose were also selected for detailed analysis of impacts to littoral zone riparian vegetation from an August drawdown. The analysis focused on changes in groundwater levels that may affect plant vigor and

Figure 3-4.—Eroding banks threaten a mature cotton-wood near the Million Dollar Mile South Boat Ramp.

growth. The drought tolerance of several riparian species that occur at Banks Lake is summarized in table 3-2. The value for wildlife is also summarized.

Table 3-2.—Drought tolerance of riparian species at Banks Lake

Species	Drought Tolerance	Wildlife Value
Black cottonwood	Tolerates some summer drought when established. Has shallow root system. Stores large quantities of water in trunk.	Important for cavity nesters, daytime perch for bald eagles. Leaves and young shoots browsed by deer and elk, and birds feed on buds, flowers, and seeds. Used by small mammals and birds for cover, roosting, and nest sites.
Russian olive	High drought tolerance. It is an exotic and is rapidly colonizing riparian areas.	Seeds eaten by a variety of birds and mammals. Provides nesting cover for many bird species.
Peachleaf willow (*S. amygdaloides*)	Low drought tolerance. Occurs on transitional riparian sites.	Provides cover for mammals and birds. It is a preferred food of beavers.
Coyote willow (*S. exiguna*)	Low to medium drought tolerance. It is an obligate wetland species. Occurs in the bank zone, overbank zone, and transitional zone in riparian areas.	Browsed heavily by elk. Dense stands provide cover for mammals and birds.
Red-osier dogwood	Medium drought tolerance.	Used as food and cover by mammals and birds.
Wood's rose	Low to high drought tolerance.	Food for many species of wildlife.
Source: Forest Service, 2000a; Forest Service, 2000b; Natural Resources Conservation Service, 2000.		

Fish

Banks Lake Fish Assemblage

Most of the fish species present in Banks Lake either were pumped in from FDR Lake on the Columbia River or were found in the small lakes of the upper Grand Coulee prior to inundation. Additionally, WDFW has planted several fish species, including but not limited to rainbow trout, kokanee, smallmouth bass, coho salmon, and chinook salmon. Creel surveys from the 1950s indicate kokanee salmon, burbot, bull trout, and possibly rainbow and eastern brook trout were pumped in with irrigation water from FDR Lake (Duff 1973). In the early 1950s, occasional bull trout were recorded, but with no available spawning habitat, the species never became established in the reservoir. Eastern brook trout also failed to establish a reproducing population and disappeared from catch and gill net survey data. With the exception of charr, brown trout, and rainbow trout, all of the other fish present in pre-reservoir lakes or drafted from FDR Lake were able to establish reproducing populations to various degrees. Currently, access to the outlet works for fish is limited by a barrier net that is installed and maintained by GCPHA.

Extreme drawdown during game fish spawning was a subject of concern during the recent Resource Management Planning (RMP) process. Several studies were conducted during the 1970s in Banks Lake to determine the effects of drawdown on the kokanee and yellow perch spawning, egg incubation, and fry emergence (Stober 1976 and Thomas 1978). The studies concluded that low recruitment of kokanee year classes exposed to drawdown was a factor in reducing their abundance. However, with the exception of maintenance drawdowns in recent years, drawdowns during the 1980s and 1990s have been less severe than they were during the 1960s and 1970s. Weed control drawdowns to control aquatic weeds, particularly Eurasian water milfoil, typically occur on a 10 to 15-year facility maintenance cycle. In the past, the lake level has been lowered about 20-25 feet during the winter season for facility maintenance.

Information on the status and management of Banks Lake fish species is provided in the Banks Lake RMP/EA incorporated by reference in this document, as well as in the Fish and Wildlife Coordination Act Report (CAR, see appendix A). Table 3-3 displays characteristics for Banks Lake fish species, including adult habitat, spawning substrate, spawning depth, spawning dates, spawning/reproductive characteristics, and food of young-of-year fish. These characteristics will be used to analyze the impact of drawdowns.

Spawning and Nursery Habitat

Shallow Aquatic Macrophytes.—The presence of aquatic macrophytes provides refuge for prey species and interferes with the feeding of some predator species. Exposure to predators strongly determines small fish feeding behavior. If they are relatively safe from predators, they can forage more effectively. For large predators, the visual barriers of plant stems decrease foraging efficiency; hence, growth declines as habitats become more complex (Colle and Shireman 1980).

Reproductive success of fish that spawn near the shore in reservoirs is influenced by the time and duration of flooding and the type of substrate inundated (Aggus 1979). Water levels determine the amount of nursery area available by inundating or receding from vegetation. Survival of young fish of many species is increased when cover is abundant. Lack of habitat exposes young-of-year fish to increased predation. The density of young-of-year largemouth bass (*M. salmoides*) in August in Bull Shoals Lake was directly related to acre-days of flooding of terrestrial vegetation (Aggus and Elliott 1975).

Small species of fish and juveniles of larger species occupy aquatic emergent vegetation (aquatic macrophytes) seeking food (Pardue 1973; Keast 1984) and predator protection (Crowder and Cooper 1982; Savino and Stein 1989). Differences in density and morphology of plants influence foraging intensity and degree of predator avoidance which, in turn, influence fish growth and survival (Dionne and Folt 1991; Lillie and Budd 1992; Dibble, Dick, and Killgore 1996). Foraging efficiency decreases in dense plant beds (Savino and Stein 1989; Anderson 1984). High-density plant beds provide greater protection from predators than

Table 3-3.—Characteristics of Banks Lake fish species

Family/ species	Adult habitat	Spawning					Food of young-of-year fish
		Substrate	Depths	Temper-ature	Dates	Reproductive characteristics	
GAME SPECIES – Ictaluridae – catfishes							
Channel catfish	Cool, clear, deeper water with sand, gravel, or rubble bottoms. Feeds in shallow water at night, returning to deep holes or cover during day	Holes, undercut banks, log jams, rocks	Relatively shallow	75 to 85 °F	Late spring or summer	Male builds nest and defends. Newly hatched fish have large yolks and remain on bottom 2-5 days, then swim to surface and begin to feed. Young fish remain in shallow water. Survival of young increases in turbid water	Diptera, also caddisflies and mayflies
Brown bullhead	Usually in deeper water along shoreline, but move into shallow, weedy areas to feed and spawn. Prefer shallow bays	Mud, sand or roots of aquatic vegetation near rocks, stumps, debris	As shallow as 6"	70 °F	April through June	Male or female builds shallow nest and cares for eggs. Newly hatched fish have large yolks and remain on bottom about 7 days, then begin to swim and feed actively. Young form a loose sphere and are shepherded about for several weeks by one or both parents until they are about 2", then disperse	Zooplankton and dipteran larvae initially, switching to midges, mayflies, worms, crustaceans, fish larvae, and eggs
Yellow bullhead	Shallow, clear-water parts of bays in areas of very heavy aquatic vegetation	Soft substrate near protection of stones or stumps	1-1/2 feet to 4 feet	70 °F	May and June	One or both sexes build nest in shallow depression. Males guard nest and brood young until dispersal at around 2". Can withstand more adverse conditions than brown bullheads, but removal of stumps, logs, or vegetation leads to decrease in numbers	Zooplankton and dipteran larvae initially, switching to midges, mayflies, worms, crustaceans, fish larvae and eggs
GAME SPECIES – Centrarchidae – sunfishes							
Largemouth bass	Shallow areas with rooted aquatic vegetation with brush, logs, or other cover	Sand, gravel, or rubble	1 to 4 feet	60 to 65 °F	Mid-May to end of June	Male builds and guards nest. Young remain in bottom of nest until yolk is absorbed (6 to 7 days), then rise to begin feeding and schooling. Can remain in a brood up to 31 days and are guarded by male. After dispersal from nest, small to medium individuals form small schools and cruise shorelines while feeding	Zooplankton and dipteran larva initially, then insects and fish
Smallmouth bass	Rocky reefs and gravel bars	Sand, gravel, rocks near logs, rocks, or vegetation	2' to 20'	61 to 65 °F	Late May to early July	Male builds and guards nest. After hatching, yolk sac is absorbed in 5-7 days and young rise off bottom of nest. Male guards young several days until dispersal	Zooplankton initially, switching to insects and fish
Black crappie	Dense aquatic vegetation over sand, muck, or organic debris. Feeds in weedy shallow areas < 10' in spring, then moves to deeper water during summer	Soft mud	< 8 feet	58 to 64 °F	May or early June	Males build and guard nest until fry leave. Young crappie are often found over open water of considerable depth (Pflieger). Their long planktivorous period and open water feeding reduce the degree of competition for food with other game species	Zooplankton and dipteran larvae
Bluegill	Warm shallow lakes with rooted vegetation. Adapted well to water fluctuations and absence of vegetation	Gravel, sand, or mud	2-1/2' feet	67 °F	May to early August	Male builds and guards nest. Male protects fry several days after hatching	Zooplankton initially, then aquatic insects, mollusks, crayfish, amphipods, and fish eggs
Pumpkin-seed	Clear quiet water with dense aquatic vegetation —usually denser than that preferred by bluegills	Gravel, sand, or mud	6"-12" near shore	68 °F	Late spring, early summer	Male builds and guards nest. Male protects fry up to 11 days, when young disperse. Small pumpkinseeds form part of the food of almost all predatory fishes, as well as the pumpkinseed and other sunfishes	Mayfly nymphs, zooplankton and midge larvae

GAME SPECIES – Percidae – perches							
Walleye	Returns to shallows of main lake in April after spring spawning migration. In summer, moves to deep, cooler water during the day, feeding in shallows at dusk. Holds in deep waters in winter	Rubble, gravel, bedrock, rocky shoals, or on sand or silt	Shallow water	38 to 44 °F	April	Eggs are broadcast and fall into crevices in rocky substrate. Yolk sac is absorbed rapidly, and feeding takes place prior to disappearance of yolk. Young disperse 10-15 days after hatching to upper levels of open water. By end of summer, young move toward the bottom in 10-30 feet of water	Zooplankton and fish. Highly cannibalistic if other food not available
Yellow perch	Seasonal movements follow the 68 °F isotherm. Very adaptable and able to use a wide variety of habitats	Sand, gravel, rubble, vegetation, and brush	Shallow water near shore	45 to 54 °F	April or May	No nest - eggs deposited in a ribbonlike, gelatinous mass near vegetation or submerged brush or over sand, gravel, or rubble. Young move from shallow water to deeper water in late fall. Young and adults are preyed on by almost all other predatory fishes and other yellow perch	Cladocerans, ostracods, and chironomid larvae
GAME SPECIES – Salmonidae – trouts, whitefishes							
Rainbow trout	In lakes, prefer temps < 70 °F. Move to deeper water if oxygen content is adequate	Unable to establish reproducing populations in Banks Lake	Fine gravel in a riffle	Extremely variable, depend-ing on stock	Feb. to June. Some stocks fall spawners	Spawning occurs in tributary streams	Aquatic insects, worms, fish eggs
Kokanee	In summer, in upper middle layers of open lake. Move to deeper water as water warms. Have extensive daily vertical and onshore-offshore movements	Formerly spawned along shorelines at Banks Lake, where groundwater percolated through gravel	Either in inlet stream or along shore-lines	Between 37.4 and 44.6 °F	Mid-October to mid-January	Wydowski and Whitney (1979) noted that Banks Lake had a large sustainable kokanee population. Since then, reservoir fertility has declined significantly, and juveniles can no longer survive	Zooplankton, particularly crustaceans, as well as bottom organisms
Lake whitefish	Prefers deep, cold lakes and is most abundant from 50 to 90 feet deep. In Banks Lake, fish also in shallows. Move to deeper water as temperatures warm in late spring	Rocky gravel or sand.	Shallow water < 25	46 °F	Oct. - Jan.	Larvae form aggregations along steep shorelines. Young generally leave the shallow inshore water by early summer and move into deeper water	Zooplankton initially; then, as young move into deeper water, feed on aquatic insect and midge larvae, as well as zooplankton
Mountain whitefish	Tends to frequent upper 15-20 feet	Gravel shoals along lake shorelines	5" to 4'	48 °F	Oct - Dec.	Eggs deposited in late Oct., hatch in early March. Newly hatched fry in shallows for a few weeks; at 1.2 to 1.6", fry move offshore	Plankton, midge larvae
NONGAME SPECIES – Cyprinidae – minnows							
Peamouth chub	Weedy shallows of lakes, where it tends to form schools	Stones and rubble at the shoreline edge	1" to 2"	54 °F	Late May to early June	Eggs are broadcast on gravel or rubble bottom along shoreline. Newly hatched young remain in schools along shore, moving into deeper water in late summer	Zooplankton
Northern pike-minnow	In spring and summer, adults in shallows. During fall and winter, move offshore into deeper water	Gravel beaches	Shallows	Probably similar to other cyprinids, like carp	Late May through July	No nest is constructed. Eggs are broadcast on gravelly beaches along shoreline. Young found in < 1 foot-deep water along rubble or gravel shores. In summer, moved into water about 3 feet deep with submerged vegetation	Small aquatic and terrestrial insects, becoming more piscivorous with increasing size
Carp	Quiet water in dense vegetation	Submerged weeds, grasses, roots	3" to < 4'	65 to 68 °F	Late spring - early summer	Yolk sac absorbed within a few days after hatching, and fry form large schools in shallow water. Young move into deeper water as they grow	Zooplankton initially, then add aquatic plants, insects, clams

NONGAME SPECIES - Catostomidae – suckers							
Long-nose sucker	Lake bottoms to 80 feet	Gravel	Shallow gravel areas	41 °F	Mid-April to mid-May	No nest is built. Eggs adhere to gravel and substrate. Young remain in gravel for 1-2 weeks before moving away from spawning area. Young remain in shallow, weedy areas. Young probably preyed on by wide variety of piscivorous fish and birds	Zooplankton, aquatic insect larvae and plants
Large-scale sucker	Backwaters and shallows of lakes on the bottom, but can be as deep as 80 feet	In lakes on gravelly or sandy shoals and shorelines	8"	46 to 48 °F	April or May	Fry remain in gravel or on surface of sand for first few weeks until yolk absorbed, then move to surface or mid-water and settle on the bottom by July. Growth is slow, fry < 1" by July. Fry move into shallow areas during the day and into deeper water at night. Fry may serve as forage for game fish species	Small zooplankton when at surface or midwater. After become bottom dwellers, diet shifts to aquatic insect larvae, diatoms, and plant material
Bridgelip sucker	Quiet areas in backwaters or edges of main current of rivers with sand or mud bottoms. Seldom found in lakes. Probably entrained into Banks Lake from Columbia River	Little is known about the biology of this species, but it is probably similar to other suckers	Shallow gravel areas	Probably similar to other suckers	Late May to June	Little is known about the biology of this species, but it is probably similar to other suckers	Probably similar to other suckers
NONGAME SPECIES – Cottidae – sculpins							
Prickly sculpin	Lakeshores over sand, gravel, or rubble. Small individuals in vegetated areas in shallow water. During winter, move to deeper water under cover of rocks, logs, and debris. Often in open, relying on cryptic coloring for concealment	Under rocks, logs, cans, car bodies, sheet metal	Relatively shallow	50 to 54 °F	Late February to late May	Larvae begin swimming immediately after hatching. Form schools and remain pelagic for 30 - 35 days before metamorphosing and settling on the bottom. A number of species prey on prickly sculpin including trout, whitefish, and mergansers	Zooplankton, aquatic insect larvae
Source: Scott and Crossman, 1973; Wydoski and Whitney, 1979; Simpson and Wallace 1982; and Pflieger 1997.							

medium- or low-density beds (Hayse and Wissing 1996). Studies have suggested that juvenile bluegills select higher vegetation densities to reduce predation (Savino and Stein 1982; Gotceitas and Colgan 1987; Hayse and Wissing 1996). Conversely, largemouth bass prefer to wait at the periphery of plant beds or in areas of lower plant densities.

Drawdowns can potentially affect fish in Banks Lake when water levels expose beds of aquatic macrophytes that provide cover from predation as well as substrate for food organisms.

Shallow Unvegetated Flats.—Two key shallow unvegetated flats identified by the Banks Lake RMP/EA include (1) the shallow flats just south of the Million Dollar Mile North Boat Ramp, where adjacent lake bottom is used by smallmouth bass; and (2) the flats east of Barker Flat, where the adjacent lake bottom is used by largemouth bass, sunfish (*Centrarchidae* spp.), and black crappie (*Pomoxis migromaculatus*) (figure 3-5). Other shallow flats that are also potentially important for adult and juvenile habitat include the extensive flats that occur between the Million

Figure 3-5.—Shallow unvegetated flats, like this one near Baker Flat, provide good habitat for many species of fish.

Dollar Mile North Boat Launch and the Million Dollar Mile South Boat Launch (figures 3-2 and 3-3) on the southwest side of Banks Lake.

Boulders, Cobble, and Gravel.—Boulders, cobble, and gravel are common substrates found predominantly along the steep western shoreline of Banks Lake, as well as in the shallow protected bays and unvegetated flats described above. This habitat provides spawning and rearing substrate for a number of fish species, including largemouth bass, smallmouth bass, walleye, and prickly sculpin. Additionally, the young of many of Banks Lake's fish species move offshore in summer after rearing for a number of weeks along the shallow vegetated littoral zone. Boulders and cobbles provide refugia from predators and substrate for benthic invertebrates (figure 3-6).

*Susceptibility of Juvenile Fish to Predation.—T*he above discussion of spawning and nursery habitat points out the importance of aquatic macrophytes in providing cover from predators for many species of juvenile fish, particularly during the early larval stages. Boulders, cobble, and other debris, as well as turbid water, also provide cover for juvenile fishes. Juveniles of the following species rely on aquatic macrophytes in shallow areas for predator protection throughout the year: yellow bullhead, largemouth bass, pumpkinseed, yellow perch, longnose sucker, largescale sucker, bridgelip sucker, prickly sucker, and northern pikeminnow. Water level

Figure 3-6.—Much of the shoreline along Banks Lake consists of sand, gravel, cobble, and boulders. These are generally exposed to wind and wave action.

drops that force juveniles out of the stands of aquatic macrophytes into open water without cover are likely to result in increased predation on those species. Juveniles of other fish species; however, move into deeper water during late summer and no longer depend on the cover afforded by aquatic macrophytes and thus would be affected by a drawdown to elevation 1560 feet. These species include brown bullhead, smallmouth bass, black crappie, walleye, lake whitefish, mountain whitefish, peamouth chub, and common carp. Channel catfish juveniles rely on shallow, but unvegetated areas.

Aquatic Food Base

Zooplankton.—Banks Lake is the forebay for pumped-storage power generation and is dominated by a seasonal flowthrough of irrigation water from north to south. The flowthrough creates two distinct pools, with the north pool having colder water temperatures, reduced stratification and transparency, and higher plant nutrient levels than the south pool. Zooplankton biomass and composition are significantly different in the two pools, with the south pool having a higher biomass. The zooplankton biomass of the north pool is composed of roughly equal portions of *Bosmina, Cyclops, Nauplii, Daphnia*, and *Diaptomus*. The south pool zooplankton community is dominated by *Daphnia,* with the percentage of *Bosmina* gradually dwindling to insignificant levels at the south end of the lake (Knutzen 1977).

Benthic Invertebrates.—Aquatic plants and attached organisms, such as algae, protozoans, and bacteria (periphyton), as well as detritus, provide food and habitat for a wide variety of organisms. High invertebrate densities are typically associated with aquatic plants (Hoyer et al. 1997). Very few invertebrates or fish feed directly on the large aquatic plants; instead, they feed on the attached organisms and detritus (Heckey and Hesslein 1995).

Benthic invertebrates that live in sediments also collect beneath macrophytes. Some use plant remains as food and shelter. Others eat algae that covers sediments. In the Eau galle Reservoir in Wisconsin, benthic invertebrates were more than tenfold greater in number in a coontail (*Ceratophyllum demersum*) bed than in an adjacent barren area with the same substrate (Miller et al. 1989). The inshore area under macrophyte beds in Halverson Lake, Wisconsin, contained 60 percent of the midge larvae and over 90 percent each of snails, fingernail clams, caddisfly, dragonfly, damselfly, and mayfly larvae (Engel 1985) in the lake.

Invertebrates are a major food source for forage fish and young life stages of many game fish. Young waterfowl depend heavily on invertebrates as a high-protein food source needed for rapid early growth (Hoyer and Canfield 1997).

Fish Nets at Dry Falls Dam

A requirement to install and maintain nets to reduce the loss of fish from Banks Lake into the Main Canal was placed on the Grand Coulee Project Hydroelectric Authority (GCPHA) during the licensing process for Dry Falls Powerplant. The GCPHA has had the nets installed since receiving their license to operate the Dry Falls Powerplant. The nets are suspended from floats between the Coulee City Park breakwater and an island and between the island and Dry Falls Dam. The nets are sized to reach the bottom of the lake when the reservoir is at full pool elevation of 1570 feet.

Wildlife

Aquatic macrophytes and riparian vegetation are important. Aquatic emergent vegetation and submerged plants (collectively referred to as aquatic macrophytes) are widely consumed by wildlife (Hoyer and Canfield 1997). Pelikan et al. (1971) reported that 90 percent of the net annual cattail production is consumed or used as lodge construction by muskrats. Smith and Kadlec (1985) reported that waterfowl and mammalian grazers reduced cattail production by 48 percent in the Great Salt Lake marsh. Muskrat grazing is important for maintaining diversity in the emergent zone. Open areas in the cattail marsh are produced that increase edge effect and allow submersed species and other emergent species to invade areas previously occupied by a single species of dense emergent vegetation.

Seeds, tubers, and foliage of submersed species are used as food by a variety of wildlife, especially waterfowl (Nichols and Vennie 1991). Plant material is often high

in carbohydrates, which provide energy for long migratory flights. Invertebrates produced in aquatic macrophyte beds are also important to wildlife production. They produce the protein that is vital to laying hens and chicks of many waterfowl and related waterbirds. Predators, such as eagles, osprey, loons (*Gavia* spp.), mergansers, cormorants, mink, otter, raccoons, and herons, feed on fish which, in turn, feed on invertebrates that lived in aquatic plant beds (Hoyer and Canfield 1997).

Nesting sites in, or nesting materials from, the emergent zone are important to species like red-winged and yellow headed blackbirds, marsh wrens, western grebes (*Aechmophorus occidentalis*), bitterns, Canada geese, and muskrats. At times, geese and other waterfowl nest on top of muskrat houses or muskrat food piles made of cattails (Hoyer and Canfield 1997).

Riparian areas are estimated to provide less than 1 percent of the land base in the Pacific Northwest, yet support the greatest diversity and abundance of wildlife that exist in the regions (Service, 1990). The WDFW reports that 90 percent of Washington's terrestrial vertebrate species use riparian areas for some part of their life cycle (Service, 1998). The high wildlife value of these areas is derived from the structural complexity of vegetation, connectivity with other ecosystems, a high edge-to-area ratio, abundant food and water, and a moist and mild microclimate.

Riparian habitats in Washington have been identified as priority areas for monitoring, research, and management of neotropical migrant birds (Andelman and Stock, 1994). Extensive woody riparian areas comprised of black cottonwood and willows exist around Osborn Bay. These areas provide habitat for game and nongame birds, furbearers, and other mammals. Since Banks Lake was inundated in 1951, willow and cottonwood riparian areas have developed along the margin of Banks Lake.

Information on the status and management of Banks Lake wildlife species is provided in the RMP/EA incorporated by reference in this document, as well as in the Fish and Wildlife Coordination Act Report (see appendix A). Table 3-4 summarizes wildlife species groups present in the Banks Lake littoral zone and on the surface of the lake.

Table 3-4.—Wildlife of the Banks Lake littoral zone and lake surface

Group	Characteristics
Raptors	11 species observed during 8 Service surveys conducted in 1998. Species present include bald eagles, red-tailed hawks, northern harriers, golden eagles (*Aquila chrysaetos*), prairie falcons, peregrine falcons (*Falco peregrinus*), long-eared owls, short-eared owls, and Cooper's hawks. High diversity of raptor species due to abundance of suitable raptor nesting habitat in basalt cliffs and shoreline trees.
Neotropical migrant songbirds	66 species documented at Banks Lake. Neotropical migrant songbirds have experienced widespread habitat destruction and population declines (Andelman and Stock, 1994).
Waterfowl	22 species observed by the Service. Average winter count of 4,600 ducks, geese, and swans, ranging from a high of 20,000 birds to 0 when the reservoir was completely ice covered. Southeast shoreline provides habitat for several thousand mallards and northern pintails and several hundred Canada geese during fall migration. Most breeding occurs below Dry Falls Dam, in the Devil's Punch Bowl, and in Osborn Bay. More scattered use occurs in smaller bays and inlets in the main lake and adjacent wetlands (Service, 2000).
Colonial nesting birds	5 species have been documented in the three islands in the south end of Banks Lake: great blue heron, black-crowned night heron, California gulls, ring-billed gulls, and Caspian terns. Western grebes have been observed nesting in Osborn Bay and Devil's Punch Bowl and in smaller numbers elsewhere in cattails and bulrushes in the littoral zone. American white pelicans are documented using the south end of Banks Lake during spring and fall migrations (Service 2000).
Mammals	47 species have been documented or potentially occur at Banks Lake. Mule deer, coyotes, Nuttall's cottontail, and porcupine are common. Black bear and mountain lion are thought to be transients through the area.
Amphibians and reptiles	11 species have been documented at Banks Lake. The racer was the most common species followed by the western rattlesnake. The long-toed salamander may potentially have larvae in the water during the August drawdown period. Great Basin spadefoot, western toad, and Pacific tree frogs occupy a wide variety of habitats in eastern Washington and may potentially occur in Banks Lake. Bull frogs are present. This exotic species has adversely affected native amphibians and may have adversely affected natives at Banks Lake as well.

Threatened, Endangered, and Special Status Species

As mentioned in chapter 1, *Purpose of and Need for Action*, the NMFS BiOp for the operation of the FCRPS, provided Reclamation with Reasonable and Prudent Alternative (RPA), Action 31. Action 31 recommends that Reclamation assess the environmental effects of operating Banks Lake August surface elevations to minimum elevation 1560 feet, so that additional Columbia River water may be available for migration flows for juvenile salmonids listed under ESA.

This EIS and its Action Alternative are intended to meet the intent of Action 31. The Final EIS and the Record of Decision will document the completion of RPA Action 31. Reclamation need not further consult with NMFS regarding the proposed project.

Banks Lake drawdown is one of several RPA actions recommended by NMFS to improve flows for ESA listed juvenile anadromous migrating fish. In addition to

providing physical barriers for fish migration, dams also create reservoirs, which widen the river and decrease riverflows. Decreased riverflows result in increased salmon travel time, greater predator exposure, and other mortality factors. Such flow reduction is particularly harmful to anadromous fry, which have a reduced swimming ability. Fry are greatly dependent upon riverflows to assist their journey to the estuarine environment. Park (1969) observed that after completion of dams in the upper Columbia River, downstream migration of chinook salmon fry extended through August, where previously the migration was completed by July (Mains and Smith 1964). Therefore, another impact of dams on anadromous salmon is the shift in rearing from the estuary to reservoirs and extended residence in mainstem rivers (Northwest Fisheries Science Center 2000). The FCRPS Biological Opinion (NMFS 2000) is incorporated by reference into this EIS.

As part of the informal consultation process, Reclamation requested the Service to provide a list of federally listed or proposed species that may occur in the area of Banks Lake. In a letter dated May 30, 2001, the Service provided Reclamation with the federally listed and proposed species, as well as candidates for Federal listing, in the Banks Lake area. Although no federally listed endangered species were included in the May 30, 2001, Service letter, the Service announced an emergency listing of the Columbia Basin distinct population segment of the pygmy rabbit (*Brachylagus idahoensis*) as endangered, on November 30, 2001 (Federal Register 2001). The bald eagle *(Haliaeetus leucocephalus*) and the Ute ladies'-tresses (*Spiranthes diluvialis*), both federally listed as threatened species, were included in the Service letter. No proposed-to-be-listed species were provided. The Western sage grouse (*Centrocercus urophasianus)* and the Washington ground squirrel (*Spermophilus washingtoni*) were included by the Service as candidate species for Federal listing. Although candidate species are not afforded the same protection as listed species under ESA, they are evaluated in this EIS. The following discussion on threatened and endangered species, as well as the threatened and endangered species discussion included in chapter 4 of this EIS, provides Reclamation's Biological Assessment, as required under 50 Code of Federal Regulations (CFR) 402.

The following text provides a brief description of the status and distribution; life history and ecology; and the reasons for decline of the species described above.

Snake River Fall Chinook Salmon

A detailed analysis of this species is included in the Biological Opinion for the operation of the Federal Columbia River Power System (NMFS 2001). The Biological Opinion is incorporated by reference into this EIS. This EIS focuses specifically on potential impacts of an August drawdown to those special status species that exist, or potentially exist, at Banks Lake.

Pygmy Rabbit

Status and Distribution.—Within Washington, the range of the pygmy rabbit (*Brachylagus idahoensis*) has been reduced to five isolated fragments of sagebrush-dominated habitat within Douglas County. The pygmy rabbit is listed as a State endangered species. On November 30, 2001, the Service announced an emergency listing of the Columbia Basin distinct population segment of the pygmy rabbit species as endangered (Federal Register 2001). Surveys conducted by the Service were unable to find any pygmy rabbits within the Banks Lake area (Service 2002); however, the Service recommends that additional surveys be conducted before any future activities are allowed which could adversely affect the sagebrush-steppe community.

Life History and Ecology.—This is the smallest North American rabbit species and is one of only two rabbit species in North America that dig their own burrows in deep, loose soil. They are dependent on tall, dense sagebrush for food and shelter.

Reasons for Decline.—WDFW (1995) indicates that most of the original pygmy rabbit habitat in Washington has been degraded to the point that it cannot support this species. Additional losses may occur through conversion of the shrub-steppe to cropland or grazing land for cattle or through wildfire.

Bald Eagle

Status and Distribution.—The bald eagle (*Haliaeetus leucocephalus*) is a Federal and State listed threatened species. They were the most common raptor observed during surveys conducted by the U.S. Fish and Wildlife Service at Banks Lake (Service 2000). Eagles were found around the entire shoreline of Banks Lake, perched in large trees—usually black cottonwood or ponderosa pine. They were also observed on rocky islands and outcrops near shore and on rock outcrops up to 0.5 mile from shoreline, often high on cliff faces, as well as on ice during winter (Service 2000). Most of the large trees along the shoreline were used by eagles at some time during the winter. About a dozen specific trees nearly always contained one to ten individuals. The high count in 1998 was 126 eagles, with an average count of 63 birds for that year. The high count in 1999 was 63 eagles, with an average count of 46 birds. Northrup Canyon probably contains the largest bald eagle communal roost in eastern Washington (Service 2000).

Bald eagles have nested on the north side of Steamboat Rock for several years. One chick was found in the nest on June 2, 1998, but no nesting activity was observed there during 1999. A new nest was discovered near Osborn Bay in 1998, with at least one eaglet successfully fledging from that nest. The Steamboat Rock nesting pair became established and successfully nested adjacent to intense recreational activities in the State park. A popular boat-in campground is located just east of the nesting site. The impact of human disturbance is expected to increase as nearby recreation activities and public awareness of nesting eagles rise (Reclamation, 2001b).

Bald eagles are known to roost in Russian olives present in the riparian zone at Banks Lake. Mature cottonwoods and willow trees are also used. Many of the mature cottonwoods and willows are at risk from shoreline erosion.

The Steamboat Rock Bald Eagle Nest Territory Management Plan was developed to manage and protect the nest site at Steamboat Rock. That plan, however, does not address the recent expansion of the nesting territory into Osborn Bay.

Life History and Ecology.—The abundance and availability of prey is probably the most important factor determining the presence and density of eagle territories. Reservoirs and introduced fishes and concentration areas for wintering waterfowl may mitigate, to some extent, the impact that salmon declines may have had on eagles. Eagles may be able to nest or winter at locations that historically did not have sufficient prey to support them. There are 4,051 lakes and reservoirs in eastern Washington. Of the 76 fish species in Washington's inland waters, 30 are introduced (Wydoski and Whitney 1979). Stinson et al. (2001) speculate that some introduced fish species are more available to eagles during the late nesting period than are live salmon. Introduced fish species eaten by bald eagles that also occur at Banks Lake include black crappie, walleye, smallmouth bass, brown bullhead, lake whitefish, channel catfish, yellow perch, largemouth bass, and sunfishes (Stinson et al. 2001).

Nesting bald eagles feed predominantly on fish and waterfowl, which are usually associated with large, open expanses of water (Stalmaster 1987). They forage mostly close to shoreline perch trees (less than water surface elevation 1640 feet), and areas of shallow water may be preferred, because the limited depth brings fish closer to the surface (Buehler 2000).

Reasons for Decline.—One of the most significant problems for Washington's bald eagles is the continued loss of mature and old growth Douglas fir forest used for nesting habitat in the lowlands around Puget Sound, due to urbanization. Most eagles are sensitive to disturbance during nesting (Stinson et al. 2001). Salmon declines in the Columbia River may have adversely affected populations in Washington.

Ute Ladies'-Tresses

Status and Distribution.—Ute ladies'-tresses (*Spiranthes diluvialis*), a perennial orchid, was federally listed as threatened in 1992. It is also a State threatened species. Its presence was confirmed in southeastern Idaho in 1996 along the upper Snake River and in northern Washington in 1997. A population is also known to occur in Okanogan County, Washington (NMFS 1999). Prior to this, it was known only from a few locations in Montana, Colorado, Wyoming, and Nebraska.

This is a wetland and riparian species found in springs, wet meadows, river meanders, and flood plains from elevations 1500 to 7000 feet (Service 1998). Banks Lake habitats where *S. diluvialis* may occur include wet meadows fed by freshwater springs; riparian forest, riparian shrub, and wet meadow mosaics; wet areas in open

shrub or grassland; wetlands created in gravel or borrow pits; and habitats dominated by grasses, rushes, and sedges.

Life History and Ecology.—Ute ladies'-tresses inhabit full sun to partial shade in early to mid-seral communities subject to flooding or periodic inundation. Beaked spikerush *(Eleocharis rostellata)* appears to be the dominant species in habitat occupied by Ute ladies'-tresses and is a good indicator throughout its range. Other species commonly associated with the orchid include creeping bentgrass *(Agrostis stolonifera)*, Baltic rush, long-styled rush, and scouring rush *(Equisetum laevigatus)*. Other common associates include rushes *(Juncus* spp.*)*, paint-brushes *(Castilleja* spp.*)*, thinleaf alder saplings *(Alnus incana)*, narrowleaf cottonwood saplings *(Populus angustifolia)*, sweetclover *(Melilotus* spp.*)*, willow saplings *(Salix* spp.*)*, sedges *(Carex* spp.*)*, red clover *(Trifolium praetense)*, and western goldenrod *(Solidago* spp.*)*.

The Service conducted Ute-ladies'-tresses surveys in late August 1999 during the peak blooming period when this species is most conspicuous. The Service found no Ute ladies-tresses and little potential habitat within the Banks Lake area (Service letter dated August 31, 1999). The Service concluded that the Banks Lake shoreline is either too steep and rocky, too dry, or inundated for too long during the growing season to provide suitable habitat for this species. The Service did, however, identify two perennial streams along the northwest shoreline and Bebe Springs as potentially suitable habitat, and recommended that additional surveys be conducted at these sites. Plants bloom in late summer. However, complicating surveys is the fact that this species can remain dormant for several growing seasons or produce only vegetative shoots.

Reasons for Decline.—Urbanization, stream channelization, water diversions, watershed degradation, conversion of riparian and flood plain to agricultural uses, and decline of pollinators have all contributed to the decline of this species (WDNR 2001). This species also appears to have a very low reproductive rate and does not compete well with aggressive species, such as reed canarygrass or purple loosestrife.

Western Sage Grouse

Status and Distribution.—Western sage grouse is a candidate for Federal listing and a State threatened species. There are two populations in Washington with a total of about 1,000 birds. They occur 34 miles apart in Douglas County and parts of Kittitas and Yakima Counties. Both populations exhibit relatively low numbers of males at leks making them vulnerable to predation, inclement weather, fire, and increased grazing pressure. Small reductions in habitat quality may have significant effects on the continued use of leks. It has not been documented within the Banks Lake study area, but it has been found in sagebrush habitat adjacent to Barker Canyon (Reclamation, 2001).

Life History and Ecology.—Western sage grouse nesting habitat was characterized by Sveum et al. (1998), who found that most of the nests (71 percent) were in big sagebrush *(Artemesia tridentata Nutt.)*/bunchgrass communities.

Successful nests had less shrub cover (51 percent) and shrub height 25 inches (64 cm) than nests that were depredated (70 percent and 35 inches (90 cm), respectively). During summer in Washington, sage grouse were observed moving from sagebrush to wet areas with annual forbs in fallow fields. Sage grouse on the Yakima Training Center did not frequent springs, major streams, and associated riparian areas for water and food (Cadwell et al. 1994). However, in Oregon, they were observed feeding on forbs near playas, waterholes, and meadows in summer (Willis et al. 1993).

Reasons for Decline.—Primary threats to remaining sage grouse populations include the potential reduction of lands in the Conservation Reserve Program and the potential for large-scale fires that eliminate large stands of sagebrush. Protection of remnant patches of native habitat is the most critical need for sage grouse (Hays et al. 1998).

Washington Ground Squirrel

Status and Distribution.—The Washington ground squirrel (*Spermophilus washingtoni*) is a candidate species for Federal listing and a candidate for State listing. Its range in Washington extends east of the Columbia River from the center of the State southward into Oregon. The known occurrence of this species presently consists of three disjunct populations—two in Washington on the Hanford Reservation and in the Columbia National Wildlife Refuge near Othello and one in Oregon (Betts 1990). The Washington Gap Analysis Program indicates that core habitat for this species includes the southern portions of Grant and Douglas Counties south of Banks Lake, but none is present in the Banks Lake area (Washington Coop. Fish and Wildlife Research Unit 2001). According to The Service (2000), this species was documented in the southeast portion of the study area several years ago.

Life History and Ecology.—This species inhabits sagebrush and grassland in the Columbia Plateau. Betts (1990) found that *S. washingtoni* colonies were found in habitat that had significantly greater values for percent cover of annual grasses, total grasses, and forbs than the surrounding unoccupied habitat. Their range is restricted to the sandy soil regions.

Reasons for Decline.—Grazing, fire, cultivation, and irrigation have degraded and altered much of the vegetation of the Columbia plateau.

Species of Concern

Fringed Myotis

Status and Distribution.—The fringed myotis *(Myotis thysanodes)* is a Federal species of concern. In Washington, it occurs primarily east of the Cascade Mountains. The Washington Gap Analysis Program indicates that the habitat at Banks Lake lies within the core zone of this species (Washington Coop. Fish and

Wildlife Research Unit 2001). Fringed myotis have been documented in nearby Moses Coulee, but not at Banks Lake (Service 2002).

Life History and Ecology.—This is a bat of arid forests, deserts, and grasslands, especially near riparian areas. It roosts in caves, mines, rock crevices, and buildings. It is a colonial species and forms nursery colonies of hundreds of individuals.

Reasons for Decline.—Abandoned mine closures, recreational caving and mine exploration, renewed mining at historic sites, and building and bridge conversion adversely affect roost sites. Pesticide spraying can have direct poisoning effects on fringed myotis populations. Vegetative conversion, livestock grazing, and timber harvest can modify the insect prey base and affect bat populations.

Long-Eared Myotis

Status and Distribution.—This species (*Myotis evotis*) occurs throughout Washington, except in the more arid areas of the central and southeastern part of the State. The Washington Gap Analysis Program shows the habitat at Banks Lake lies within the core zone of this species (Washington Coop. Fish and Wildlife Research Unit 2001). Service (2002) indicates that, while this species has not been documented at Banks Lake, it is likely to occur there. It is a Federal species of concern.

Life History and Ecology.—The long-eared myotis is a species of coniferous forests, roosting in trees, buildings, and rock crevices. It forages around trees and near watercourses in arid areas. Females form small nursery colonies of 1 dozen to 3 dozen individuals.

Reasons for Decline.—This species is vulnerable to roost and maternity colony site destruction or disturbance from abandoned mine closures and recreational impacts. Destruction of prey base by forest and agricultural area pesticide use and contaminants is also a factor.

Pale Townsend's Big-Eared Bat

Status and Distribution.—This bat *(Corynorhinus townsendii)* occurs throughout Washington, except in the highest mountain ranges. The Washington Gap Analysis Program shows the habitat at Banks Lake lies within the core zone of this species (Washington Coop. Fish and Wildlife Research Unit 2001). It has not been documented in Banks Lake, but it has been observed in nearby Moses Coulee. The Service (2002) considers it likely to occur at Banks Lake. It is a State candidate species and Federal species of concern.

Life History and Ecology.—This species occurs from grasslands to forested areas, roosting in trees, buildings, and caves. It forages mostly in uplands, rather than over water or riparian areas. This species relies heavily on abandoned mines for roost and maternity colony sites.

Reasons for Decline.—The primary threat to the big-eared bat is from disturbance or destruction of roost and maternity colony sites from recreational caving, mine reclamation, and renewed mining activity in historic areas. Timber harvest adversely affects roosting and foraging habitat, and pesticide spraying in forests and agricultural areas adversely affects prey base.

Small-Footed Myotis

Status and Distribution.—The small-footed myotis *(Myotis ciliolabrum)* occurs throughout eastern Washington. The Washington Gap Analysis Program shows the habitat at Banks Lake lies within the core zone of this species (Washington Coop. Fish and Wildlife Research Unit 2001). This bat has not been documented at Banks lake, but it has been documented in nearby Moses Coulee. The Service (2002) considers it likely to occur at Banks Lake. It is a Federal species of concern.

Life History and Ecology.—The small-footed myotis occurs in open, arid areas in deserts, chaparral, and pinon-juniper forests, foraging around cliffs, rock outcrops, and dry canyons. It roosts singly or in small groups in cliff and rock crevices, buildings, concrete overpasses, caves, and mines.

Reasons for Decline.—Western small-footed myotis are adversely affected by mine closures and by recreational use of these sites. Destruction of prey base from pesticides and other environmental contaminants also adversely affects this species.

Yuma Myotis

Status and Distribution.—The Yuma myotis (*Myotis yumanensis*) is scattered throughout Washington, except in the highest mountains and extremely arid areas. The Washington Gap Analysis Program shows the habitat at Banks Lake within Grant County lies within the core zone of this species (Washington Coop. Fish and Wildlife Research Unit 2001); however, no habitat is listed for Douglas County. A large roost with more than 1,000 individuals of Yuma myotis has been located near Northrup Creek (Service 2002). It is a Federal species of concern.

Life History and Ecology.—Yuma myotis occur in a variety of habitats, including riparian, scrublands, deserts, and forests. It roosts in bridges, buildings, cliff crevices, caves, mines, and trees. Summer maternity colonies can number several thousand females and young. Males roost singly. This species forages over water, along streams, near springs, and along riparian and shoreline vegetation. It is extremely reliant on water.

Reasons for Decline.—This species can be adversely affected by closure of abandoned mines without adequate surveys and by disturbance of maternity roosts in caves and buildings. Because this species frequently occurs in buildings and other human structures, it is vulnerable to destructive pest control activities. Some riparian and forest management practices may be detrimental.

Black Tern

Status and Distribution.—The Washington Gap Analysis Program indicates the presence of some core habitat for the black tern (*Chlidonias niger*) in the Banks Lake area (Wash. Coop. Fish and Wildlife Res. Unit 2001). This small insectivorous tern occurs Statewide in or near freshwater marshes, ponds, or lakes. A large colony of terns exists on Goose Lake on the Colville Reservation and in Douglas County. There are no breeding records for the black tern at Banks Lake. Service (2002) believes the most likely occurrence of this species at Banks Lake would be during spring and fall.

Life History and Ecology.—The preferred summer habitats are inland marshes and sloughs with dense cattail or other emergent vegetation (aquatic macrophytes) interspersed with open water. It is a colonial nester.

Reasons for Decline.—The continuing loss and degradation of breeding habitat, due to wetland drainage, is the main reason for the decline in black tern populations. Reduced hatching success in the Midwestern States may be due to agricultural pesticides.

Columbia Sharp-Tailed Grouse

Status and Distribution.—This State threatened subspecies (*Tympanuchus phasianellus columbianus*) was documented in the past in Barker Canyon and, possibly, Northrup Canyon (Service 2002). The Washington Gap Analysis Program indicates that core habitat for this species exists in the vicinity of Banks Lake in Douglas County (Washington Coop. Fish and Wildlife Research Unit 2001). Approximately 700 birds occur in north-central Washington in small, scattered populations (Fed. Register 1999).

Life History and Ecology.—The Columbia sharp-tailed grouse is found in shrub-steppe, grassland, mountain shrub, and deciduous riparian habitats.

Reasons for Decline.—The population of this grouse has declined substantially as a result of habitat loss and degradation. Conversion of native habitats to agricultural crop use, livestock grazing, and suburban development, as well as dam construction, herbicide spraying, and fire continue to threaten this subspecies (Fed. Register 1999).

Loggerhead Shrike

Status and Distribution.—The loggerhead shrike (*Lanius ludovicianus*) is a State candidate species. The Breeding Bird Atlas shows breeding records for the Banks Lake area for this shrike. The Washington Gap Analysis Program also lists core habitat for this species in the Banks Lake area (Wash. Coop. Fish and Wildlife Res. Unit 2001). The Service (2002) indicates that six individuals were observed during 1998 breeding bird surveys at Banks Lake.

Life History and Ecology.—This predatory bird of open areas of shrub-steppe, pine-oak, and pinon-juniper woodlands zone feeds on insects, small birds, and mammals.

Olive-Sided Flycatcher

Status and Distribution.—The Breeding Bird Atlas data do not show any documented sightings for this species (*Contopus borealis)* in Grant or Douglas Counties. Additionally, the Washington Gap Analysis Program does not show Banks Lake to be either core habitat or peripheral habitat (Washington Coop. Fish and Wildlife Research Unit 2001). The Service (2002), however, indicates that it is likely to be present in Northrup Canyon, immediately adjacent to Banks Lake. This is a Federal species of concern.

Life History and Ecology.—This flycatcher typically nests high in conifer trees. It forages for flying insects from snags and other high perches.

Reasons for Decline.—Though this species occurs over a very large range, its overall density is low. Its populations have declined precipitously in most regions, with an overall loss of 67 percent noted since 1966. Deforestation in its neotropical wintering range, as well potential adverse impacts from silvicultural and other land-use practices (Cornell Lab 2001), contribute to its decline.

Western Burrowing Owl

Status and Distribution.—This State candidate species and Federal species of concern is found in the shrub-steppe zone of central Washington. The Breeding Bird Atlas has no documented sightings of burrowing owl at Banks Lake. The Washington Gap Analysis Project indicates that core habitat exists near Banks Lake, but not within the study area (Washington Coop. Fish and Wildlife Research Unit 2001). According to The Service (2002), it has not been documented at Banks Lake.

Life History and Ecology.—This small owl prefers open, broken, or flat areas in shrub-steppe or agricultural areas. It requires ground squirrel or other mammal burrows for nesting.

Reasons for Decline.— Populations are declining, due to widespread elimination of burrowing rodents, primarily prairie dogs and ground squirrels. Loss of habitat from conversion of rangeland to irrigated land and, in some areas, loss of habitat to suburbanization are major threats to this owl. Burrowing owls are usually tolerant of human activity but vulnerable to predation by domestic pets.

Northern Sagebrush Lizard

Status and Distribution.—The northern sagebrush lizard (*Sceloporus graciosus graciosus)* occurs primarily in the shrub-steppe zone in central Washington. The Washington Gap Analysis Project indicates that the area of Banks Lake is in the

peripheral zone of this species, rather than in the core zone (Washington Coop. Fish and Wildlife Research Unit 2001). This species has not been documented in Banks Lake (Service 2002). It is a Federal species of concern.

Life History and Ecology.—This lizard inhabits desert floors, mountain and forest slopes, and open flat lands. Sagebrush areas are preferred habitats, though the lizard does not climb into the bushes. It occurs mainly on fine gravel soils and sandy and rocky soils adjacent to water. It requires rock crevices, mammal holes, or other cover.

Reasons for Decline.—Habitat loss, due to conversion of sagebrush to agricultural uses and intensive livestock grazing, are the primary threats to this species. Additionally, aerial spraying of pesticides may adversely affect its prey base.

Columbia Spotted Frog

Status and Distribution.—The Columbia spotted frog (*Rana luteiventris*) has been documented in the Banks Lake area (Service 2002), as well as in areas scattered across much of eastern Washington. The Washington Gap Analysis Program indicates that much of Banks Lake is in the peripheral zone of this species, rather than in the core zone (Washington Coop. Fish and Wildlife Research Unit 2001). This species population has dramatically declined in the last 50 years. It has been virtually eliminated from the Puget Sound. It is a State candidate species.

Life History and Ecology.—This frog prefers warm water marshes, wetlands, and bogs with nonwoody wetland vegetation. Vegetation in breeding pools generally consists of grasses, sedges, and rushes. It has a slow development rate, taking from 4 to 6 years to reach sexual maturity (Turner 1960).

Reasons for Decline.—The presence of introduced predatory fish into previously fish-free water bodies has contributed to the decline of amphibians in western North America (Corn 1994). Additionally, habitat loss and degradation, due to wetland drainage, urbanization, livestock grazing, and logging, have also contributed to its decline. Its slow development rate also subjects it to increased disturbance and competition from more robust exotics, such as bullfrogs.

California Floater

Status and Distribution.—This mussel (*Anodonta californiensis)* has been extirpated from much of its original distribution, from southern British Columbia south to northern Baja California, and east to Wisconsin and Arizona. In Washington, it is presently found only in Curlew Lake in Ferry County (Pacific Biodiversity Institute 2002). It has not been documented at Banks Lake (Service 2002). It is a Federal species of concern and a State candidate species.

Life History and Ecology.—This mussel prefers unpolluted lakes and slow streams in areas less than 6.6 feet deep with sandy bottoms or mud bottoms (Service

2002). Juveniles are parasitic on the gills, fins, and barbels of fish. The fish species selected is usually a minnow of the Gila genus. The host fish forms a cyst around the parasitic larvae and is unharmed by it.

Reasons for Decline.—The California floater has very narrow requirements for finding and attaching to an appropriate fish host. The decline in native host fish species is the likely cause for the decline of this mussel (Pacific Biodiversity Institute 2002). Pollution, sedimentation from logging and grazing, dam building, and exotic fish introductions may also have contributed to its decline.

Chelan Rockmat

Status and Distribution.—This species *(Petrophyton cinerascens)* is endemic to cliffs along a 17-mile area on the Columbia River between Chelan and Wenatchee, in Chelan and Douglas Counties, Washington. The Service (2002) indicates that it may also potentially occur along the basalt cliffs of Banks Lake. It is a State threatened species.

Life History and Ecology.—Chelan rockmat is a low, mat-forming perennial with 2- to 6-inch-tall flowering stems. This species has an extremely narrow range, suggesting it lacks competitive vigor or has a nutrient requirement met only by a specific substrate (Washington DNR 2001). It has been found only in crevices and ledges of open cliffs and rock outcrops along the Columbia River.

Reasons for Decline.—Habitat destruction from rock quarrying, road construction, and power line and radio tower construction are thought to be the principal threats to this species. Recreational activities, such as rock climbing, may also have adverse impacts.

Sticky Phacelia

Status and Distribution.—This species *(Phacelia lenta)* is endemic to a small area along the basalt cliffs of the Columbia River, in an area of approximately 12 by 8 miles in Douglas County, Washington. It occurs on crevices and adjacent open rocky habitats. Elevations range from 1300 to 3400 feet. Recent searches of suitable habitat have not located any specimens outside of Douglas County (Washington DNR 2001). The Service (2002) indicates that it may also occur along the basalt cliffs of Banks Lake. It is a State threatened species.

Life History and Ecology.—Sticky phacelia occurs in basalt outcrops with generally very little other vegetation present. However, it is speculated that competition may be high for these sites, given the lack of soil and limited water availability.

Reasons for Decline.—Direct destruction of this plant's habitat is the major threat to its long-term survival. Rock quarrying and road construction should be

avoided in this species' habitat. Aerial herbicide application on adjacent agricultural fields may also pose some threat.

Recreation

Banks Lake is recognized locally and regionally for its diverse and outstanding recreational opportunities. The reservoir's clear waters support one of the finest fisheries in the state and outstanding opportunities exist throughout the area for camping, swimming, boating, picnicking, and other recreational pursuits.

Many recreationists are drawn to Banks Lake because of the diverse and scenic natural features of the area (e.g., basalt outcrops and spectacular coulee walls) and areas unique to the region (e.g., Northrup Canyon). The coulee walls rising on the east and west sides of the reservoir enclose and separate Banks Lake from the surrounding agricultural and high desert landscape, giving recreationists, residents, and other users a strong sense of place and isolation. The small incorporated communities on the north and south ends do not detract from the remoteness that is possible at Banks Lake.

Public use varies seasonally, with peak activity and visitation occurring from mid-May through September. Local residents use the area, as well as many visitors who generally travel 100 to 200 miles. Most out-of-area users are from the Puget Sound (Seattle/Tacoma) area, who are looking for uncrowded recreational opportunities, sunny days, and warm water. The Banks Lake Visitor Profile and Recreational Use Study survey conducted in 1998 showed camping, swimming, and fishing to be the area's most popular activities. More than 500,000 persons annually visit Steamboat Rock State Park (SRSP).

Grant County residents generally use the reservoir and surrounding lands during the day, but the lake is a popular overnight destination for visitors from other parts of the state. Grand Coulee Dam, a regional tourist attraction, draws many first-time visitors to the Banks Lake area. Apart from the Grand Coulee Dam Visitor Arrival Center and Lake Roosevelt National Recreation Area, other attractions near Banks Lake log between 7,650 and 45,715 annual visits each. Cumulatively, the area's attractions registered over 2.6 million visitors in 1997 (see table 3-5), about the same as in the preceding years in the decade.

A variety of public agencies and private entities currently provide 19 developed recreation areas. These areas are served by a wide range of developed day and overnight recreation sites and facilities, and generally are concentrated at the south and northeast ends of the reservoir.

Table 3-5.—Visitation to Grand Coulee/Banks Lake area, FY 1997

Facility	Visitors
Grand Coulee Dam Visitor Arrival Center	467,347
Lake Roosevelt National Recreation Area	1,462,820
Steamboat Rock State Park	583,496
Crown Point Vista	45,715
Roosevelt Recreation Enterprise Houseboat Rentals	13,559
Coulee Playland Resort	20,000
Colville Tribal Museum	12,179
GCDA Chamber of Commerce	13,231
Coulee Dam Visitors Center	7,650
Dry Falls Interpretive Center	17,542
Total	2,643,539

Source: Grand Coulee Dam Area Chamber of Commerce, 1998

Land-Based Recreation

Land-based recreation activities include both developed and dispersed camping, bank fishing, sunbathing, hunting, off-road vehicle (ORV) riding, picnicking, hiking, bicycle and horseback riding, nature study (wildlife and wildflower observation), sightseeing, and photography. Of these, camping and hunting are the most popular.

Recreation use survey respondents ranked camping as the most important and common recreation activity at Banks Lake. Overnight opportunities include fully developed recreational vehicle (RV) and tent sites, as well as dispersed, informal campsites. Full-service RV utility sites and formal tent sites are provided at Coulee City Community Park, Steamboat Rock State Park, Coulee Playland, and Sunbanks Resort. The Jones Bay, Osborn Bay Southwest, and Dry Falls campgrounds offer a range of developed facilities (e.g., vault toilets, fire rings, picnic tables, and pedestal grills), but no RV utility hookups.

While much of the recreation use is concentrated at developed recreation sites, either managed directly by the state (e.g., Steamboat Rock State Park), under lease from the state (e.g., Sunbanks Resort, Coulee Playland), or under lease from Reclamation (e.g., Coulee City Community Park), a significant amount of dispersed use occurs in undeveloped areas along the lake's shoreline. The most popular dispersed camping areas occur in the following general locations: southeast Banks Lake south of the Million Dollar Mile North Boat Launch, Kruk's Bay/Airport Bay, Osborn Bay, Barker Flat, Old Devils Lake/Lovers Lane, and along the Steamboat Rock peninsula's west shore. These areas are accessed primarily by the area's primitive road system and/or by boat. In 1998, 56 heavily used, dispersed campsites were inventoried.

Located on Reclamation lands northwest of the Banks Lake Golf Course and east of the airstrip, the ORV area encompasses 130 acres and contains an ORV track and archery range. The archery range consists of several scattered hay-bale-mounted targets and a small parking pullout.

Day Use Activities

Many developed and dispersed day use opportunities exist at Banks Lake. Developed picnic sites and playgrounds are offered at Coulee City Community Park, Steamboat Rock State Park, Coulee Playland, and Sunbanks Resort. Day use activities include fishing, boating, sun bathing, hiking, ORV and horseback riding, bicycling, archery, model airplane flying, sightseeing, water skiing, scuba diving, wind surfing, personal water craft (e.g., jet skis), rock climbing, wildlife observation, cross country skiing, showshoeing, and ice fishing. Golfing is available at the Banks Lake Public Golf and Country Club.

Hunting begins in September with the opening of dove season and extends through mid-March. The general hunting season for mule deer, white tail deer, upland birds, and waterfowl begins in October. Upland game birds include quail in the brushy draws; chukar in hilly, rugged terrain; and Hungarian partridge and Canada geese in the stubble agricultural fields. Duck hunting is popular on Banks Lake and in the region's small potholes and lakes. Mule deer can be found in the sagebrush-covered flats and draws surrounding the Grand Coulee.

Nature study, wildlife watching, and hiking are increasingly popular activities. The Banks Lake area supports a variety of wildlife observation opportunities, trails, scenic vistas, and unique plant communities (e.g., Northrup Canyon Natural Area) for study. Migratory and resident birds include great blue herons, white pelicans, sandhill cranes, hawks, long-horned owls, and bald eagles. Mammals like deer, beaver, muskrat, and rabbit are abundant. There are constructed trails in the Steamboat Rock State Park Recreation Area, which includes the Northrup Canyon Natural Area and Steamboat Rock, and at Sunbanks Resort (a WDNR leased facility).

Water-Based Recreation

At full pool, the reservoir surface covers approximately 27,400 acres and provides approximately 82 miles of shoreline. The reservoir offers excellent opportunities for water-based activities such as boating, fishing, water skiing, personal water craft (PWC) riding, wind surfing, and swimming. The highest concentration of boating activity occurs in the Devil's Punch Bowl, Osborn Bay, Kruk's Bay/Airport Bay, and Jones Bay areas. The reservoir surface is open to motorized boating with few restrictions.

User fees are required at the three boat launch sites managed by the SPRC (see table 3-6). A charge of $5 is assessed at the SRSP Day Use Area and Boat Launch and

Steamboat Rock Rest Area and Boat Launch, and a $5 fee is assessed at the Osborn Bay SW Campground and Boat Launch. Annual, unlimited boat launch permits are available for $40. Camping fees at SRSP, Coulee Playland, and Sunbanks Resort include use of boat launch facilities. Although launch fees are not required at Coulee City Community Park, a donation box is provided.

Table 3-6.—Boat launch sites and operation and maintenance responsibilities.

Responsible organization	Boat launch sites
Washington State Parks and Recreation Commission	Osborn Bay Southwest Campground and Boat Launch
	Steamboat Rock State Park Day Use Area
	Steamboat Rock Rest Area and Boat Launch
Washington Department of Fish and Wildlife	Osborn Bay Southeast Boat Launch
	Dry Falls Boat Launch
	Dry Falls Campground and Boat Launch
	Barker Flat Campground and Boat Launch*
	Million Dollar Mile North Boat Launch
	Million Dollar Mile South Day Use Area and Boat Launch
Sunbanks Resort Lessee	Sunbanks Resort
Coulee Playland Concessionairre	Coulee Playland
Coulee City	Coulee City Community Park

*No operation and maintenance activities are currently performed by the Washington Department of Fish and Wildlife.

No direct user fees are currently required at the six boat launch sites managed by the WDFW. However, state legislation passed in March 1998 requires motor vehicles using marked WDFW access sites to display a current annual fish and wildlife "stewardship decal." The annual fee for the stewardship decal is $10, but they are issued at no charge to people who buy an annual saltwater, freshwater, combination, small or big game hunting, or trapping license. A fee of $5 is charged for additional decals if people want to put them on their other vehicles. Failure to display a decal while parked in a WDFW access site could result in a fine. The revenue generated through decal sales is used for access site stewardship and maintenance. Signs are prominently displayed at the WDFW sites where a decal is required.

During reservoir drawdowns, rocks and sandbars are sometimes exposed or lie just below the surface, causing the Dry Falls, Million Dollar Mile North and South, Barker Flat, and Osborn Bay Southeast boat launches to become difficult to use. Launching is reported to increase at the Steamboat Rock Rest Area and Boat Launch during low reservoir water surface elevation periods (Steinmetz 1998).

Swimming is ranked as the second most common activity on Banks Lake. Developed swimming areas are provided and maintained at the SRSP Day Use Area, Coulee City Community Park, Coulee Playland, and Sunbanks Resort. Coulee City Community Park sometimes experiences stagnant water conditions in their swimming area. Consequently, the city is considering the installation of an aeration

device or other measures to improve the park's swimming area. Periodically low water levels in the swimming area are also a concern.

Users rank fishing as the second most important and third most common activity in the area. Banks Lake is regarded as one of the finest fishing lakes in the state for bass, perch, and walleye, and offers great fishing opportunities year-round. Popular fishing areas for smallmouth bass are Barker Cove and along the western shore of the Steamboat Rock peninsula; Osborn Bay, Kruk's Bay, Jones Bay, and Devil's Punch Bowl for largemouth bass; and deep water near Barker Flat for walleye and rainbow trout. During the winter season, ice fishing is popular and can last as long as 4 months.

Boat Launch Sites

The WDFW is responsible for the operation and maintenance of six boat launch sites, and the SPRC is responsible for three boat launch sites at Banks Lake (see table 3-6). Operation and maintenance for the other boat launches located on the reservoir (Sunbanks Resort, Coulee Playland, and Coulee City Community Park) are the responsibility of the respective lessee or concessionaire.

Economics

Hydropower Resources—FCRPS

Banks Lake and the pump-generating plant that pumps water into Banks Lake are an integral part of the Grand Coulee power generating complex and are also used as a means of regulating Federal Columbia River Power System (FCRPS) power production. The pump-generating plant houses six pump/generators and six pumps. Banks Lake plays an important part because of its use in regulating power system loads by both generating and using power.

The Grand Coulee power complex is one of 14 Federal power projects in the Columbia River drainage that are interconnected by the Bonneville Power Administration transmission system to form the FCRPS project on which the action agencies consulted in the 2000 BiOp. The FCRPS facilities are coordinated with other utilities to take advantage of differences in streamflows, loads, generation, and maintenance schedules to better use their resources. Utilities can then more efficiently use their hydropower and thermal facilities. This coordination allows the system to be operated as if it were owned by a single operator, synchronizing operations to maximize power production. Grand Coulee provides about one-third of the FCRPS's total generating capacity.

The Grand Coulee power complex consists of three powerplants and a pump-generating plant. The power complex generates around 21 billion kilowatt hours (kWh) annually of which about 900 million kWh (4.7 percent) is used for pumping CBP irrigation water. The rest is marketed commercially by BPA, the Federal power

marketing agent for the Pacific Northwest. BPA markets the power primarily through its own transmission lines in Washington, Oregon, Idaho, western Montana, and small parts of Wyoming, Nevada, Utah, California, and eastern Montana. BPA also sells or exchanges power with utilities in California and Canada.

BPA schedules and markets the generation from Grand Coulee. Power operations must conform to several multiple use operation requirements, such as flood control, fish augmentation flows, FDR Lake daily drawdown limitations, downstream flow fluctuation limits due to bank instability, etc. Scheduling of the BPA load is divided into two categories, heavy load hours of 6 a.m. to 10 p.m. Monday through Saturday, and light load hours for the remainder of the time. Commonly, only a few of the large units will be run during light load hours, while many more units will run, often including the pump/generator (P/G) units during heavy load hours to help balance and meet BPA system loads.

Left and Right Powerplants

The Left Powerplant and Right Powerplant, at the Grand Coulee complex, are operated for commercial power purposes and during the irrigation season to provide power for Pumping Plant units 1-6. Generators 1, 2, and 3, located in the left powerhouse, are each used to provide pumping power directly to Pumps 1-6 without being connected to the transmission system. Residual power not used for CBP purposes is provided to the 230-kilovolt (kV) switchyard for commercial use.

Third Powerplant

The Third Powerplant is operated for commercial power purposes and provides power to the 500-kV switchyard for distribution by BPA through their distribution grid. During an average year, approximately 50 percent of the total energy production is generated by the Third Powerplant. An important contribution of the Third Powerplant is its ability to provide "spinning reserve" to the FCRPS. Generators are provided enough water to keep them spinning yet not generating any appreciable amount of power; this allows for an almost instantaneous ability to provide power for unexpected or unusually high demands. This spinning reserve is a much more cost efficient means of providing for immediate power needs than coal- or gas-fired generation.

Pump-Generating Plant

The primary purpose of the plant is to pump water for irrigation delivery to CBP lands via Banks Lake. For the period of 1989-1998, a 10-year average of 2,592,000 acre-feet of irrigation water has been pumped for irrigation. The pumping season runs about 198 days, from approximately April 1 through October 15 of each year. Pumping needs are weather dependent and normally increase during the hottest months of July and August. However, if a constant pumping rate were required for

198 days of the irrigation season, an average pumping rate of approximately 6,600 cfs would be needed.

Each of the six P/G plant pumps is rated at 65,000 horsepower and is capable of pumping 1,600 cfs at 292 to 310 feet of head. Each of the six pump-generators is rated at approximately 67,000 horsepower and 50,000 kilowatts (kW) in the generation mode. Total plant pumping capacity is approximately 20,000 cfs, depending on pumping head. The excess pumping capacity allows the P/G plant to be used in a "load management" mode. Pumping schedules can be managed to allow delivery of water into Banks Lake when power demands are low and accordingly power purchase costs are also low. This load management typically results in heavy pumping during the night and weekend hours with little or no pumping during power "peak" hours. This operation not only provides load management but enhances Federal revenues by consuming power (pumping) when power has its least value and allowing maximization of generation and sales when revenues are highest. As Banks Lake level drops, use of the P/G units is affected. To operate all six P/G units, the lake surface must be above elevation 1568 feet. As the lake lowers, fewer units can operate—five units can operate at elevation 1566.5 feet, four units at 1565 feet, three units at 1563.5 feet, two units at 1562 feet, and one unit at 1560.5 feet.

The 6 pump-generators provide 300,000 kW when in the generating mode. When using the 6 pumps and the 6 pump-generators for pumping 600,000 kW of power are used. This provides a "load swing" of 900,000 kW. This operational flexibility contributes a great deal of versatility when managing the FCRPS, both from a system operation and a marketing perspective.

The P/G units also provide peak pumping capability to ensure CBP irrigation water deliveries during the heavy delivery months of July and August. Pumping capacity of the original six pumps is limited to approximately 10,000 cfs. Irrigation deliveries in July and August may require that pumping by the six pumps continue full time; thereby losing the financial advantage of pumping during low load hours. Operations of the P/G units allow meeting those irrigation demands without undue fluctuation of Banks Lake.

Typical weekday summer pumping normally takes place from about 10 p.m. the previous day to 8 a.m. of the current day. The number of pumps operated depends on the amount of irrigation withdrawals taking place. At 8 a.m., the pumps and P/Gs running in the pump mode are stopped. The P/G units may then be restarted in the generation mode if needed to meet power load requirements or spinning reserve demands. BPA typically does not use Banks Lake for pump generation during the irrigation season; it becomes more valuable for pump generation December through February.

Typically, on Fridays at approximately 10 p.m., the pumps and P/G units are started to provide continuous pumping throughout the weekend until 8 a.m. on Monday.

The number of units used will depend on irrigation withdrawals and the need to refill Banks Lake.

During the winter nonirrigation season, the P/G plant is operated only to meet power requirements. The P/G units may be operated to either produce energy or meet system requirements, such as spinning reserve or standby reserves. System requirements are significantly affected by weather conditions. Severe cold spells may result in operation of the P/G units in the generation mode. Stabilization of Banks Lake is maintained at winter levels by pumping into the lake the water needed to replace water used for generation. In addition to replacement of water used for generation, additional water is pumped to make up for evaporation and seepage.

Powerplant on the Main Canal below Banks Lake and Dry Falls Dam—GCPHA

A municipal low head hydropower generation plant is located just below Dry Falls Dam on the Main Canal and is owned by the three irrigation districts that receive CBP water. This facility generates power for commercial sale from CBP irrigation water releases from Dry Falls Dam and is not part of the FCRPS. The Main Canal powerplant is operated by the Grand Coulee Project Hydroelectric Authority (GCPHA), who markets the power through contracts with the cities of Seattle and Tacoma, Washington. Generating capacity is 26 MW for the plant with annual generation averaging 92,000 MWh. As a condition of the Federal Energy Regulatory Commission (FERC) licensing for the powerplant, barrier nets must be placed in Banks Lake at the beginning of the kokanee salmon entrainment period (May 15) and remain in place until the end of the irrigation season.

Public Utility District Powerplants on the Columbia River

There are five publicly owned hydropowerplants on the Columbia River in Washington downstream of Grand Coulee and Chief Joseph Dams. They are Wells Hydoelectric Project owned and operated by Douglas County Public Utility District (PUD), Rocky Reach and Rock Island hydro-projects owned and operated by Chelan County PUD, and Priest Rapids and Wanapum Developments owned and operated by Grant County PUD. The operation of these five powerplants is coordinated with the FCRPS, and they all have fish passage structures.

Wells Hydroelectric Project

This project is located 15 minutes north of Chelan, Washington, at river mile 515.6 and is the chief generating resource for Douglas County PUD, producing its first commercial power generation in 1967. The project has ten generating units rated at a combined 840 MW and provides power to Douglas County PUD, Puget Sound Energy, Portland General Electric Company, PacifiCorp, Avista Corporation, and the Okanagan County PUD (Douglas County Public Utility District 2002).

Rocky Reach Project

This project is located about 7 miles upstream from the city of Wenatchee, Washington, at river mile 473.7 and consists of 11 generating units that have a combined capacity of 1,287 MW. The initial seven generators were placed in commercial operation in November of 1961, with an additional four generators being added and placed in service in 1971. Electric output is provided to the Chelan County PUD distribution system and its 7 million customers, as well as the regional grid of BPA (Chelan County Public Utility District, Rocky Reach Hydro Project, 2002).

Rock Island Project

The Rock Island Project is located about 12 miles downstream from Wenatchee, Washington, at river mile 453.4 and consists of a dam and two powerhouses. The first powerhouse was constructed and placed in service in 1933 and consisted of four generating units. An additional six units were added and placed in service in April of 1953, bringing the total generating capacity of the ten units to 212 MW.

The second powerhouse with its eight generators was placed in commercial operation in August of 1979 and has a capacity of 410.4 MW, making the total nameplate capacity of both powerhouses 632.4 MW. Electric output is delivered to Chelan County PUD distribution system in the Wenatchee area and also to the BPA transmission grid (Chelan County Public Utility District, Rock Island Hydro Project, 2002).

Priest Rapids Development

The Priest Rapids Development consists of a dam and hydroelectric generation station with a rated capacity of 955.6 MW. It is located at river mile 397.1 and began commercial power generation in October of 1959. About 64 percent of the electric output is distributed through the transmission network of the BPA to 12 purchasers, with the remaining output being used by Grant County PUD (Grant County Public Utility District 2002).

Wanapum Development

The Wanapum Development consists of a dam and hydroelectric generation plant 18 miles upstream from the Priest Rapids Development, at river mile 415.8. The generating plant consists of ten units and has a total capacity of 1,038 MW and has been in commercial operation since January 1965. Electric output is delivered to the BPA transmission network for distribution (Grant County Public Utility District 2002).

Regional/Local Economy

Banks Lake is located along the northern border of Grant County, although some relatively small areas of the western shoreline of the lake extend into Douglas County. The steep cliffs that surround most of Banks Lake limit access to the lake, especially on the west side of the reservoir. State Route 155 runs along the east side of the lake and provides primary access to the lake and most developed recreation facilities. Any impacts on the economic environment from the Action Alternative due to changes in recreation use of the lake would be expected to occur in Grant County. For these reasons, Grant County is selected as the affected area for this study. The following information was used as the basis for analyzing impacts on the local economy.

Grant County is a mostly rural area with small towns scattered throughout the county. The entire county has a population of 74,698 (U.S. Census Bureau 2000g). This figure represents an increase of 36.4 percent over the 1990 population. However, the county only accounts for approximately 1.3 percent of Washington's population—5,894,121 (U.S. Census Bureau 2000h). Moses Lake (located in south central Grant County) is the largest city with a population of 14,953. Farther north is the county seat, Ephrata, which is about 30 miles south of Coulee City. Coulee City is found at the southern end of Banks Lake. Ephrata has a population of 6,808 and Coulee City has a population of 600 (U.S. Census Bureau 2000a, 2000c). Electric City, population 922, is located at the north end of Banks Lake (U.S. Census Bureau 2000b). The town of Grand Coulee is farther northeast near the Grand Coulee Dam.

In 1999, the people of Grant County had a per capita personal income (PCPI) of $19,424. The county ranked 32 out of the 39 counties in Washington (Bureau of Economic Analysis 2001a). This PCPI was only 64 percent of the State average of $30,380 and 68 percent of the national average, $28,546 (Bureau of Economic Analysis 2001b). Income and employment data for 1999 are shown in table 3-7.

Total personal income amounted to $1,398,915,000. This amount ranked 18 in the State, and Grant County accounted for 0.8 percent of the State total. Farming accounted for 11.3 percent or $158,160,000 of the total. Total employment amounted to 38,743 full- and part-time jobs. Employment in farming provided 18.7 percent of these positions, the most of any economic sector. Services (17.2 percent) and government (16.6 percent), at all levels, were the next most important sectors for employment.

The earnings of people employed in Grant County amounted to $919,294,000 in 1999. The largest industries, by earnings, were State and local government (22.1 percent of total earnings), manufacturing (16.7 percent on total earnings), and farming (14.7 percent of total earnings).

In 1990, the unemployment rate for Grant County was 8.5 percent (Bureau of Labor Statistics 2000). This rate rose to 10.6 percent in 1996 and fell to 10.1 percent in the

Table 3-7.—Employment and income data for Grant County, 1999

Economic sector	Employment *		Personal income and earnings**	
	Number of jobs	Percent of total	1999 dollars	Percent of total
Total	38,743	100.0	1,398,915,000	100.0
Wage and salary workers	30,999	80.0	800,725,000	57.2
Proprietor's	7,744	20.0	118,569,000	8.5
Farm occupations	7,230	18.7	134,997,000	9.7
Non-farm occupations	31,513	81.3	784,297,000	56.1
Ag services, forestry, and fishing	1,766	4.6	27,989,000	2.0
Mining	(D)		(D)	
Construction	1,520	3.9	46,230,000	3.3
Manufacturing	5,027	13.0	153,495,000	11.0
Transportation and public utilities	1,469	3.8	47,879,000	3.4
Wholesale trade	1,592	4.1	48,820,000	3.5
Retail trade	5,506	14.2	94,168,000	6.7
Finance, insurance, and real estate	(D)		(D)	
Services	6,680	17.2	119,171,000	8.5
Government	6,444	16.6	223,220,000	16.0
Plus: Dividends, interest, and rent			270,788,000	19.4
Plus: Transfer payments			276,163,000	19.7
Plus: Personal contributions for social insurance			(44,984,000)	-3.2

*Employment in full- and part-time jobs.

**Personal income and earnings in thousands of 1999 dollars.

(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.

Source: Bureau of Economic Analysis, Regional Economic Information System, 1999 (Bureau of Economic Analysis 2001c, 2001d.

year 2000. The poverty rate in Grant County declined from 19.6 percent in 1989 to 17.7 percent in 1993 and then to 14.9 percent in 1997 (U.S. Census Bureau 2000e, 2000f, 2000i). This rate was still much higher than the Washington State average of 10.2 percent.

A regional input-output model, Impact Analysis for Planning (Implan), was used to establish the baseline economic conditions in Grant County. This version of Implan (Professional 2.0) utilizes 1998 data, which are the most current available. Implan analysis identified the total industry output for Grant County, Washington, as being $3,384,384,000 in 1998 (Minnesota Implan Group, Inc. 1998, 1999, 2000). At the

same time, the Grant County economy supported 37,709 jobs, and labor income was $938,912,000.

An examination of U.S. Census Bureau employment data for the year 2000 shows that the economy in the North Grant County area accounted for only 5.4 percent of the total employment in the county. In addition, the local North Grant County economy is more diversified than commonly thought (see table 3-8). These employment data indicate that recreation related industries, including the categories of Arts, Entertainment, Recreation, Accommodations, and Food Services account

Table 3-8.—Number of jobs by industry for Grant County and North Grant County

Industry	Grant County jobs	Grant County total jobs	Banks Lake South CDP	Coulee City	Coulee Dam (town)	Electric City	Soap Lake	Totals by industry for north Grant County	North Grant County total jobs
	Number	Percent	Number					Number	Percent
Agriculture, forestry, fishing & hunting, and mining	5,528	18.8	10	40	16	2	50	118	7.4
Construction	1,490	5.1	2	21	21	21	26	91	5.7
Manufacturing	3,721	12.7	-	19	-	15	66	100	6.3
Wholesale trade	1,376	4.7	-	15	5	7	9	36	2.3
Retail trade (Some but not all of these positions may be recreation related.)	3,109	10.6	12	20	44	34	68	178	11.2
Transportation & warehousing and utilities	1,748	6.0	7	7	27	54	22	117	7.4
Information	276	0.9	1	7	2	6	11	27	1.7
Finance, insurance, real estate, and rental and leasing	837	2.9	-	6	21	13	18	58	3.7
Professional, scientific, management, administrative, and waste management services	1,505	5.1	3	8	17	16	18	62	3.9
Educational, health and social services	5,353	18.2	15	38	100	70	109	332	20.9
Arts, entertainment, recreation, accommodation, and food services	2,012	6.9	4	14	79	48	51	196	12.4
Other services	1,145	3.9	-	14	22	27	19	82	5.2
Public Administration	1,264	4.3	-	7	93	66	22	188	11.9
Total	29,364	100.0	54	216	447	379	489	1,585	100.0
	5,121	17.4		Recreation related employment			374		23.6

CDP = Census Designated Place
Source: U.S. Bureau of the Census, Census 2000

for only about 12.4 percent of the employment. Retail trade employs about 11.2 percent—some of which may be recreation related. Other non-recreation sectors account for more than three-fourths of the jobs in North Grant County. Employment in recreational related industries in the North Grant County area is, on a percentage basis, somewhat more important in this area than it is for Grant County as a whole (12.4 percent verses 6.9 percent).

Irrigated Agriculture

The CBP currently supplies water for full irrigation of approximately 670,000 acres, but the CBP has been authorized for more than 1 million acres. All water for the CBP is supplied from the Columbia River through Banks Lake with the exception of three small pumped irrigation blocks in the Pasco area and minor contributions that are made by Crab Creek and Rocky Ford Creek. The CBP extends from an area south of Banks Lake to lands south of the confluence of the Snake River with the Columbia. The Columbia River, from Trinidad to Pasco, forms the western boundary of the irrigated lands.

Up to 67 different crops are grown in the CBP, with alfalfa, potatoes, apples, and vegetables being major contributors to over a half billion dollars worth of crop value each year. Reclamation currently diverts about 2.6 million acre-feet of water from the Columbia River for delivery to irrigators within the CBP. Reclamation utilizes a water right from the State of Washington, which the United States holds in trust for the irrigators. At Banks Lake, it is possible for Reclamation to deliver the capacity of the Main Canal (10,000 cfs) down to water surface elevation 1540 feet.

In the event that the pumping plant were to be completely offline and unavailable on August 31, with no possibility of returning to service before October 31, and if Banks Lake were to be at elevation 1560 feet on August 31, then Banks Lake would, in an average diversion year, experience a near-maximum draft to meet the September and October irrigation demands. (The chances of such a scenario actually occurring would appear to be very low.) Additionally, over the last 10 years, 3 years—1993, 1994, and 2001—would have exceeded the available supply from Banks Lake in the given worst-case scenario as shown in table 3-9.

Table 3-9.—Available water supply to meet demands

Year	August	September	October	September + October
1993	418,590	270,330	186,880	457,210
1994	448,978	300,660	208,958	509,618
1995	411,591	260,437	137,655	398,092
1996	460,411	272,942	142,026	414,968
1997	410,867	220,590	120,266	340,856
1998	458,349	280,155	150,514	430,669
1999	424,231	277,133	171,844	448,977
2000	431,104	228,406	136,590	364,996
2001	399,142	299,750	196,747	496,497
2002	433,183	297,473	117,990	415,463
Average	429,645	270,788	156,947	427,735
Percent of total	17	11	6	

Historic Resources

Historic resources are defined as buildings, sites, structures, or objects, each of which may have historical, architectural, archeological, cultural, and scientific importance. There is a legislative and regulatory basis that requires the identification, evaluation, protection, and management of historic resources in Federal undertakings. The following discussion is responsive to the data needs required principally by the National Historic Preservation Act of 1966, as amended. Specific site locations are prevented from disclosure by the Archeological Resources Protection Act (ARPA) of 1979. The latter, and the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 define notification and tribal consultation processes to follow in the event of an inadvertent discovery of human remains of Indian ancestry during an undertaking on Federal lands. It also encourages agencies to have a discovery plan in place where actions will occur in an area that has the potential for human remains. And finally, it defines a process for agencies to use to determine if recovered human remains are affiliated with federally recognized Tribes and a process for disposition of affiliated remains.

Previous Investigations

In 1947, prior to inundation, Banks Lake was surveyed for archeological sites by the Columbia Basin Archaeological Survey under the direction of the Smithsonian Institution (Drucker 1948). Fifteen sites were recorded in and adjacent to Banks Lake, of which nine are known to be inundated, four are above the flood pool, and the location of one is uncertain.

Detailed and comprehensive studies of historic resources have occurred recently because of the Banks Lake Resource Management Plan. These are:

- An archeological and historical overview of the upper Grand Coulee (Banks Lake) by Archaeological and Historical Services of Eastern Washington University (Stevens, ed. 1999). The report is a synthesis of the available literature of the span of cultural history for the lands encompassed by the Banks Lake Resource Management Plan.

- An intensive cultural resources survey of Reclamation lands in and around Banks Lake was conducted in 2000 (Hamilton and Hicks 2000) and a follow-up effort in 2002 tested a small number of sites (Hamilton and Hicks 2002). The project recorded 607 historic properties of various kinds and includes those sites recorded or mentioned in the previous investigations noted above, as well as 20 traditional cultural properties (TCPs). Some TCPs are not included in discussions of historic properties due to confidentiality provisions of the ARPA.

An intensive cultural resources survey of the 5-foot drawdown zone, between water surface elevation 1570 feet and elevation 1565 feet of Banks Lake, was conducted during the fall 2002 drawdown as part of this EIS (Engseth 2003). Sixty-six historic properties of various types were identified. In addition, nine traditional cultural properties were identified in this drawdown zone between elevation 1570 feet and 1565 feet.

Two properties on Banks Lake have been either listed or formally determined eligible for listing on a historic register: Salishan Mesa and McEntee's Crossing. Salishan Mesa is a complex of cultural features representing multicomponent prehistoric and historic Indian occupations. The site consists of rock alignments and cairns on and between two small mesas, a small rock shelter on the east side of the larger mesa, and a habitation area with at least one housepit near a spring. The site was determined eligible for listing on the National Register of Historic Places in 1987. McEntee's Crossing is listed on the Washington State Inventory of Historic Places and consists of a historic trail and wagon road in Coulee City.

Prehistoric Sites

Sites attributable to American Indian habitation and use predating Euro-American exploration and settlement are numerous and diverse. They represent a variety of uses related to short- and long-term habitation, resource procurement and processing, and rituals, including large habitations, logistical camps, task-specific sites, talus pits, rockshelters, pictographs, cairns, rock enclosures, and mesa-top occupations. As a collection of properties, these sites document a significant settlement system outside of the Columbia River valley proper. Overall, the diversity of site attributes, such as artifact density, assemblage structure, and features, suggests a complex history of prehistoric use in the coulee. Of the 673 known sites on

Reclamation lands at Banks Lake, there are 262 prehistoric sites and 154 isolated finds. Of this total number of discoveries, 66 have been identified in the area of potential effect for this EIS. Upper Grand Coulee potentially contains sites relevant to the oldest traditions of the Colville Confederated Tribes (CCT). Protection and understanding of these sites is in the interest of the CCT.

Historic Sites

There are 96 sites and 117 isolated finds related to Euro-American settlement recorded on Reclamation lands at Banks Lake. Of this number, three are in the area of potential effect for this EIS. These sites range in age from the last quarter of the 19th century until the filling of Banks Lake, circa 1950. Historic property types include dumps, homesteads, mines, roads, trails, rock alignments and features, and railroad-related property. The most frequently occurring historic property type is refuse dumps.

Multicomponent Properties

This property type incorporates sites yielding evidence of occupations spanning the prehistoric and historic time periods. On Reclamation lands at Banks Lake, 44 sites are multi-component, and, of these, two are in the area of potential effect for this EIS.

Traditional Cultural Properties

A traditional cultural property (TCP) is a site eligible for inclusion in the National Register when it is associated with cultural practices or beliefs of a living community that are rooted in the community's history and are important in maintaining the continuing cultural identity of the community. Investigations for this category of historic properties occurred concurrent with the previous investigations noted above. A number of TCPs were identified in the Banks Lake area; the most obvious and noteworthy is Steamboat Rock, which has frequent references to it in the historical literature as an important legendary site. A recent M.S. thesis by Corey Carmack elucidates the traditional significance of this property (Carmack 2001).

Some TCPs co-occur with archeological sites, while other TCPs are landscape features without an archeological component. A few TCPs are potentially eligible for the National Register. The locations of most TCPs are considered confidential by the ARPA. Nine TCPs were identified in the drawdown zone between elevations 1570 and 1565 feet.

Native American Sacred Sites

Sites that are important to American Indian religions and considered sacred form a separate resource category, which may relate to other resources, including historic

resources and Indian Trust Assets, and in some cases natural resources. Executive Order 13007 (May 24, 1996) directs executive branch agencies to accommodate, to the extent practical and not inconsistent with essential agency functions, access to and use of Indian sacred sites by religious practitioners and to avoid adversely affecting the physical integrity of such sites.

During the analysis and data gathering for the Banks Lake RMP, information on sacred sites and related issues was solicited from the Colville Confederated Tribes and Yakama Nation. Steamboat Rock was identified as a site sacred to the Colville Confederated Tribes.

Indian Trust Assets

Indian trust assets (ITAs) are legal interests in property held in trust by the United States for Indian Tribes or individuals. While most ITAs are on-reservation, they may also be found off-reservation. Examples of trust assets include lands, minerals, hunting and fishing rights, and water rights.

The United States has a trust responsibility to protect and maintain rights reserved or granted to Indian Tribes or individuals by treaties, statutes, and executive orders. This responsibility is sometimes further interpreted through court decisions and regulations. This trust responsibility requires that Federal agencies take reasonable actions to protect trust assets when administering programs under their control.

Several American Indian Tribes and bands have interests in this EIS area. Banks Lake from the vicinity of Steamboat Rock southward is in the area ceded in the Yakama Treaty of June 9, 1855. The treaty established the Yakama Reservation and reserved rights and privileges to hunt, fish, and gather roots and berries on open and unclaimed lands to the 14 Tribes and bands who signed that treaty.

The Colville Confederated Tribes, whose reservation was established by Executive Order of April 9, 1872, also considers Banks Lake and surrounding area traditional territory for some of the tribal members of the twelve confederated Tribes and bands on the Colville Reservation.

Sometimes the government and the Tribes disagree on what is considered to be an ITA, and who holds the right. This document neither judges the validity of, nor defines, rights claimed by any Tribal government or member.

While much of the Banks Lake area retains resources that support hunting, fishing, and gathering activities, some areas may have been disturbed to the extent that they no longer can support such traditional uses. Currently, these activities are allowed throughout the study area, except that hunting is not permitted at the existing State Game Reserve and in the State Parks Management Zone.

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, dated February 11, 1994, requires agencies to identify and address disproportionately high and adverse human health or environmental effects of their actions on minorities and low-income populations and communities as well as the equity of the distribution of the benefits and risks of their decisions. Environmental justice addresses the fair treatment of people of all races and incomes with respect to actions affecting the environment. Fair treatment implies that no group of people should bear a disproportionate share of negative impacts from an environmental action. To comply with the environmental justice policy established by the Secretary, all Interior agencies are to identify and evaluate any anticipated effects, direct or indirect, from the proposed action, or decision on minority and low-income populations and communities, including the equity of the distribution of the benefits and risks.

Table 3-10 shows total population and minority data for Grant County, Washington, the project area, and Washington State (U.S. Census Bureau 1990 and 2000). The racial minority population, which includes Black, American Indian/Eskimo/Aleut, Asian/Pacific Islander, and persons of another race, was 14 percent of Grant County's total population in 1990 and 23 percent in 2000, compared to 11 percent and 18 percent, respectively, for Washington State. The Hispanic population, a separate minority ethnic group that can be of any race, was 17 percent of Grant County's total population in 1990 and 30 percent in 2000, compared to 4 percent and 7 percent, respectively, for Washington State.

Table 3-10.—Total population and minority data for Grant County and Washington State

Area	Year	Total	Racial Minority	White	Hispanic
Grant County	1990	54,758	7,782	46,976	9,427
	2000	74,698	17,524	57,174	22,476
Washington State	1990	4,866,692	557,755	4,308,937	214,570
	2000	5,894,121	1,072,298	4,821,823	441,509

In 1998, the estimate of people of all ages in poverty was 15 percent for Grant County, compared to 10 percent for Washington State.

Although current racial and ethnic data are not available, discussions with those familiar with employment in Grant County revealed a majority of the Hispanic population in Grant County is employed in the agricultural and related sectors.

County-level racial and ethnic employment and income data were not available for 2000 at the time the draft EIS was prepared. Racial and ethnic employment and income data for individual businesses in the county were also not available. Population projections by race and ethnicity and projected racial and ethnic employment and income data for the 50-year period of analysis were not available.

Surface Water Quality

Banks Lake was formed by embankment dams on the north and south ends of the upper Grand Coulee in Central Washington. The capacity of the reservoir is 715,000 acre-feet, and it is filled by Columbia River water being pumped from FDR Lake into the feeder Canal by electricity generated at Grand Coulee Dam. Initially, only pumps were installed to lift the water into Banks Lake. Later six pump/generators were installed to pump water into Banks Lake and to generate power if the flow was reversed and water flows from Banks Lake into FDR Lake. Generally, water for irrigation is pumped into Banks Lake and is released through the Bacon Siphon to Billy Clapp Lake on the southern end of the 27-mile long Banks Lake. The average depth of Banks Lake is 41 feet with a maximum depth of 86 feet at full pool water surface elevation of 1570 feet. The maximum width of the lake is 5 miles, but the average width is considerably less than 5 miles. A ridge in the bottom divides the pool into northern and southern pools. The northern pool is cooler, has less stratification and lower transparency, and more plant nutrients than the southern pool. Mixing of water in the northern pool is greater than in the southern pool because of the reversing flow of the pump/generators. The southern pool has higher biomass, and greater stratification and transparency than the northern pool.

Both of the basins within Banks Lake stratify slightly during the summer months; warmer water develops near the surface and mixes downward from solar heating. Cooler water is pumped into the lake from FDR Lake. The cooler water mixes with the slightly warmer upper layers of the lake. This partly mixed lower part of the reservoir is very close to the same temperature below the zone heated by air temperature and the solar radiation. This mixing tends to limit the stratification of the lake in the north basin, so it is less stratified than the southern basin. Neither basin becomes strongly stratified, and solar heating varies almost linearly from the surface to the lower mixed layers, with slightly more heat being accumulated in the near surface than in the deeper parts of the lake. During the fall of the year, the surface of the lake is cooled as the air temperature decreases and the temperature profile becomes nearly uniform as the near surface zone is cooled. However, Banks Lake normally does not mix throughout its depth in most years, and the surface zone can cool until ice forms on the surface during the winter.

Soils around the reservoir are eroded by wind-driven waves and wakes from boats. The most likely eroded soils are predominately very fine sandy loam, silt loam, sandy loam, or fine loamy sand. The above cited areas are predominately the fine, sandy, or loam type soils. These soils are easily suspended by wave action, and are likely

washed and graded along the shorelines in these areas. Erosion along the shoreline and sediment from surface runoff has caused muddy or turbid areas in Banks Lake.

According to water quality standards established by the Administrative Code for the State of Washington, Banks Lake falls under the surface water classification of a "Lake classification." Lake classification water bodies should support the following beneficial uses:

- Water supply, which includes domestic, industrial, and agricultural
- Recreation for primary contact, boating, sport fishing, and aesthetic enjoyment
- Commerce and navigation
- Wildlife habitat
- Fish and shellfish migration, rearing, spawning, and harvesting; and clam, mussel, and crayfish rearing, spawning, and harvesting.

Specific numerical or narrative water quality criteria are established for each water body. The irrigation distribution system of the CBP is also classified under this same classification. An oversight group has recently been established as part of a Memorandum of Understanding (MOU) between Reclamation, Washington State, the Environmental Protection Agency (EPA) and the irrigation districts. The group will work to develop water quality criteria and standards appropriate to Banks Lake based on data, water uses, and information assembled by the group.

CBP water quality data have been collected for nearly 40 years, but few if any data have been collected on Banks Lake. Some data exist for the outlet of Banks Lake and the Main Canal at Pinto Ridge (1988-1997), and sparse data on FDR Lake were collected from 1992-1997. A few reservoir samples were taken in September 1998 and in 2001 for Banks Lake. These data were reviewed to assess existing conditions for Banks Lake. Data from the lake were typically in the range of 10 to 20 mg/L for phosphorus, which is below the action level of 35 mg/L set by the State for the Columbia Basin area. Temperature at the surface varied from the mid-70s to the low 80s (°F) during August. The water quality criteria are being reviewed under the current MOU between Reclamation, the Washington Department of Ecology (WDOE), EPA, and the water users. Banks Lake is not listed in the current Section 303d report submitted to EPA nor is any maximum contaminant levels (MCLs) exceeded from the Drinking Water Regulations.

Groundwater Quality

The upper aquifer under Banks Lake is the Wanapum unit with a confining interbed called the Wanapum-Grande Ronde. Below the upper confining layer exists another

aquifer called the Grande Ronde. Below these three layers is a bedrock or basement layer. The upper aquifer averages about 400 feet in thickness to the east of Banks Lake, and to the south it varies from a few feet to more than 1,200 feet. The Grande Ronde aquifer is cut off by the basement layer of granite and basalt near Grand Coulee Dam and is about 1,500 feet thick south of the CBP. The average depth of this layer is roughly 1,000 feet under most of the Banks Lake area. Groundwater moves downward near Banks Lake and to the south/ southwest in a horizontal direction from the Columbia River in the Wanapum aquifer. Movement in the Grande Ronde layer is horizontally from the Colombia River in a south/ southwesterly direction and is within the aquifer or upward from the aquifer, because the confining layer forms a basin in the area.

Groundwater in Washington State is reserved and protected for existing and future beneficial uses. Drinking water is one of the most stringent beneficial uses and is used as the criterion to protect the groundwater for all other beneficial uses. The groundwater quality is a function of the source water, precipitation and the Columbia River, the soils and rock in the aquifers, and the geology of the area. Most of the rocks in the area are of volcanic origin or are weathered volcanic soils. The dissolved solids in most of the area are less than 450 mg/L, suitable for most beneficial uses, according to a 1987 U.S. Geological Survey (USGS) report on the groundwater quality in the basalt units of the Columbia River area (Steinkampf 1989). This report indicated that the primary water types found were calcium-magnesium bicarbonate or sodium bicarbonate.

Banks Lake is very near the main source of groundwater, the Columbia River, which has about 1 mg/L of nitrate-nitrogen in it, and little recharge from agriculture is up-gradient to Banks Lake. The groundwater quality around Banks Lake is not affected by irrigated agriculture, but dry land farming in the area and local sources of nitrogen are affecting nitrogen concentrations in the groundwater. About 20 percent of the domestic and water supply wells sampled in the Columbia Basin have nitrate-nitrogen above the 10-mg/L MCL for drinking water. However, in the immediate area of Banks Lake only one set of wells had any nitrate-nitrogen above 10 mg/L. Data from the Washington State Interagency Ground Water Committee (Cook 1996) report only the wells at Coulee City RV Park exceeded the 10-mg/L MCL for nitrate; values of 17.7 and 23.4 mg/L were observed. The source of the contamination is unknown, but poor well design and construction are likely contributors for shallow and uncased wells. All other wells near Banks Lake had nitrogen concentrations ranging from 0.38 to 5.9 mg/L with a mean of 1.9 mg/L. Both the Washington State Interagency Ground Water Committee (Cook 1996) and USGS (Steinkampf 1989) reports indicate that most public water supply wells are from deep wells that are isolated from any surface or shallow sources of nitrogen. These data show that nitrate-nitrogen is not a public health concern at this time.

Some pesticides at very low concentrations have been detected in the groundwater around Banks Lake, but none of them exceeded MCLs established for them.

Visual Quality

The Banks Lake area has spectacular scenery, characterized by the basalt cliffs, headwalls, and talus slopes of the upper Grand Coulee that encompasses most of the study area. The landscape is further enhanced by a vegetative mosaic of shrub-steppe, mesic shrub, upland forest, and riparian/wetland plant communities. There are scenic views and vistas from recreation areas along the lakeshore, from State Route 155 along the eastern shoreline, and from the lake itself. Basalt landforms, such as Steamboat Rock and Castle Rock, are dominant features and focal points for most views in the north half of the study area.

Scenic quality is one of the attributes that attract visitors to the Banks Lake area. As seen from the reservoir or shoreline, the landscape is largely undeveloped and visually appealing in most areas. The dominant visual elements are natural features such as water, basalt cliffs/coulee walls, granitic outcrops, and shrub-steppe plant communities.

While most of the landscape is undeveloped, there is also clear evidence of human activity. Visual intrusions and enhancements include urban/residential areas (Coulee City, Electric City, and Grand Coulee); developed recreation areas; dispersed campsites; an ORV area; highways, primary/secondary roads and jeep trails; an airport; gravel/material sites; electric transmission lines; residential subdivisions; and some agricultural lands. This combination of natural elements and cultural modifications provides a pleasing visual setting to most visitors.

Impacts from dispersed recreation, especially dispersed camping and motor vehicle travel, are readily apparent in some areas. Localized impacts in the form of braided, unauthorized "two-track" secondary roads are common, and soil erosion from rutting and gullying due to wet season travel is prevalent in some areas.

Irrigated and dry land agriculture dominates the landscape in the upland areas located above the reservoir's coulee headwalls. This landscape has relatively open, uninterrupted views, with dry land and irrigated wheat fields and stubble the most prominent features. Adjacent to the reservoir, Coulee City and Electric City have traditional rural townscapes surrounded by newer suburban development patterns. Agricultural, rural residential areas, and developed recreation areas are considered visual enhancements by most viewers, whereas jeep trails, gravel/material sites, and electric transmission lines are generally considered visual intrusions.

From about 3 miles north of Coulee City, a northbound traveler on State Route 155 will see a semiprimitive, natural appearing landscape enclosed primarily within the basalt walls of the upper Grand Coulee. From this point to Steamboat Rock State Park, there are two recreation viewpoints and few cultural modifications.

Views from Dry Falls Dam located near the southern end of the study area include some distracting elements, including highways, a braided network of unpaved roads and jeep trails, electric transmission lines, breakwater structures and marinas, and

other developed recreation facilities that detract from the surrounding rural landscape.

Scenic Quality Ratings—The Bureau of Land Management's (BLM) visual resource management system was used to classify the area's visual resources. To rate visual quality, the study area was divided into 13 scenic quality units based on physiographic characteristics such as landform and vegetation. The scenic quality of each unit then was evaluated for seven key factors—landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications—and given a numeric value. These values were totaled to determine the unit's scenic quality class.

Table 3-11 presents the results of the scenic evaluation. Five units were rated "A" because they clearly possessed "distinctive" landscapes and high scenic quality. Of these, the Middle Banks Lake and Upper Banks Lake units received the highest rating, because they are the most primitive and naturally appearing. Of the remaining units, five were rated "B"—"common" landscapes with a variety of interesting visual features, and three were rated "C"— "minimal" landscape beauty. The "C" units had the highest concentration of cultural modifications and visual intrusions present because they are within rural/residential areas or incorporated city landscapes.

Table 3-11.—Scenic quality ratings, Banks Lake, Washington

Rating unit	Scenic quality rating
Dry Falls Dam	B
Coulee City	C
South Banks Lake 2	C
South Banks Lake 1	B
Middle Banks Lake	A
Upper Banks Lake	A
Steamboat Rock	A
Barker Flat	A
Old Devil's Lake	A
Kruk's/Jones Bay	B
North Banks Lake	B
Osborn Bay	B
North Dam	C

Air Quality

The Banks Lake study area is under the jurisdiction of WDOE's Eastern Regional Air Pollution Control Authority Office. Washington's air monitoring network measures ambient air quality near population centers in selected areas of the State.

The closest monitoring sites to Banks Lake are Spokane to the east and Yakima to the southwest.

Due to the absence of nearby point sources, such as commercial and/or industrial facilities, air quality is high and exceeds the National Ambient Air Quality Standards and criteria.

Soils

Soils in the study area consist of three general soil groups and a total of five general soil map units in Grant County, and three general soil map units in Douglas County. Each of the general soil map units identifies broad areas that have a distinctive pattern of soils, relief, drainage, and landscape. The Grant and Douglas County soil surveys rate suitability for recreation, wildlife habitat, and building site development for each of the 51 soil map units found in the study area (USDA 1984 and USDA 1981).

Soils that pose the most severe risk of erosion are essentially silt loams. Some of these are covered by a mantle of loess and/or subject to periodic flooding. Where these soil types occur, they are excessively slick and easily disturbed by vehicles when wet and become easily airborne when dry. These soil types cover a substantial portion of the study area and often include the same land areas currently used for developed recreation. Where soil compaction accelerates the velocity and volume of surface runoff, the extent and magnitude that soil erosion can occur are increased.

Shorelines erode continually at Banks Lake. Issues of particular concern include the continued loss of riparian vegetation (e.g., black cottonwoods) used as roosting sites by bald eagles and other raptors, and shoreline encroachment on public lands and facilities. Land use activities (e.g., livestock grazing, dispersed recreation, and motor vehicle travel) have accentuated erosion. Other factors that contribute to shoreline erosion include large wakes from boats or wind during high water. The lacustrine soils found along the reservoir shoreline are particularly prone to erosion (Harris 1998). Erosion is prominent along the west shore of the Steamboat Rock peninsula; north and south of the Million Dollar Mile North Boat Launch; south of the Million Dollar Mile South Boat Launch; Barker Flat; and Electric City Community Park (Coulee Playland).

Social Environment and Public Health

A description of the location, population, income, and employment of the affected area appears in the economics section of this EIS. A description of the minority and low-income population is included in the environmental justice section of the EIS. Social values are identified here, as well as a description of the mosquitoes environment.

Social Environment

Comments heard at the public scoping meeting and received in written comments reflect the social values of those directly or indirectly associated with Banks Lake. Different individuals and groups have their own views of Banks Lake, which reflect their social values, such as viewing the lake as an integral part of their business and local economy, a place for water-based recreation, a storage facility for irrigation water and/or power production, or a source of water to help anadromous fish. Many individuals expressed concern that negative impacts to their local communities associated with any drawdown would be greater than positive benefits to anadromous fish elsewhere. Others countered that providing increased water for endangered salmon runs would outweigh any negative impacts to everything else.

The social values of these individuals and groups have likely changed over time. It is probable they will continue to change during the 50-year period of analysis. However, it is not possible or appropriate to predict how they will change.

Public Health—Mosquitoes

Mosquitoes belong to the insect order *Diptera*. Mosquito mouthparts form a long piercing-sucking proboscis with which females obtain a blood meal needed for egg production. Nectar is the main food source for male mosquitoes. Four distinct stages make up the life cycle of the mosquito: egg, larva, pupa, and adult. Larval and pupal stages are typically aquatic. Biting mosquitoes can become a serious nuisance to people recreating in areas with nearby mosquito populations. They may also be a health concern where transmission of disease agents, which are often maintained in bird populations, from mosquitoes to humans occurs.

Successful disease transmission requires several generations to increase the size of the adult mosquito population and amplify the virus within the bird population (e.g., Madder et al. 1983), which then will increase the likelihood of transmission to humans. Optimal conditions for development of high densities of adult mosquitoes are large water surfaces and long periods of time (Tadzhieva et al. 1979). Timing of availability of breeding areas is likely important and Madder et al. (1983) found that *Culex pipiens* and *Cx. restuans* egg production declined in late summer. Length of time that mosquito production areas are available is also critical. Minimum mean time for embryonic, larval, plus pupal development time (*Culex* species) was about 8 days at a high temperature of 86 ^{o}F (30 ^{o}C) (Madder et al. 1983). The Washington State Department of Health (2002) suggests that water that stands for greater than 10 days is needed for production of *Culex tarsalis*. In a study by Williams et al., (1993) it took about 2 days for first instar larvae to appear in newly filled pool areas.

The association of dams with mosquito and human health problems has been recognized (WHO 2000) and the Tennessee Valley Authority (TVA) early on made recommendations for limiting mosquito production in impoundments (Cooney 1976). Cooney (1976) listed a number of measures to help control mosquitoes in TVA facilities: (1) monitoring of mosquito populations; (2) the application of

approved insecticides when levels reach a nuisance threshold; (3) implementation of an effective water-level management scheme; (4) maintenance of effective internal drainage; (5) control of marginal vegetation; and (6) operation of dewatering projects for mosquito control. Gartrell et al. (1972) suggested that dewatering areas controls mosquito production in the spring and summer. Water level management destroys mosquito eggs and larvae by stranding them onshore or drawing them into open water where they are exposed to predators (Snow 1956). Reservoir drawdowns during the summer and fall of at least 20 feet were effective in providing mosquito control in TVA reservoirs (Hess and Kiker 1943) by decreasing marginal vegetation. Mosquito production is often highest in shallow, stagnant waters with dense, emergent vegetation. Wind-swept shorelines lacking vegetation and pools containing fish and other mosquito larvivores are not conducive to mosquito production (e.g., Pratt and Moore 1993).

Mosquito-Borne Disease

Several arthropod-borne viruses associated with mosquitoes are found in Washington State. The Washington State Department of Health (2002) lists western equine encephalitis and St. Louis encephalitis as being diseases relevant to Washington State. Both of these viruses are maintained in a mosquito-bird-mosquito cycle and *Culex tarsalis* is a principal vector. These traits are shared to a great degree with the newly emergent (in the Western hemisphere) West Nile Virus (WNV).

History, Origin, and Status of West Nile Virus

West Nile Virus is a typically mosquito-borne virus indigenous to Africa, Asia, Europe, and Australia (Campbell et al. 2002). West Nile Virus was recently introduced to North America and first detected in 1999 in New York City. The virus spread across the United States by 2002 (CDC 2002). The virus is maintained in nature in a mosquito-bird-mosquito transmission cycle primarily involving *Culex* spp. mosquitoes (CDC 2002). A large number of birds can become infected with WNV. Most survive (http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm), with highest mortality rates in passerines as shown in a laboratory study (Komar et al. 2003). Members of the crow family (*Corvideae*) are the most susceptible to death from WNV (Crane 2003).

In the United States, most human infections with WNV occur in summer or early fall (Campbell et al. 2002) and coincide with high abundance of adult *Culex* mosquitoes (Kulasekera et al. 2001). Mosquito feeding preferences can increase or decrease the potential of mosquitoes for transmitting the virus to humans. Opportunistic feeders that feed on both mammals and birds are best for bridging WNV from birds to humans and other mammals. Goddard et al. (2002) suggested that a suite of *Culex* species is important for maintaining and bridging WNV in wetland ecosystems in California. Transmission of WNV is most intense when initially arriving in a geographic area. West Nile Virus will decline to a lower level

after susceptible wild birds have either died or recovered and developed immunity to reinfection. Transmission of WNV to humans requires a reservoir of infected, viremic animals (mostly birds) from which mosquitoes carry the virus to people (Crane 2003).

To prevent WNV infection in humans, extensive early season larval control has been recommended (CDC 2001). This prevents the build-up of mosquito populations.